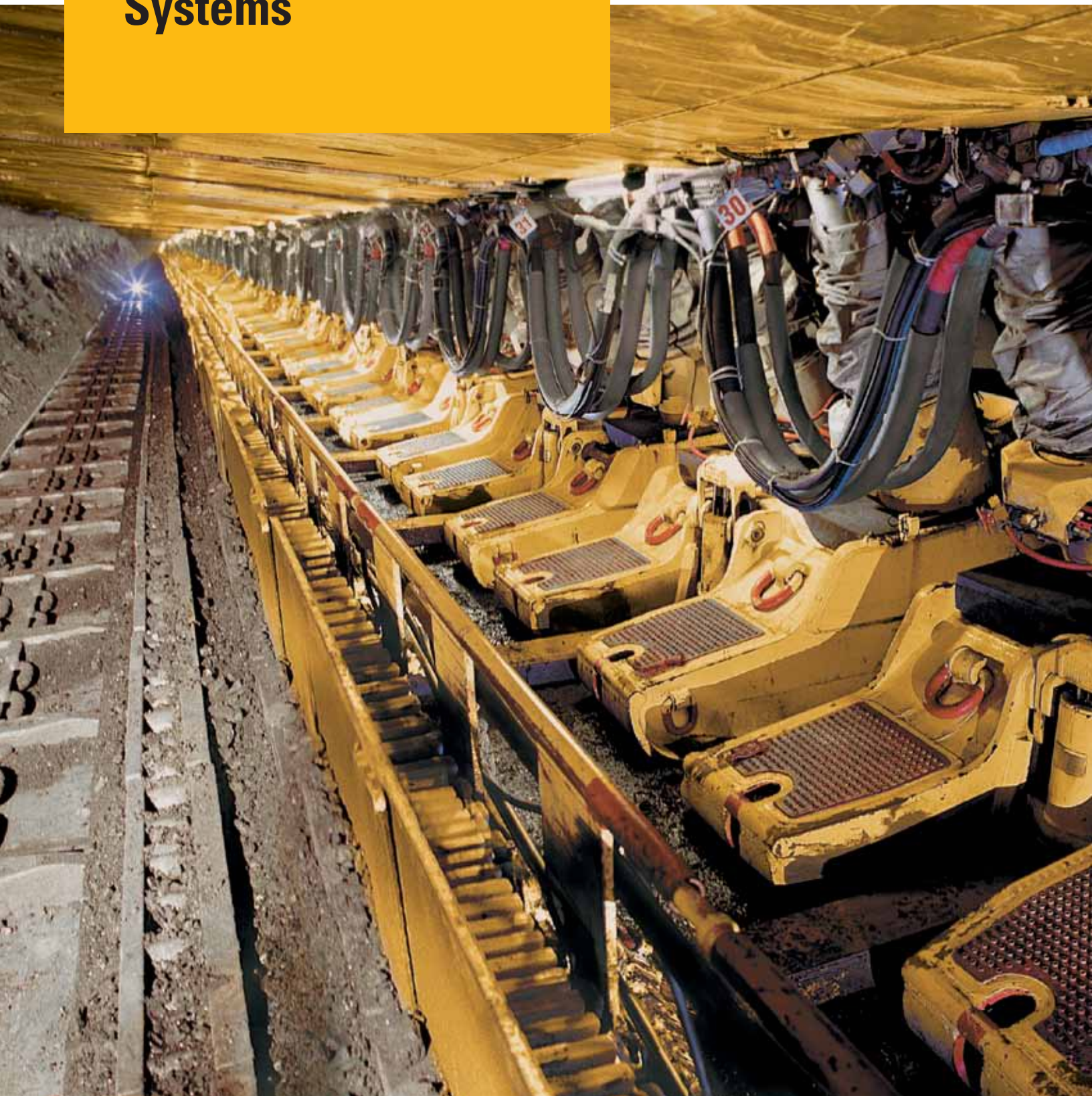


# Roof Support Systems







## Customized Design: Roof Support Systems

Caterpillar is the world leader in longwall roof support technology. In the early 1970s, demanding mining conditions in German coal mines set the stage for extensive R&D in roof support technology. Steeply inclined coal seams both thick and thin, weak roofs and massive sandstone roofs, soft floors, and geological faults called for a high degree of customization.

The resulting expertise has been deployed and applied to all mining areas of the world and provides customers with state-of-the-art technology customized to maximize control of the roof and floor of their longwalls. This not only eliminates downtime resulting from control of the strata surrounding the coal seam; but also facilitates automation of roof support systems, even in very difficult geological conditions.

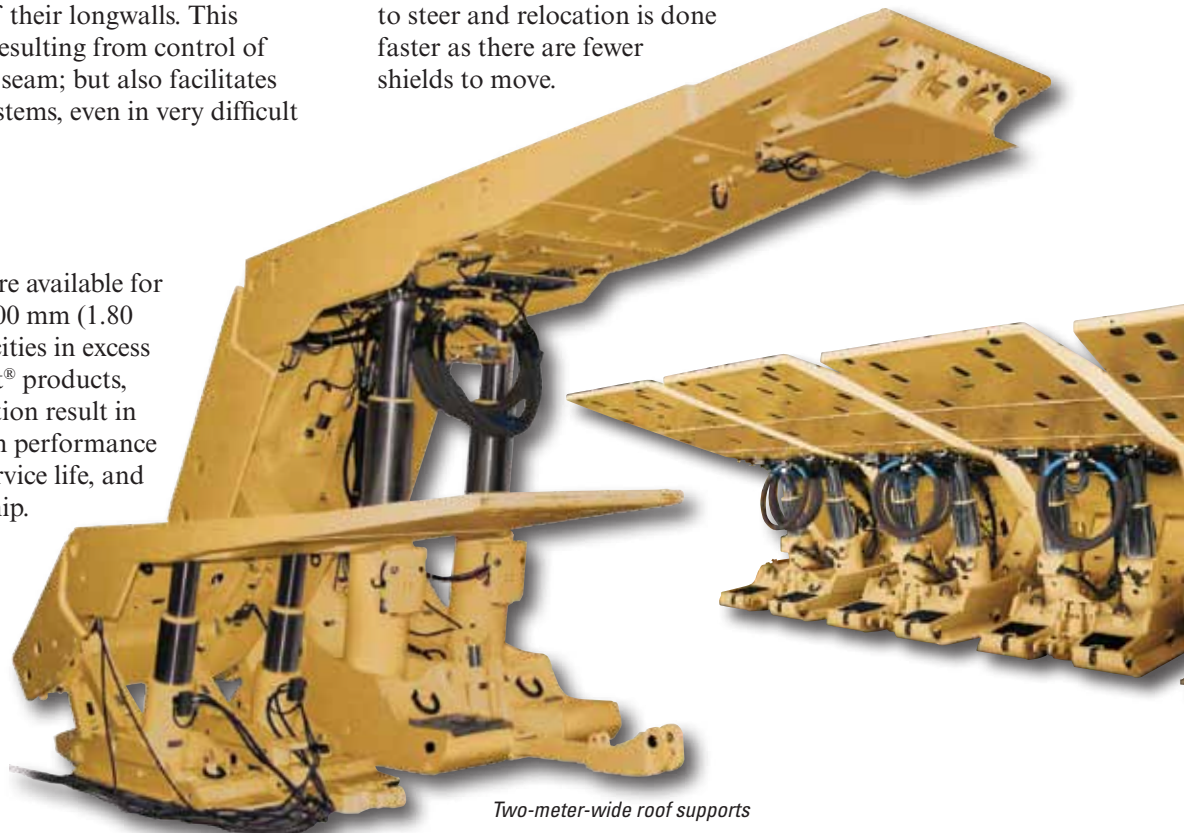
1.75-meter-wide shields. Fewer shields mean lower investment and less maintenance – and fewer parts to malfunction. Longwalls are easier to steer and relocation is done faster as there are fewer shields to move.

### Seamless Range

A full range of roof supports are available for mining heights from 550 to 7 500 mm (1.80 to 24.60 ft), with support capacities in excess of 1 750 tonnes. As with all Cat® products, top quality and leading innovation result in products that deliver maximum performance and system availability, long service life, and lowest possible cost of ownership.

### Two-meter Roof Supports

The two-meter-wide roof support offers several advantages over conventional 1.50- or



*Two-meter-wide roof supports*

## Engineering Excellence

Caterpillar maintains extensive facilities for the design, testing and manufacture of its products. All engineering departments have powerful workstations with state-of-the-art engineering software to enable simultaneous stress analysis and cost effectiveness of design. Finite Element Analysis is used to meet fatigue life requirements of components and products. Design Failure Mode and Effects Analysis is used to maximize reliability of all critical areas to eliminate the risk of in-service failure.

Prior experience is used as a feedback process to capture relevant information from many different longwall operations to continuously upgrade product performance for the benefit of our customers. This is invaluable for longwall projects where difficult geological conditions prevail. Cycle testing is a vital part of the design process.

Our manufacturing facilities are continually upgraded to take advantage of developing technologies and techniques to achieve maximum quality at minimum cost. In-house technology processes and organizational skills are constantly improved to stay competitive and maximize reliability and performance of high-production automated longwall systems.

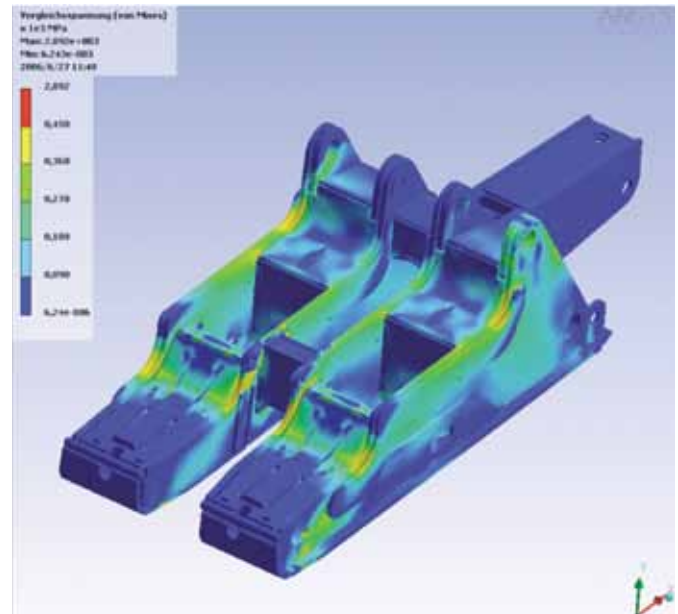
## We Listen

We constantly listen to our customers to find ways to improve our products and services. Customer representatives are involved in all relevant stages of the project to ensure site-specific optimization of the product. For example, during prototype inspection, customers participate in fine tuning under simulated underground conditions.

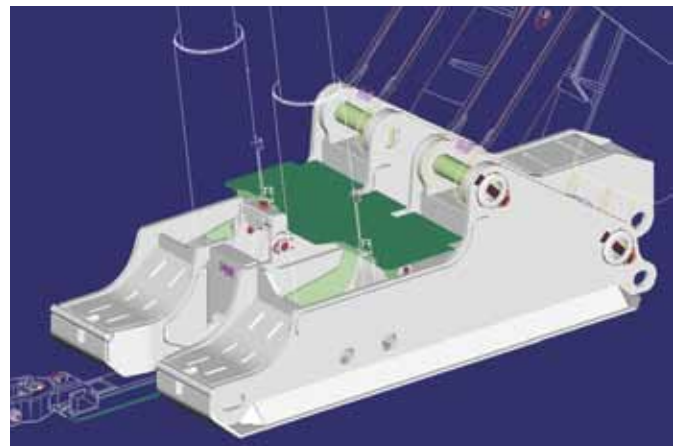
## Fabricated Components

Design and fabrication of structural elements make up a major part of any shield project. The highest standard of structural elements is critical for reliability and long service life in the demanding underground mining environment. Caterpillar meets this need with exacting design processes coupled with superior fabrication technology. Design quality and durability of welded fabrications are ensured by extensive use of butt and full-penetration weld seams.

This technology offers improved resistance to fatigue and allows use of non-destructive ultrasonic testing to detect any subsurface quality deficiencies. These tests are a vital part of Caterpillar's manufacturing quality assurance procedure.



Stress analysis (FEA) of the shield base



3D design of a high-seam shield base



Robot welding



## Control Systems

Caterpillar manufactures a complete range of shield support control systems ranging from manual hydraulic controls to the highly acclaimed PMC™-R electronic control system for the most advanced face automation and equipment monitoring. Top priority is given to control flexibility, user friendliness, reliability, ease of maintenance and safety. The Cat PMC™-R electrohydraulic longwall face control system represents the cutting edge in longwall automation technology and facilitates full automation, monitoring and remote diagnostics for all face equipment. All information can be transferred to the surface in real time to allow maximization of longwall performance. The unit is extremely rugged for long life under tough mining conditions.

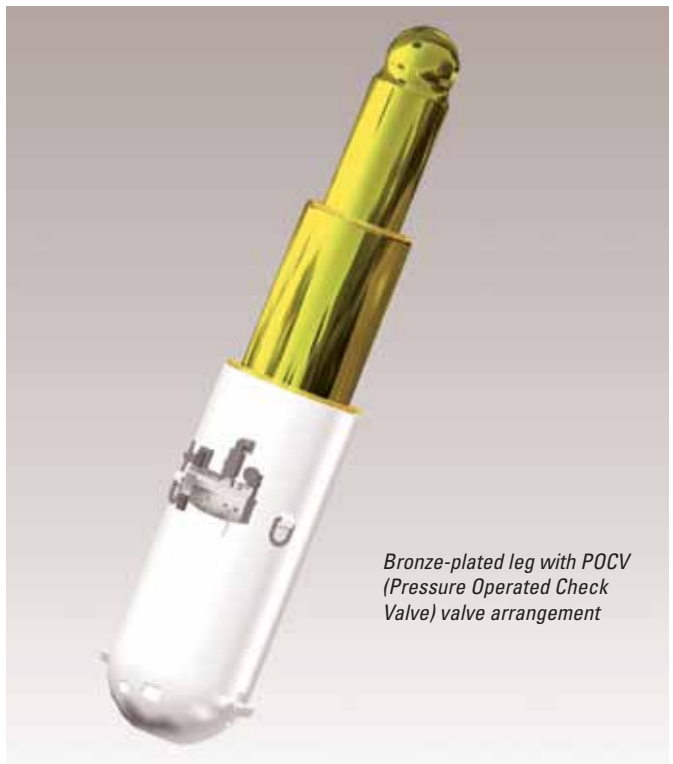
## Legs and Cylinders

Legs and cylinders are designed and manufactured to the highest quality and performance standards. Double- and triple-stage systems are available with equal yield rating in all stages. Materials and designs are selected to ensure long service life under arduous underground conditions. Plating is applied to meet the most corrosive environments.

The normally-used internal bores are designed based on the above-mentioned Finite Element Analysis. An expensive extrusion is technically not required. A range of standard and rapid yield valves is available to protect shield supports from potentially destructive loads and stress peaks which may originate from rock burst or from periodic caving under heavy roof conditions.



*The LCD modules of the PMC™-R can display text in a wide variety of languages.*



*Bronze-plated leg with POCV (Pressure Operated Check Valve) valve arrangement*

## Roof Supports for Special Applications

Caterpillar has extensive experience in the design of shield supports for specific mining conditions and for soft-rock longwall applications other than coal. Steep-seam supports and supports with articulated forepole extension canopies and high tip loads have been developed for extreme geological situations.

### Steep-seam Mining

Faced with the enormous reserves of high quality coal blocked underground and the intensive look of many customers for promising solutions, we have developed and introduced various specific, state-of-the-art systems to also mine steeply inclined coal seams.

Given our long experience in this field and our proven applications and automation, Caterpillar can offer tailor-made solutions for nearly all conditions, including particularly steep applications. High availability, productivity, and safety are also paramount for these systems.

### Conventional Sublevel Caving

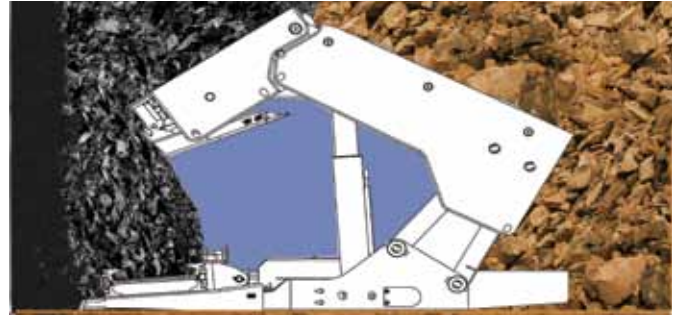
Conventional sublevel caving supports allow coal to be drawn from the roof using articulated canopies with special chutes integrated into the gob shield, the front AFC or a second AFC located behind the shields. A large number of shield installations have been supplied to customers, particularly in central and eastern Europe.

### Longwall Top Coal Caving

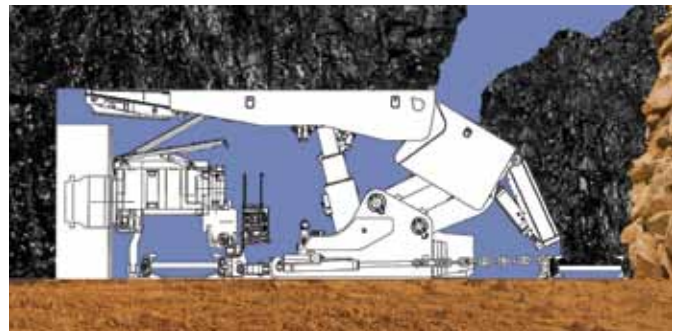
The Longwall Top Coal Caving (LTCC) roof support allows mining to a total seam height of more than 10 m (33 ft) by using a longwall shearer to cut the bottom 2.80 – 3 m (9.20 – 9.80 ft) and then caving the top coal behind the roof supports onto a rear AFC. This type of longwall is in service for example at a mine in the Hunter Valley, Australia.



*Steep-seam Mining*



*Conventional Sublevel Caving*



*Longwall Top Coal Caving*



*LTCC Roof Support for an Australian mine*





## Equipment You Can Rely On

### Extensive Testing

Before our shields are shipped to the customer, Caterpillar carries out an extensive series of tests on all structural, hydraulic and control components in our own test center. Sophisticated tests check the fatigue strength and load-bearing capacity of individual products. Caterpillar has all test systems required for roof supports and their components:

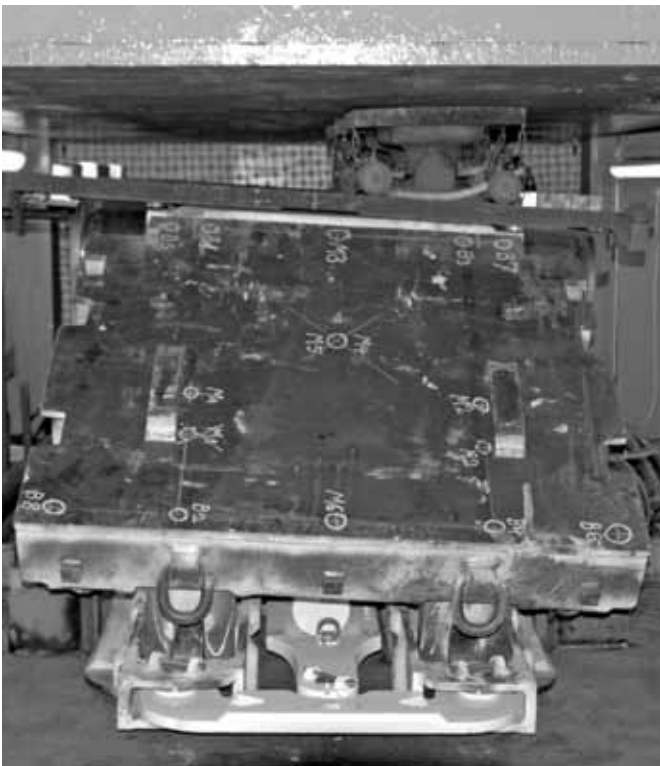
- Three shield test rigs with a force resistance of up to 20 000 kN and a test height of more than 5.0 m (197 in)
- Leg and cylinder test machines up to 15 000 kN
- Hydraulic test rigs with pressures of up to 1 000 bar and a volumetric flow rate of more than 500 L/min

### Test Process

The main tests involve longitudinal and lateral bending load and torsion loads in addition to compressive and tensile load. Tests are usually performed with up to 70,000 load cycles with 10% to 20% overload. Complete roof supports are tested as well as individual components such as base, canopy, legs, cylinders, controls, pressure relief valves and hoses. Test measurements confirm calculations and allow constant product improvement and full exploitation of optimization and savings potential. Testing ensures that equipment is suitable for the intended use and will have a guaranteed service life as specified even under extreme conditions.



*Test rig for roof supports*



*Plow shield during cycle testing*

## **We Support You all the Way**

Customer consultation and support start at the beginning of a project and continue through all stages: engineering, prototype inspection, compatibility testing, commissioning underground and throughout the entire service life of the equipment. Caterpillar provides comprehensive training of customer personnel in operation and maintenance. Computer-based interactive training provides an understanding in design concepts and helps personnel become proficient in operation, diagnostics and troubleshooting and in identifying parts. In addition to the training at Caterpillar, training classes are provided at mine sites. This training continues during installation and commissioning underground.

## **Our Network**

A network of local service and support facilities ensures that Cat systems produce at maximum capacity throughout their service life. These service centers stock parts and perform component overhauls and equipment upgrades. Our well-trained service team is highly experienced and motivated to provide excellence in customer service.



# Roof Support Systems

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at [mining.cat.com](http://mining.cat.com) and [www.cat.com](http://www.cat.com)

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