

Warner Electric

Boston Gear

TB Wood's

Formsprag Clutch

Wichita Clutch

Marland Clutch

Industrial Clutch

Nuttall Gear

Warner Linear

Delroyd Worm Gear

Stieber Clutch

Ameridrives Couplings

Inertia Dynamics

Matrix International

Huco Dynatork

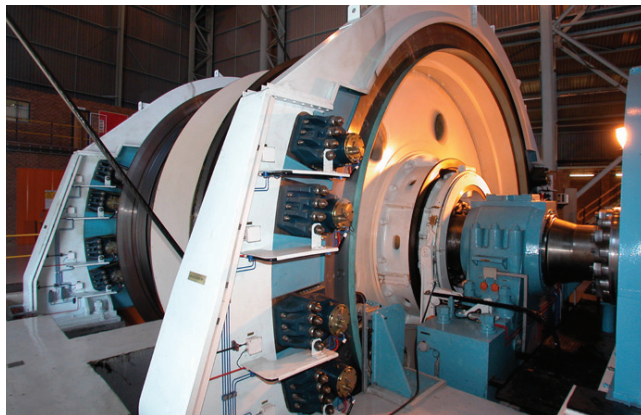
Bibby Transmissions

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# Braking for the World's Deepest and Fastest Man Riding Hoists



 **Twiflex**<sup>®</sup>  
Limited

An Altra Industrial Motion Company

# Braking for the World's Deepest and Fastest Man Riding Hoists

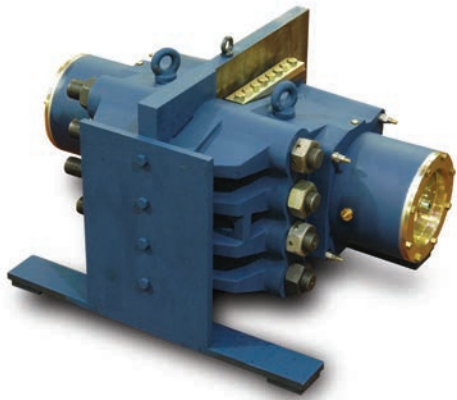
*Brakes for mine winders call for continual mining at greater depths and more advanced technology than ever before*

Years of reliable operation in deep hoist mining have placed Twiflex as a world leader in the field of mine winder braking technology. This leadership was further reinforced when Twiflex was chosen as the brake manufacturer for two of the world's deepest and fastest man riding hoists.

Installed in one of South Africa's deepest gold mines, the Blair multi-rope, single drum winders are manufactured by Fuller Vecor and operate down Anglo American's Vaal Reef number 11 shaft. Known as "Super Winders" they are designed to raise and lower the weight of 14 family cars down a 3.1 kilometre deep mine shaft. Of course this payload is not excessive, but add to it the weight of the 3 kilometre long ropes and the engineering requirements make these some of the world's largest winders.

Design parameters are indeed impressive:


Drum diameter	5.7 metres
Drum width	2.2 metres
Hoisting depth	3150 metres
Payload	13500 metres
Rope speed	19 m/sec
Rope diameter	42 mm
Brake disc diameter	7.21 metres
Winder inertia	2,780,220 kgm sq
Required braking torque	4,315,781 Nm



Safe control of these prestigious "Super Winders" is of paramount importance. To achieve this Twiflex employ on each winder a total of 12 off VMS / VR type disc brake calipers acting on two discs 7.21 metres in diameter. Each of the calipers weigh over 770 kg and are applied by means of powerful direct acting springs giving a braking force equal to 180000 N for each brake. With a total of 12 brake calipers acting on two 7.21 metre diameter discs, the total braking torque available for an emergency stopping situation is 7,311,600 Nm.

The basic principle behind the design of large mine winder disc brakes is much the same as the one employed for automotive brakes. Both are hydraulically controlled, the automotive brakes using hydraulic pressure to apply force to a piston which in turn applies direct force to a friction pad against a disc.

In mine winder disc brake technology each caliper module contains a disc spring pack which provides direct mechanical force to a friction pad against a disc. The brake is then released by applying hydraulic pressure to a piston and cylinder arrangement which compresses the spring pack. Controlled braking can therefore be achieved by varying the hydraulic pressure to each caliper.



When considering selection for mine winder disc brakes it is necessary to design a system that will statically hold twice the weight of the cables and fully loaded skip at the bottom of the mine shaft. This criteria results in providing braking torques far in excess of the requirements for normal retardation and holding. Consequently an advanced Twiflex braking control system is employed which accurately regulates the degree of hydraulic pressure needed for optimum retardation.

Conventional winders are designed with 4 to 5 metre drum diameters and result in a contact velocity between the disc and pad of between 15 to 18 metres/sec. These “Super Winders” are engineered with drum diameters of 5.7 metres. This results in contact velocities of 25 metres/sec, and therefore higher disc temperatures cause the need for an advanced design of pad material. The Twiflex Development Team worked closely with their friction liner manufacturer and developed and tested a pad that can maintain its coefficient of friction up to 350 degrees C.

Another factor is the energy absorbed by such a braking system during an emergency stopping situation. In this case it can be as much as 155 MJ, therefore brake pad area and disc thickness are important when considering acceptable disc temperatures. For this application the 12 off VMS / VR caliper brakes employed on each winder have a total pad area of 4.3 square metres and act on brake discs 80 mm thick.

It is estimated that 45% of the world’s gold resource is in South Africa and most of its gold bearing rock runs down at an angle 20/30 degrees from the surface. Recovering this precious metal means continual mining at greater depths, and Twiflex is currently discussing braking systems for winders capable of operating to hoisting depths of 5 kilometres. It therefore seems likely that such technology will continue to provide fresh challenges for engineers long into the future.

## About Altra Industrial Motion

Altra Industrial Motion (NASDAQ:AIMC) is a leading multi-national designer, producer and marketer of a wide range of electromechanical power transmission products. The company brings together strong brands covering over 40 product lines with production facilities in nine countries.

Altra's leading brands include Boston Gear, Warner Electric, TB Wood's, Formsprag Clutch, Wichita Clutch, Industrial Clutch, Ameridrives Couplings, Kilian Manufacturing, Marland Clutch, Nuttall Gear, Stieber Clutch, Twiflex Limited, Bibby Transmissions, Matrix International, Inertia Dynamics, Huco Dynatork, Ameridrives Power Transmission, Delroyd Worm Gear and Warner Linear. For information on any of these technology leaders, visit [www.AltraMotion.com](http://www.AltraMotion.com) or call 815-389-3771.



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