General Magnetic

MagnoDrive PMM Top Drive for PCPs

Value Proposition

Significant OPEX Reduction:

- ✓ No Gearbox, Belt or Sheave changes through full operating speed r
- ✓ Significantly reduced electric power consumption (10% – 30%)
- ✓ Virtually eliminates motor maintenance and downtime
- ✓ An annual oil change is the only maintenance required
- ✓ Lifecycle over 10 years

Production Increase by:

- ✓ Reduced production losses from lower preventive and reactive maintenance
- ✓ If field has an electrical capacity constraint, can deliver additional power within the same envelope

Characteristics:

- ✓ Fail-safe Electronic Resistance Brake
- ✓ Safe Installation and Workovers – Balanced Lifting
- ✓ Maximum rated torque available from 30rpm
- ✓ Low Noise – 68 db at 3 meters
- ✓ Certified for use with ABB, Unico, Yaskawa, Danfoss and Schneider VFDs
- ✓ Enhanced Remote Monitoring and Control

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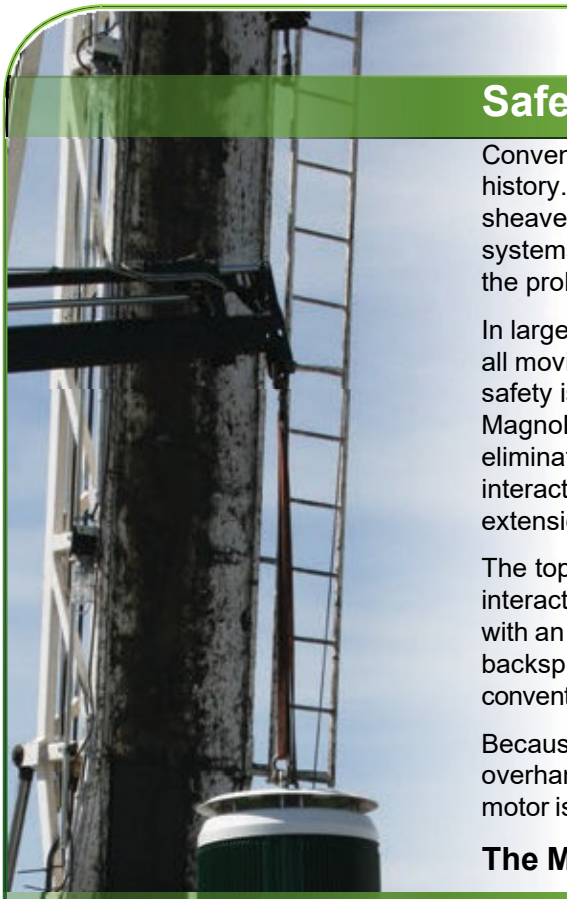


Safety is the Number One Priority

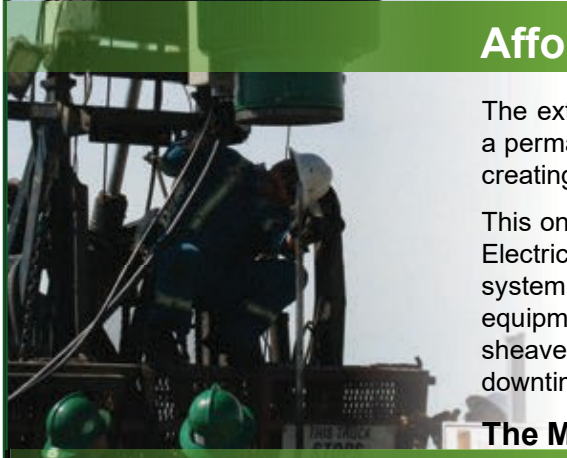
Conventional progressive cavity pump top drives have had a checkered safety history. This is primarily due to the large number of rotating parts, such as belts, sheaves, and gears. In more recent years efforts to improve mechanical braking systems have tried to deal with these issues, but have only addressed part of the problem.

In large rotating mechanical equipment like progressive cavity pump top drives, all moving parts are sources of potential accidents. The only real answer to this safety issue is to eliminate or dramatically reduce the number of rotating parts. MagnoDrive permanent magnet motors tackle the safety issue head on by eliminating moving parts that could injure either through failure or accidental interaction. The only external rotating part on the MagnoDrive is a single shaft extension.

The top of the MagnoDrive has a rod clamp guard that reduces any accidental interaction with the rod clamp, which is external to the motor. The VFD comes with an integrated failsafe electronic resistive brake that eliminates uncontrolled backspin, offering a superior and simple way to handle backspin over the conventional mechanical systems such as reverse flow oil pumps and disc brakes.

Because the MagnoDrive is round, lifting is now inherently safe as there is no overhanging mass like conventional PC top drives. When installed on a well the motor is concentric on the wellhead with no resultant mechanical stress.

The MagnoDrive – Your employees are worth it



Affordability makes it Practical

The extra cost to manufacture a PM motor involves a onetime cost to create a permanent magnetic field in the rotor. This replaces the cost of continuously creating that magnetic field on the rotor in a conventional induction motor.

This onetime cost is offset by real and quantifiable savings in operating costs. Electrical energy consumption is significantly reduced, along with enhanced system efficiencies brought about by the elimination of speed reduction equipment. There are no gearboxes to lubricate, belts to tighten or replace, or sheaves to adjust or replace when a speed change is needed. This reduces downtime, costly interventions and replacement parts.

The MagnoDrive - Your logical choice for total cost reduction

Flexibility in Field Operations

The MagnoDrive is simple to install and operate. By design it has no overhung mass and therefore installation is easier when changing out conventional top drives on a retrofit, or for installation on new wells. The motor is concentric with the well which permits quick, easy, and safe mounting on the stuffing box.

Operating through the MagnoDrive's full RPM range does not require well shut down to allow expensive and time consuming belt, sheave or gearbox changes to optimize its power curve. All it requires is the push of a button to change VFD parameters. These properties make the MagnoDrive the ideal top drive for remote monitoring and control applications. The MagnoDrive can be operated with a number of certified VFD products, providing greater opportunity for customization by producers desiring a particular product.

The MagnoDrive - The choice of operators focused on well optimization

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Efficiency Paybacks Year after Year

Conventional electric motors do not have the operating efficiencies or torque throughout their RPM range to enable variable frequency drives on their own to be the complete solution. Any significant changes in speed ultimately require changes in the gear ratio between the motor and the pump.

The MagnoDrive direct drive PCP top drive motor is engineered specifically for PCP top drive applications and uses a permanent magnet (PM) motor topology. The MagnoDrive has been designed specifically for low speed applications (under 500 RPM) which eliminates power transmission and speed reduction products like belts/sheaves, gears and/or hydraulics. The MagnoDrive has unique operating characteristics that make it ideally suited for PCP top drive applications, including:

- Industry leading motor efficiencies (97.4%) and the ability to integrate optimization equipment like pump off controllers with continuously variable speed
- Exceptionally high starting torque and, unlike conventional motors, can deliver rated torque efficiently over entire operating RPM
- Eliminating speed reduction equipment increases system efficiencies (Measured line to rod string efficiency 92.9%) which reduces electrical energy consumption
- Environmentally friendly with reduced greenhouse gas (GHG) emissions and low noise emissions (68 decibels at 10 ft.)

The MagnoDrive - Leading the pack in system efficiencies that drive to the bottom line

Reliability is Obvious and Proven

First generation General Magnetic products have been operating continuously in harsh field conditions with Canadian producers over eight years. Fourth generation MagnoDrive products have been specifically designed to improve upon an already stellar reliability record, delivering greater reliability, increased efficiencies, and operating advantages.

Eliminating rotating speed reduction equipment eliminates the need for the periodic maintenance and replacement of that equipment inherent in conventional top drives. The only rotating equipment on the MagnoDrive is the motor rotor, bearings, and integrated fan. This simplicity of operation almost eliminates maintenance other than periodic bearing oil changes. In harsher climates where heat, humidity and dust are significant maintenance and reliability factors, the advantages of the MagnoDrive are even more obvious.

The MagnoDrive – Leading the pack in reliability and reduced maintenance

Product Capability Highlights

200 Series

300 Series

400 Series

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Speed Range	30-450rpm
Max Efficiency	97.4%
Max Ambient Temp	50°C [120°F]
Max Thrust Load	18,000 kg [40,000 lb] continuous
Voltage	480 VAC
200 Series	
Max Torque	1,132 Nm [835 ft-lb]
Max Power	43.8 kW [58.7 hp]
Max Current	88 Amps
300 Series	
Max Torque	1,580 Nm [1,165 ft-lb]
Max Power	61.7 kW [82.7 hp]
Max Current	117 Amps
400 Series	
Max Torque	2,000 Nm [1,480 ft-lb]
Max Power	76.7 kW [102.8 hp]
Max Current	156 Amps

Report on Motor Efficiency and Electrical Energy Savings

Considering motor efficiency alone, operating costs, specifically electrical energy costs, are often far more significant than the cost of the motor itself. The following excerpt from Pumps and Systems, June 2009 is from an article called “How Much Do Electric Motors Really Cost?” written by John O’Brien.

“Here is a breakdown of how much one 200 hp, 1,800 rpm and 460 V TEFC motor costs in power in a calendar year (7,200 hours of operation):

- Average cost of power in the United States: $.068/kWh
- Annual Power Cost: $70,669
- Initial Purchase Price: Slightly more than $10,000

Considering the above factors, one 200 hp pump motor running 6 days a week for 50 weeks a year will cost more than $70,000 dollars at the end of one year. Interestingly enough, ***most end-users spend more time negotiating the initial purchase price of a motor than understanding the true cost for operating that motor.****”*

When one considers system operating costs, this factor becomes even more relevant.

Electrical Energy Costs - PCP Top Drive Implications

Until recently, when considering the operating costs of progressive cavity pump top drive applications the cost of electrical energy has not been a significant differentiating factor between conventional systems using electric motors powering either hydraulic or direct drive systems using belts, sheaves, or gears. Until now, system efficiencies (the overall efficiency from line to rod string) have hovered in the 70% range, with some highly optimized systems approaching 80%. There has been little direct comparative data collected on comparative efficiencies, so these numbers are anecdotal but represent broad industry opinion. Because of this, purchasing decisions have focused more on initial capital cost supplemented by operator preference as the key differentiating items.

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Comparative Advantage of MagnoDrive Technology

The MagnoDrive direct drive system will deliver annual electrical energy savings over conventional top drive systems. System efficiencies (the power lost between the line power in and the power transferred to the rod string) for conventional top drives varies significantly with factors such as the losses inherent in speed reduction equipment, operating policies of producers, age of equipment, and environmental conditions such as temperature extremes, excessive humidity, and dust. General Magnetic has participated in a comparison that had an example of overall system efficiency in the mid 80 percent range on a system highly optimized to a specific well. GMII has also participated in a comparison with a non optimized electric hydraulic unit that had system efficiencies of around 75%. In these cases the observed power consumption reductions ranged from close to 10% to over 20%. Anecdotal information from operators suggests system efficiencies are more typically in the 70-75% range for conventional products operating in Canada.

In environments like South America and the Middle East the efficiencies of conventional systems would probably be lower. In addition, the higher rates of belt replacement, associated downtime and cost, as well as reduced production in these environments increase the operating costs in conventional systems.

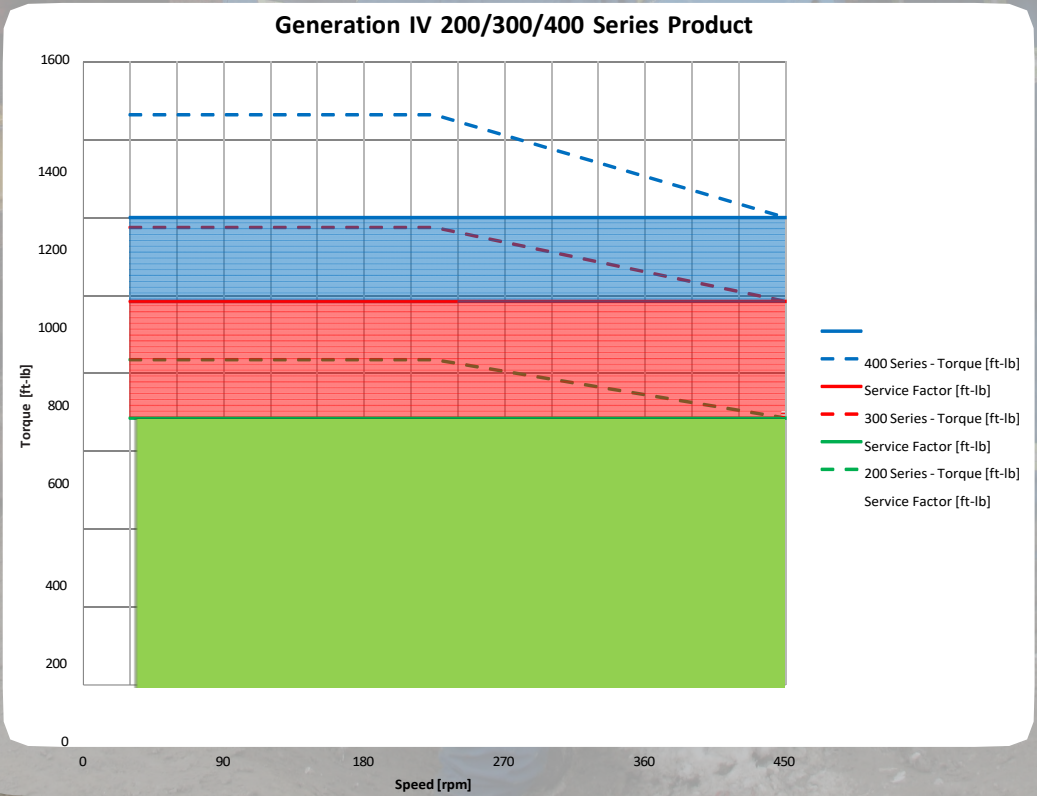
Driving to the Bottom Line

Electrical energy savings can be considerable and drive to bottom line affordability when considering the installation of a MagnoDrive. With observed reductions in energy consumption from 10-20%, an indication of potential annual savings under different scenarios is presented in the following table. The assumptions are for a 100 hp equivalent top drive with an 85% load factor, with the all in cost of power at 10 cents/kWh.

Initial Base Power Consumed (kWh)	MagnoDrive Electrical Energy Reduction	Power Reduction	Power Price	Power Savings
555,000	10%	55,500	$0.10	$ 5,550
555,000	15%	83,250	$0.10	$ 8,325
555,000	20%	111,000	$0.10	$ 11,100

Total annual energy savings in specific applications will be dependent upon overall power consumption and the cost of power in a particular region.

Product Family Capability



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Your Assurance of Quality

- ✓ MagnoDrive developed and manufactured by a dedicated team of rotating equipment engineers and technicians
- ✓ MagnoDrive certified to UL and CSA standards. Please ask for details.
- ✓ Canadian quality and standards of excellence assured

ISO 9001:2015 CERTIFICATION
Intertek ™

General Magnetic International Inc.

- ✓ A Canadian Company
- ✓ ISO 9001 Certified Development and Manufacturing Facilities

Contact Us

104, 2880 – 107 Ave SE
Calgary, Alberta T2Z 3R7

Phone: 403.279.9133 | Fax: 403.279.9188

Sales: ryandyjur@generalmagnetic.ca
Service: techsupport@generalmagnetic.ca