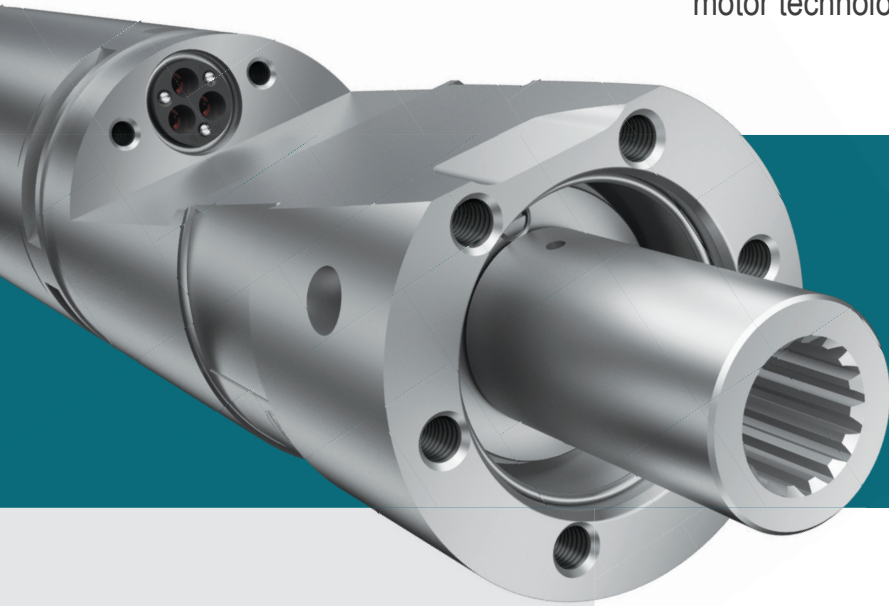


# 406 ESP Motor Technology

Performance and cost-saving advantages of Borets 406 PMM and IM motor technology are lifting Operators' expectations for ESPs in unconventional well production



Wells completed with 5.5 in., 23 lb/ft casing

Wells completed with 5.5 in., 20 lb/ft casing requiring annular clearance for control line or capillary tube

ESPs with shrouds or operating in liners

## Benefits

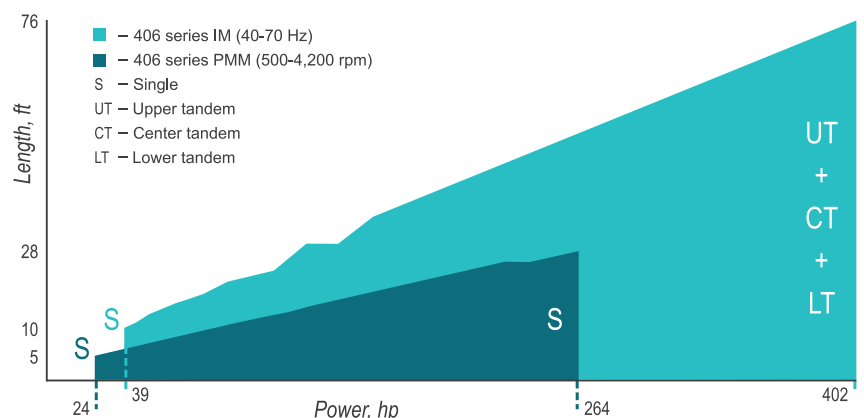
- Increased early production enabled by higher horsepower ESP access in smaller casing dimensions
- Reduced electrical power costs by up to 20% per barrel fluid lifted across a wide range of ESP application
- Reduced risk of becoming stuck in hole with ESP
- Increased annular clearance enhances natural gas breakout before intake and facilitates downhole chemical treatment program
- Deeper pump setting depths enabled by shorter motor length (PMM)
- Improved reliability through elimination of tandem motor connections (PMMs)
- Improved reliability through reduced tandem motor connections vs. 375 series motors

Borets' 406 series ESP permanent magnet motors (PMM) and induction motors (IM) provide maximum horsepower availability to electric submersible pump systems in casing sizes with more restrictive internal diameters (ID).

Wells completed with 5.5 in. and either 20 lb/ft, or 23 lb/ft casings cannot easily accommodate ESP systems using 456 series motors. Without exceptional steps to reduce the motor outside diameter (OD), motors with an OD of 4.56 in. have very small or insufficient annular clearance to fit these casing sizes. Smaller ESPs using 375 series motors (with 3.75 in OD) fit in these casing sizes, however, even triple-tandem configurations will lack sufficient horsepower to provide the full range of production required. ESP systems powered by Borets 406 motor technology overcome such limitations in these applications.

With a nominal OD of just 4.06 in, Borets 406 series motors power ESP systems up to 402 hp. Benefiting from higher horsepower rotor density than IMs, 406 PMMs come as single-section motors up to 264 hp and are shorter in length than any IM hp equivalent. The 406 PMMs deliver the additional benefits of reduced electrical power costs and lower heat rise, which positively influence equipment reliability and system run life. Developed and first introduced by Borets in 2006, this motor technology has a long, proven track record of performance and can reduce electrical power cost up to 20%.

## 406 Motor HP Range Availability

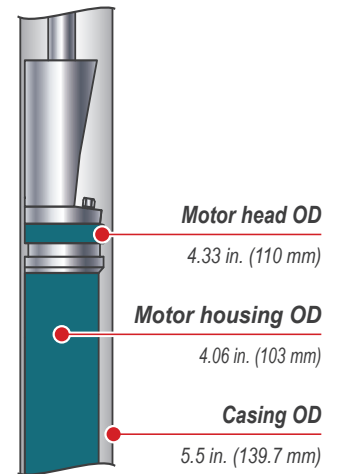


## Features

- High motor efficiency (up to 90% for PMM)
- High power factor (0.95 for PMM)
- Nominal rotational speed (PMM) 3,600 rpm
- Adjustable operating speed range (PMM) 500 – 6,000 rpm\*
- Synchronous operation (PMM) – no slip
- Treated IM rotors optimize conductivity and motor cooling
- Advanced rotor bearing design for better stability and operational longevity
- Protection for MLE and pothead connection during deployment

\* Upper speed range may be limited by motor voltage rating

The 406 motor design is optimized to deliver maximum achievable horsepower for this diameter motor body. The slender profile of this motor provides increased annular clearance facilitating both the natural breakout of gas prior to the intake as well as downhole chemical treatments using capillary tube to deliver chemical additives. The 406 PMM and IM motor head design incorporates an integral pothead protection feature immediately below the pothead connection to the motor.



While this feature profile marginally increases the motor OD at this single point, it provides robust protection for the MLE and pothead connection during system deployment, while still conforming to the overall running OD as defined by the ESP-MLE cable dimensional envelope.

## 406 PMM and IM Performance

Production economics in 5.5 in. heavier-walled casing improve even further when 406 PMMs are utilized. In contrast to their IM equivalent, PMMs operate with a higher power factor and efficiency across the full spectrum of expected motor load. The benefit to efficiency and power savings is even more magnified at reduced motor loads often encountered as a consequence of variable flow rates typical in unconventional well production. Operating current is lower by 10% - 15% than for an equivalent IM.

Specifications	IM		PMM	
Motor Efficiency	Up to 83%		Up to 90%	
Motor Power Factor	0.84		0.95	
Max (Internal) Temperature, °F (°C)	392 (200)		392 (200)	
Motor Housing Nominal OD, in. (mm)	4.06 (103)		4.06 (103)	
Motor Head OD, in. (mm)	4.33 (110)		4.33 (110)	
Involute Spline Type	25 mm – 24T		25 mm – 24T	
Maximum Power, hp (kW) @	50 Hz	60 Hz	3,000 rpm	3,600 rpm
	Single	121 (90) / 145 (108)	220 (164)	264 (197)
	Triple tandem	335 (250) / 402 (300)		

