Complete Longwall Systems
Joy is a leader in the development of innovative mining technology and equipment designed to enable our customers to consistently produce at the lowest cost per ton over the life cycle of the equipment.

**Complete Longwall Systems**

Joy offers a complete range of longwall equipment to suit the needs of mining operations worldwide.

Joy is globally recognized as a leading manufacturer of complete longwall systems. Joy provides its customers with a single, accountable source for shearsers, roof supports, face conveyors, stageloaders, crushers and mobile belt tail pieces.

Joy designs and manufactures the major elements of modern, high production longwall systems and provides the integrated approach necessary for the productivity gains required for success in underground mining.

The major elements of a Joy longwall system are a shearing machine, an armored face conveyor (AFC), roof supports, stagger loader, crusher and mobile belt tailpiece. Joy manufactures these individual elements and provides professional project management capability to incorporate them into an integrated system and deliver that system on time, to specification and on budget.
Previously, each part of the system was designed and manufactured by different suppliers. Working independently, these companies improved the availability of individual elements of the system to the upper 90% level. Manufacturers optimized the performance of their products with limited concern of the effect that these isolated improvements might have on the total system. The approach led to mismatched systems and did not always provide the industry with the best solution.

The design and supply of a complete Joy longwall system under a single engineering and manufacturing control provides several benefits to the operator:

- Individual product design improvements are made with system implications already considered, balanced and optimized
- Complete electronic systems are based on the same protocols and architecture, and eliminate problems in communicating control, diagnostic and monitoring signals between elements of the system
- Operators reduce procurement and management costs
- System optimization is the responsibility of a single supplier
- Commercial responsibility for interface issues is no longer in question

Realize lowest cost per ton in longwall system applications.
Joy built the first all electric multi-motor shearing machine in the world in 1975. This innovation brought a new level of reliability and maintainability to the machine. The advantages of this modular all-electric concept and the benefit of eliminating complex, dirt sensitive hydraulic circuits from the underground environment are well recognized by the mining industry. Joy's modular design consists of five main structural elements.

**Modular Design for Operational Flexibility**

The body of the shearer normally consists of three high tensile steel fabrications bolted together to form a slim main section with no under-frame. This design provides maximum under-body clearance for material passage in a given seam thickness. The elimination of the under-frame also enhances underground transportation.

The controller case, which forms the center section, contains the electric control system including: vacuum contactors, transformers, OPTIDRIVE inverters and bus-supply for AC haulage, micro-processors, control circuitry and diagnostic data display screen. The Joy design features gob-side access to the electrical controller section and motors which means that normal maintenance can be carried out in a safe working environment.

Two traction sections (housing a haulage motor, primary traction gear case and hydraulic system) are bolted and doweled to each end of the controller case. The hydraulic system raises and lowers the ranging arms and lumpbreaker and rotates the cowl. The secondary traction gearcases (or down-drives) are bolted to the traction cases in an arrangement that permits the custom fitting of the shearer within the AFC and roof support envelope. A wide selection of Joy designed and manufactured down-drives can be fitted to the shearer to suit mining conditions and AFC selection.

Two high tensile steel ranging arm castings house the cutter motors and cutter gearcases. Custom gear design for high power densities draws on many years of experience and the latest Finite Element Analysis (FEA) techniques. This coupled with Joy's exacting manufacturing standards, heat treatment processes, gear grinding capabilities, gear charting, metalurgical lab checks, % gears cut for test and Coordinate Measuring Machine (CMM) reporting has maximized performance, reliability and extended rebuild intervals.
The latest generation JNA control platform uses multiple fieldbus technology. This enables dramatic reductions in wiring and terminal connections with improved reliability and maintainability. Cutting speed limits can be reconfigured via a menu roll-down option or this can be programmed into the JNA system.

Shearer data can be transmitted to the headgate and from there to the surface by way of the mine wide network.

**Memory Cut**

Joy has also advanced in the area of shearer steering technology by supplying a state-of-the-art "memory cut" system. Using the JNA memory cut, a cutting sequence can be programmed into Joy’s system. The system permits the shearer operator to create an initial cutting profile or template under manual control, and the machine then automatically replicates the profile on subsequent cuts until conditions change. The operator then updates the profile by manually cutting a new pass. These higher levels of automation improve machine efficiency and better control out-of-seam dilution from the roof and floor, resulting in cleaner product and lower machine maintenance cost while also reducing operator exposure to dust and noise.
JOY roof supports, for high capacity longwalls, are custom designed to meet exacting cycle and operating requirements. Joy offers roof supports in both 1.75m and 2.05m (nominal) widths to suit all applications including ultra-wide faces.

Finite Element Analysis (FEA) along with prototype static and dynamic load testing are essential Joy design processes.

Joy has also introduced the Design Failure Mode and Effects Analysis (DFMEA) process. This process looks at possible failure mode, and weighs the severity and the probability of occurrence. These factors are combined to define an index for each component or subassembly of the equipment. This approach is extremely beneficial in the prioritization of design efforts and resources. Joy structures have gained an enviable reputation in the mining industry and this is due to exacting design, the use of high strength steels, automated welding that increases weld integrity and the elimination of stress prone transverse welds.

Joy has also developed a scientific relationship between test and underground life expectancy. Joy now works with its customers to provide them with a better insight into this relationship to establish a life plan for the equipment.

The hydraulic legs or jacks, used to set the canopy to the roof, generally are double telescopic to provide maximum open-to-closed height ratio. JOY legs are extruded allowing large diameter ports in the forging for faster fluid flow and faster cycles. The elimination of vulnerable welded stack pipes also increases reliability. The extruded design also benefits the leg geometry by allowing the leg to be positioned closer to vertical in a given seam height. The more near vertical the leg stands, the better its load is applied to the mine roof. The Joy design of canopy and base structures includes four large quality steel castings for areas of load input at the end of the legs. FEA design has eliminated stress risers and produced greater life expectancy.

Joy has invested several years of research and testing on bearing materials and has developed a robust scientific method for the analysis of bearing loads. Simplistic classical methods are no longer appropriate. The improvement in bearing materials complements the much superior seal material and seal design to provide extended life expectancy of modern JOY legs.

Other features include a variety of base lift arrangements to free the base from soft floor conditions, and a reverse mounted advancing ram and relay bars to overcome difficult applications.
Compak Valve System

All the major hydraulic functions of the JOY roof support are actuated through the pilot controlled Compak Valve which consists of three sections: the solenoid manifold, main valve block and return manifold. The solenoid valves are the link between the electronic control system and the spool valves, which perform specific functions.

The Compak Valve System has exceptionally high reliability. A solid brass body makes it corrosion resistant and insures low maintenance costs. The major advantage of this valve design is its ability to operate at pressures greater than 4500 psi / 31 MPa on a supply of 6 to 15 volts. This allows the solenoid to be activated on demand; unlike other systems that require the hydraulic feed to be interrupted by a control solenoid. This improves cycle times and the ability to control multiple functions simultaneously. The valve block comprises up to 16 spool valves, which are more reliable than the contamination sensitive ball-and-seat valve designs.

Shearer Initiated Roof Support Advance

Joy offers the Shearer Initiated Roof Support Advance (SIRSA) option that can be supplied as infra-red and/or trailing cable systems. Both systems operate by sending a signal from the shearer to the roof supports to activate a selected shield operating sequence.

Roof Support Electronics

In roof support electronics, the new JOY RS20s system represents state-of-the-art electro-hydraulic control systems. The RS20s control system is the fastest, most versatile system ever and represents the next level of technology. Its speed and bandwidth support advanced options such as voice and video communications that the industry needs to support fully automated remote operation.

The RS20s system consists of the Micro (the microprocessor) and the Mimic (user interface) and provide the following benefits:

- Designed for the highest levels of reliability and functionality while addressing the industry’s ergonomic and operating issues
- Provides integrated longwall automation and diagnostics
- Smaller boxes are located in the best-protected and ergonomically suited positions on the roof support and can remain on the supports during face moves eliminating another potential cause of damage
- Small-diameter inter-shield cables are flexible and rugged, and are interchangeable with Joy’s easy to use, 4-way connectors
Joy manufacturers all the key elements for the armored face conveyor (AFC) including the head and tail frames, line pans, gear boxes, sprockets, couplings and shearer haulage systems.

The JOY AFC design uses cast steel sigma sections with exacting tolerances. This casting technology eliminates the weld fabrication of clevis and pan connections, which are inherently unreliable. The cast design provides tighter tolerance assurance which is essential in today's market place. Joy's high specification abrasion resistant upper deck plates, selected to meet pan life requirements, result in maintenance free, long life fabrications.

**JLP-1 Alined Pan**

The JOY JLP-1 ALINED Pan is Joy's principal global AFC line pan product and a complete range of line pans from 34 to 58mm are available to suit a wide range of applications and production requirements.

The JOY JLP-1 ALINED Pan combines the best features of both the JOY Cast Pan and the JOY Machined Pan to give the market a cost effective, quiet running, low-energy consumption, controlled articulation line pan. Deckplates made from abrasion resistant steels can be selected in a variety of thicknesses to suit equipment life requirements.

**BROADBAND® Low Profile Chain**

Joy's BROADBAND low profile chain is a proprietary design owned by Joy (patent pending). BROADBAND low profile chain consists of flat forged vertical links connected by conventional round wire horizontal links. The design produces a stiffer, lower profile chain that provides several benefits, including lower AFC height for the equivalent chain size, lower cost face extensions or increased tons per hour capacity upgrades utilizing existing line-pan. Finally the increased link-to-link and link-to-sprocket contact areas provide lower contact stresses thus reducing wear and increasing chain and sprocket life.

As longwall faces increase in length Joy's BROADBAND low profile chain with its greater stiffness and wear life will become an industry standard.

Joy's BROADBAND low profile chain is available in 34mm, 42mm, 50mm and 58mm sizes.
**Sprockets**

The single unit construction offers a self-contained assembly: comprising a drive shaft, inboard bearings and sprocket rings with automatic lubrication of a fully sealed unit. The spocket profile is enhanced to provide increased chain and sprocket life. The unit can be used on either end of the AFC, and is contained within the width of the frames to minimize face-end re-routing. The cradle support provides a safe and simple means of assembly. This arrangement combines the highest levels of life and reliability with simple maintenance and easy replacement.

**Gearboxes**

In-house design and development using the latest computer modeling techniques, combined with many years of experience, have created an extensive range of gearboxes that employ both the helical, spur and planetary designs.

**Turbo Transmission Technology**

The JOY Turbo Transmission Technology (TTT) drive system provides the simplest, most reliable high torque starting capability for large AFCs at the lowest operating cost. The JOY TTT provides trouble-free, repeat starting of the AFC to ensure continuity of production.

The JOY TTT allows off-load start up, reducing power supply and voltage drop. Microprocessor control progressively applies torque to the AFC chain as it accelerates to full speed, significantly increasing the life of chain, sprocket and gearboxes. The “no bearing” TTT drive unit is simple in construction, provides inherent load sharing, and is extremely reliable. These factors result in the lowest maintenance and overhaul costs of any drive system available.

**Shearer Haulage Systems**

Joy's Ultratrac 1500 and Ultratrac 2000 haulage systems have become the standard of the global industry and have been imitated by most other suppliers.

Ultratrac 1500 was developed for retrofitting existing 1500mm line pan systems with a stronger, more robust forged rack. Ultratrac 2000 is fitted to 1.75 m and 2.05 m line pans and utilizes a heavy duty, forged rack system to give increased sprocket and trapping shoe life, and is capable of negotiating severe seam undulations. Ultratrac 2000 is a direct drive system that provides increased tunnel clearance and product throughput.
The stageloader, crusher and belt tail-end components are vital for the efficient operation of the longwall system. To provide optimum performance and reliability, the entire unit is designed to match the operating parameters, roadway conditions and the characteristics of the mineral being mined.

**Stageloaders**

JOY stageloaders are manufactured for excellent reliability with high availability by use of heavy-duty components, including heavy pan side sections and high impact resistant flight bars along with high quality, heavy-section, steel sides.

Optimum chain tensioning is achieved by means of a hydraulic tension pan that is integrated into the stageloader drive frame and supported by a thick platform to maintain rigidity. The tension pan uses hydraulic cylinders that are easily accessible for maintenance.

The beam behind the stageloader drive frame is self-supporting and incorporates heavy-duty line pans with spill plates. The floor-mounted section includes the crusher fitted with a vertical articulating hinge on its outby-end to permit the unit to follow the contours of the entry floor without inducing excessive forces into the system.

The necessary number of inspection pans is provided along the length of the stageloader for access to the bottom chains.

A JOY stageloader is custom built for high capacity and reliable performance. It is designed to move continuously with the longwall and the necessary overlap is provided to suit the mining conditions.

**Crushers**

Joy designs and manufacturers a complete range of stageloader crushers. These are designed for difficult conditions, and can efficiently crush lump coal and oversize rock for easier conveying and improved system productivity.

To suit customer preference, JOY crushers are available in a direct gear-drive model or a V-belt drive.

All JOY crushers incorporate a frame fabricated from heavy steel plate and strengthened by heavy ribs for maximum rigidity. Easy access to the crusher roll is provided through an inspection door in the top of the frame.
Models are available where the top of the frame can be completely removed to lower the transportation height.

The crushing deck is fabricated from thick steel plate to withstand the impact of crushing. Product size adjustment is accomplished by vertical movement of the roll shaft assembly, which is carried out by means of hydraulic cylinders for making rapid adjustments.

Crushers can be designed to accommodate replaceable bits.

JOY crushers have proved to be extremely rugged and trouble free with little maintenance required.

**Mobile Belt Tail Pieces**

Joy offers a complete range of mobile belt tailpieces, so that longwall retreat can take place without stopping the belt or interrupting the flow of coal from the longwall face.

Joy manufacturers various models of longwall belt tailpieces for low, medium or high seam applications. The variations include a "Matilda" style unit as well as self-propelled crawler and skid-mounted units.

There are two basic types of self-propelled units. First, those driven directly from the shield support hydraulic system; and second, those that have an "on-board" hydraulic pump.

The crawler-mounted units are complete with heavy-duty replaceable pads and are internal planetary gear driven. Roof jacks and belt wipers are standard equipment. Leveling jacks are located on each corner.
The JNA Headgate System is based on Joy's latest evolution of electronic hardware and software architecture. This rugged electronic platform is designed to perform effectively in the harsh mining environments where Joy's on-board control systems operate.

Key features of the system include enhanced equipment monitoring and diagnostics, face equipment control and integration, underground data logging and a surface data communication link.

**Equipment Diagnostics**

Diagnostic information is displayed for all underground JOY equipment at a single location. To accomplish this, the system communicates directly with each piece of JOY longwall equipment. Typically, these include the shearer, roof supports, AFC, and AFC and programmable logic controllers. Although each piece of face equipment operates very differently, the JNA Headgate System provides a uniform approach for all equipment diagnostics.

**Face Equipment Control and Integration**

A single controller is responsible for the system integration features such as Shearer Initiated Roof Support Advancement (SIRSA), anti-collision logic and external feedback. This single controller is also used for AFC and roof support control features and can replace existing JOY control systems.

**Multilingual Support and On-line Help**

Text on the JNA Headgate System is not limited to English, other languages, including Chinese, Polish and Russian are readily supported. Extended help features such as on-line parts books and service manuals can be displayed as well.
Operational information is stored from each sub-system for a defined period. The stored data provides the capability to view trends such as shearer position and chain tension over time.

**Underground Data Logging**

With the Surface Data Communication Link, real-time operational information is transmitted to multiple computers on the surface. The information is identical to the information available underground. An electronic system on the surface receives the data from the underground JNA Headgate System for real-time display and data storage. This feature allows recorded data to be played back for in-depth analysis. In addition, the data can be retrieved and analyzed without affecting production.

**Surface Data Communication Link**

Many mines are now using mine-wide Supervisory Control And Data Acquisition (SCADA) systems to monitor the production process. The JNA Headgate System provides an Object Linking and Embedding (OLE) for Process Control (OPC) interface that enables information from JOY equipment to be easily transferred to the mine’s SCADA system. All major manufacturers of SCADA systems support OPC.

The JNA Headgate System has been designed to add significant value in longwall mining operations. Several benefits include the ability to reduce downtime while maximizing production, a significant reduction in complexity due to a decrease in components and cabling, the flexibility to interface with virtually any mine-wide monitoring or communications system and achieving true system integration.

The JNA Headgate System can be implemented in a complete JOY longwall mining system or with individual pieces of JOY longwall equipment.
Customer expectations for modern longwalls continue to grow in terms of capacity, durability, reliability, features, automation and systems integration. Joy has responded proactively by introducing professional Project Management for major longwall contracts.

Joy has implemented a formal project management structure and discipline within its global organization, based on proven methods developed by the internationally-recognized Project Management Institute (PMI). PMI’s “A Guide to the Project Management Body of Knowledge” (PMBOK Guide, 2000 Edition) defines project management:

*Project management* is the application of knowledge, skills, tools and techniques to project activities to meet project requirements. Project management is accomplished through the use of the processes such as: initiating, planning, executing, controlling and closing.

The project team manages the work of the projects, and the work typically involves:
- Competing demands for: scope, time, cost, risk and quality
- Stakeholders with differing needs and expectations
- Identified requirements

Simply put, Joy’s success measures for its project managers are: deliver the project on time, on spec, on budget and achieve high customer satisfaction in the process. This idea is embodied in the triple-constraint triangle, familiar to all professionally trained and certified project managers at Joy:

Finally, recognizing the importance of timely, efficient communications between stakeholders for projects that require significant coordination and/or integration, Joy can offer a dedicated project website with functionality to suit the project.

For details on Joy’s project management capabilities, contact your local Joy sales office.
All JOY products and services are sold subject to Joy’s standard terms and conditions of sale, including its limited warranty. These will be furnished upon request. The company reserves the right to alter or improve the design or construction of its machinery as described herein and to furnish it, when so altered, without reference to the illustration or descriptions in this bulletin.