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Mud Motor – Recommended Practices

During normal drilling operations, only place tongs on the Top Sub and the Bit Box. These are the parts on each end of the motor. Placing tongs on other components of the motor or applying torque to connecting pieces can cause damage or loss of major components. The only time any tongs should be placed on the other components is during Service work at a motor repair facility.

Ensure that the drilling rig, pump and Mud Pump Pressure Gauge are in correct working order. The mud motor works on Volume and must have a constant flow that is adequate for the motor being used. The Mud Pressure Gauge is used to provide a measurement of Mud Pressure and the torque being produced from the drill bit being pushed against the formation. Ensure that the Supervisor and Driller understand how the motor works and the terms: off-bottom pressure, differential pressure, and the stall pressure as defined below.

Off-Bottom Pressure: Determine the Volume of mud that is required to operate the motor. For example, a 4-3/4" motor may require 180 Gallons Per Minute (xxx LPM). The Mud Pressure Gauge will display the Pressure Required to pump that specific volume of fluid (drilling mud) from the pump – through the mud hoses, drill rig, the drill pipe, the mud motor and the drill bit (with jet nozzles). The Driller should Observe and Record this number. This is your Off-Bottom Pressure. It is a fairly consistent number that should be observed each time a joint of pipe is added and the mud pump is throttled up to begin drilling. The pressure will increase slightly each time a joint of drill pipe is added, since the pressure required to pump the same volume of mud increases as the length of the drill string increases. Other factors that will affect mud pressure are Jet Nozzle Size and mud Viscosity. Let's assume 600 PSI for this example.

Differential Pressure: As the drill bit is pushed forward to drill the formation, the Mud Pressure displayed on the Mud Pressure Gauge will increase. This is a result of the rotation of the drill bit meeting resistance from the formation. To properly operate the mud motor, the driller wants to allow the Hydraulic Action of the mud motor to be his guide. As a starting point, we recommend that the driller apply enough pressure (from the drill rig) to increase the Differential Pressure by 100 PSI. If the Off-Bottom Pressure is 600 GPM and you add 100 PSI of Differential Pressure, the pressure on the Mud Pump Pressure gauge will now be 700 PSI. To optimize performance, the driller needs to hold enough thrust pressure from the drill rig to maintain differential pressure. More differential pressure can be used, but the driller must avoid Stalling the motor as explained below.

Stall Pressure: The drill rig has enough thrust pressure to force the drill bit into the formation hard enough for it to meet enough resistance and Stall. The driller will know when this has happened, because the Mud Pressure Gauge will increase significantly and become steady, the motor will not be turning the drill bit and Rate of Penetration (ROP) will slow, or stop. If, in the example above, the Off Bottom pressure is 600 PSI and the driller applies 100 PSI of differential pressure the pressure should be 700 PSI. When the Stall occurs (provided the pressure numbers from the example are similar), the Mud Pressure Gauge will immediately go to a higher

number, such as 900 PSI. At this point, the internal components of the mud motor will not be rotating and drilling mud will be forced through one of the Lobes of the motor, causing un-necessary wear and damage to the motor.

Drilling with a Stalled Motor. If the driller is in a “slide” mode, to build angle, the progress (ROP) may stop when the motor stalls. If the driller is in a Rotating mode, the progress (ROP) may continue, since the bit may be “locked”, but turning due to the rotation of the drill pipe. The Mud Pressure Gauge will indicate that a stall has occurred. The Mud Pressure Gauge should be monitored to avoid a stall.

If a stall occurs: If the mud motor is stalled, the driller may instinctively want to pull the bit back to get it working again. This should be avoided. The proper technique is to lower the mud pressure to relieve pressure on the motor, then the rig should move backward to remove the bit from the face of the formation. The motor should then be re-started with the bit “off-bottom” and the process should begin again. If the mud motor is pulled off-bottom in a Stall, the motor will be relieved suddenly and violently. The mud motor will “over-speed”, which can cause damage and vibration that may force connections in the motor to become loose and parts of the motor may spin in an opposite direction causing the motor to un-screw in the hole.

Pressure Loss: Each time the driller engages the mud pump to begin drilling, he should throttle the motor to the same RPM. This should result in the same Mud Pressure each time drilling begins. If the Off-Bottom pressure is observed to be lower than on the previous joint, surface equipment and gauges should be checked and the driller should consider pulling the drill motor out of the borehole to check to see where the pressure loss is coming from. (refer to Off-Bottom Pressure)

Post Bore Procedure: After the borehole is complete, the operator should document the Total Hours that the motor has been used (total hours from the current bore, plus any hours of operation from previous use). The motor should be “flushed” with fresh water for storage. Do not put Oil or Anti-freeze in the power section of the motor, since this can damage the Rotor (which has a rubber liner). Generally speaking, if the motor is operated correctly, it should be dis-assembled at a motor shop after approximately 80 to 100 hours of use. This will allow the components of the motor to be individually inspected and the worn components can be changed for new components (re-build).

During drilling operations, the mud motor is used in a “slide” mode to build angle in the direction that it is oriented. The motor can be “Rotated” (by turning the drill string) to increase ROP and advance through sections that do not need borehole direction change. After a “slide” mode has been used and the borehole angle change is aligned to allow Rotation, the driller should pull back slightly to free the bit, before going in to “Rotation”. As the driller begins to rotate the drill string, he should slowly apply rotational pressure and watch the Drill Rig Rotation Pressure Gauge to see that the motor is not in a bind. Rotation should be kept as slow as possible (15 to 20 RPM). Let the drill motor do the work. Fast Rotational Speed while rotating simply wears out components on the motor and causes damage.

A good driller will find the optimum ROP (rate of penetration) by studying and maintaining a proper Differential Pressure, Avoiding Stalls, keeping his Rotation around 20 RPM and servicing the motor properly.

It should be mentioned that pumping debris, such as gravel and drilling mud with a high solids (sand) content will damage the motor. Clean Mud is a friend to all mud motors and drilling tools.

Build Rates: Generally speaking, the mud motor should not be rotated through a curve section that has a tighter Radius than about 700 Feet (213 meter radius). The curve section and build portion of the borehole should be spread out and gradual. If the motor is used to build too much angle or drill too tight of a radius, the motor can be broken. This damage typically is noticed when the driller goes into a Rotational mode too quickly and does not notice Rotational Torque Pressure against the motor. If high torque is noticed when rotating through a

“build section”, the driller should slowly stop rotation and orient the motor into an orientation that allows it to be pulled back to a place in the borehole where rotation can be established without excessive torque.