Extreme Equipment Sales & Rentals
PowerDrive – Motor Bypass Requirements for PowerDrive
Revision 1.0

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Applicability: All PowerDrive
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Background Information

PowerDrive depends on correct estimation of bit pressure drop to provide steering force to deviate the wellbore. If the actual pressure drop created by the bit and restrictor is less than what is estimated during the pre-job hydraulics calculations, the PowerDrive may not generate sufficient force to steer the wellbore as desired. PowerDrive requires a bit pressure drop of up to 750psi, which is much more than the typical backpressure of a bit alone (around 200psi in most cases).

Estimation of the flow rate bypass through the motor bearing stack is a critical part of these hydraulics calculations. The increased pressure drop of PowerDrive will affect the bypass rate of most mud motors, making most "rule-of-thumb" estimates invalid.

There are many types of motor bearing sections on the market, including:

1. True, zero-bypass, sealed bearing motors, where all fluid flow goes through the bit (less common)
2. Sealed-bearing motors where controlled flow is diverted past the bearings through a restrictor for cooling purposes (more common)
3. Mud-lubricated bearings that divert a larger percentage of flow through them for both cooling and lubrication (most common)

Case 1 is generally the rarest type of bearing configuration. In this case, no bypass (0%) is used in hydraulics calculations as all flow rate through the motor goes through the motor mandrel and into the PowerDrive.

Case 2 is increasingly common, as many vendors use sealed bearings. This refers only to the bearing design, not the loss of the motor – a sealed bearing is self-contained and full of grease or oil, but many vendors still bypass flow around the bearing housing to provide some cooling to the bearings. The flow bypass for these motors vary drastically by vendor and design. Some vendors use fixed restrictors to divert an appropriate amount of flow, but this loss will vary by backpressure, flow rate, and mud density and rheology.

Case 3 is the most common type of bearing, fully mud lubricated. The loss through the bearings is affected by the clearance in the bearing stack. Increasing clearances mean increasing cross sectional area for flow to pass through. Prediction of this bypass requires accurate measurements of the bearing diametric clearances. Generally, the bypass is mostly affected by the smallest gap the mud must pass in the bearing stack. For a typical 7" bearing stack, this is between 0.015" to 0.020" diametric clearance for upper and lower. This number will change over the course of the run as the bearings wear. Bearing wear rates vary by loading conditions and mud properties, and the larger the clearance, the larger the bypass.

Solution – Observe Motor Build Sheet Bearing Clearances

For PowerDrive, a "rule-of-thumb" estimate (typically 5-8%) based on nominal engineering specifications **will not guarantee correct hydraulics setup.** Extreme recommends an estimation using the actual build specifications of the motor delivered to location, and the expected mud parameters on the run. Motor vendors are the most knowledgeable source of flow rate bypass estimates using their motor designs in as-built configuration. Extreme cannot predict losses through most of these motors (especially sealed designs.)

Extreme can help estimate flow losses of mud-lube motors with standard bearing configurations. Using the upper and lower radial bearing gaps an estimate of loss can be made with anticipated mud properties using the PD^2 application. Please contact the Command Center for assistance estimating bypass percentage of a motor.

If no estimate of loss if available except for rule-of-thumb or nominal estimates, the reported clearances in the motor build sheet can be qualitatively compared against successful runs. A larger gap generally results in a higher bypass. Using the PowerDrive post-run data, flow rate through the BHA can be confirmed to determine acceptable clearance ranges for a motor bearing vendor or type, however this requires experimentation.

Example Motor Build Sheet showing diametric clearances of upper and lower radial bearings in red.

Drilling Motors

LOADOUT REQUEST- MOTOR

Customer		Job Number	
Well		Priority	
Shipping Address	yrd.	Rig	
Shipment Type		Date/Time Required	

POWER SECTION S/N

Application Details		3rd Party Monitor Inspection & Assembly?
Hole Temp (Static)	210	Not Requested
Prop Run Length Hrs		

Configuration Details	Motor #1	Motor #2	Motor #3	Motor #4
Motor Size	500			
Motor Type	Dynaforce			
Fixed Or Adjustable	FXD			
Bend Angle	0.00			
Lobe Configuration	7/8 8.4			
Stab or Slick	True Slick			
Blade Size	N/A			
Lift Sub	NO			
Top Sub Connection	3 1/2 IF Box			
Bit Box Connection	3 1/2 IF Pin			
Bearings	Mud lube			
Upper Bearing Clearance	0.015			
Lower Bearing Clearance	0.015			
Torque Lock	yes			
Demagnetized	yes			
Rotor Type	Carbide			
Rotor Catch Installed	yes			
Rubber Type	HR			

Serial Numbers	Motor #1	Motor #2	Motor #3	Motor #4
Motor level Top Asset	RVDF-50005			
Powersection Fit	0.000			
Sleeve/Stab	True Slick			
Lift Sub	N/A			

Shipper Signature		Date:	