

Drilling Guidelines

RECOMMENDED “DRILL-OFF” TEST

After the bottomhole pattern has been established, a drilling test should be conducted to determine the optimum bit energy levels to achieve maximum bit performance. The drilling test procedure is as follows:

1. Select the desired rotary speed and hold constant (based on past history with this BHA and/or critical speed analysis).
2. Select a bit weight (at the low end of the recommended bit weight) and hold constant. Mark five feet on the kelly and record the amount of time necessary to drill that distance.
3. After the five-foot interval has been drilled, increase the bit weight by 5,000 to 10,000 pounds. Mark the kelly and record the amount of time to drill this distance. Repeat this procedure until an increase in bit weight does not contribute to a significant increase in penetration rate.
4. Plot the data on a graph (weight vs. penetration rate).
5. Repeat the above procedure adjusting the rotary speed.
6. The optimum bit energy level will be the lowest weight and RPM combination which will achieve the highest penetration rate.

HARD STRINGERS

As soon as hard stringers are encountered, reduce rotary speed to 60 to 70 RPM and maintain weight on bit (WOB). Increase WOB, not RPM, to achieve acceptable rate of penetration.

- Continue drilling under these parameters through entire stringer.
- In straight rotary drilling with no PDM; flow rate should be kept as high as possible to ensure outer cutters get optimal cooling.
- Once through stringer, return to normal WOB first, then increase RPM to normal.
- PDM applications use the same procedure; however, surface RPM may be reduced further. RPM of the bit is important, but the RPM of the bent housing is also significant in maintaining bit stability when transitioning into a harder formation. Keeping the bit engaged in the formation and shearing the rock is the key to good performance through interbedded stringers.

MAKING CONNECTIONS

- When the kelly is down, lock the brake, reduce RPM to 60 to 70 RPM, and wait until WOB is reduced to 2 to 3 K.
- Stop rotary before picking up and make connection.
- After the connection has been made, start with approximately 60 RPM and rapidly increase WOB to half of previous indicated drilling WOB.
- Increase WOB until at least 10 feet an hour is reached and then return incrementally to previously optimized parameters.



INDICATIONS OF UNSTABLE BIT ROTATION

Bit vibrations cannot be identified with certainty from the surface or from MWD vibration sensors. Vibrations may be caused by either the BHA or the bit. When any of the following occur, different drilling parameters should be tested until vibrations return to acceptable levels.

- Increased surface torque fluctuation
- Large WOB fluctuations
- Loss of/or degrading MWD signal quality
- If vibration sensing equipment is in the hole, bit and BHA instability can be detected in real time

Roller Cone Suggested Operating Parameters

STEEL TOOTH BITS				INSERT BITS				
IADC Series	117 - 137	217 - 227	317 - 347	417 - 447	517 - 547	617 - 647	717 - 747	817 - 837
DBS Type Range	1 - 3	4	5 - 7	00 - 17	18 - 39	40 - 69	70 - 89	90 - 99
Formation Hardness	Very Soft (High Durability)	Medium to Medium Hard	Hard (Semi-Abrasive to Abrasive)	Very Soft (High Durability)	Soft to Medium	Medium to Hard	Hard (Semi-Abrasive to Abrasive)	Extremely Hard (Abrasive)
Formation Compressive Strength (psi)	5,000 - 20,000	10,000 - 30,000	15,000 - 40,000	5,000 - 20,000	5,000 - 30,000	10,000 - 40,000	15,000 - 55,000	>25,000
Recommended RPM	55 - 300	45 - 200	35 - 150	50 - 300	50 - 200	50 - 150	50 - 100	50 - 100
Bit Size	Suggested WOB (lb)*,**			Suggested WOB (lb)*,**				
4-3/8 to 4-7/8	12,600 - 3,000	18,000 - 9,000	23,000 - 10,000	12,600 - 6,000	16,500 - 9,000	19,000 - 12,000	19,000 - 15,000	19,000 - 15,000
5-1/4 to 5-7/8	15,000 - 7,000	21,000 - 11,000	28,000 - 15,000	15,000 - 7,000	19,000 - 11,000	23,000 - 15,000	23,000 - 16,000	23,000 - 16,000
6 to 6-3/8	26,000 - 8,000	30,000 - 13,000	32,000 - 18,000	22,000 - 10,000	30,000 - 15,000	32,000 - 20,000	32,000 - 22,000	32,000 - 22,000
6-1/2 to 6-3/4	31,000 - 9,000	33,000 - 14,000	35,000 - 18,000	24,000 - 11,000	33,000 - 17,000	35,000 - 23,000	35,000 - 25,000	35,000 - 25,000
7 to 8	45,000 - 11,000	47,000 - 20,000	63,000 - 30,000	39,000 - 15,000	45,000 - 20,000	55,000 - 25,000	67,000 - 35,000	67,000 - 35,000
8-3/8 to 9-7/8	50,000 - 12,000	52,500 - 20,000	70,000 - 30,000	44,000 - 17,000	52,000 - 23,000	62,000 - 27,000	75,000 - 38,000	75,000 - 38,000
10 to 13-1/2	75,000 - 16,000	80,000 - 23,000	85,000 - 35,000	67,000 - 18,000	80,000 - 25,000	85,000 - 30,000	90,000 - 40,000	90,000 - 40,000
IADC Series	111-131 115-135	211-221 215-225	311-341 315-345	415-445	515-545	615-645	715-745	815-835
Recommended RPM	40-225	40-180	30-120	50-225	50-180	50-120	35-100	35-100
13-3/4 to 16-1/2	72,000 - 20,000	76,000 - 30,000	80,000 - 40,000	64,000 - 20,000	72,000 - 25,000	85,000 - 30,000	88,000 - 35,000	88,000 - 35,000
17 to 28	75,000 - 20,000	82,000 - 30,000	85,000 - 40,000	70,000 - 20,000	80,000 - 25,000	90,000 - 30,000		
Bit Size	Recommended Flow Rate (gpm)***			Recommended Flow Rate (gpm)***				
4-3/8 to 4-7/8	200 - 275	200 - 275	175 - 225	200 - 250	200 - 250	200 - 250	175 - 225	175 - 225
5-1/4 to 5-7/8	200 - 300	200 - 300	200 - 250	200 - 300	200 - 300	200 - 275	200 - 250	200 - 250
6 to 6-3/8	250 - 350	250 - 350	225 - 325	250 - 350	250 - 350	225 - 325	225 - 300	225 - 300
6-1/2 to 6-3/4	250 - 375	250 - 375	250 - 350	250 - 375	250 - 375	250 - 350	250 - 350	250 - 350
7 to 8	350 - 550	350 - 550	300 - 500	350 - 550	350 - 550	300 - 500	300 - 500	300 - 500
8-3/8 to 9-7/8	375 - 650	375 - 650	350 - 550	375 - 650	375 - 650	350 - 600	350 - 600	350 - 600
10 to 13-1/2	500 - 800	500 - 800	450 - 700	500 - 800	500 - 800	500 - 750	500 - 750	500 - 750
IADC Series	111-131 115-135	211-221 215-225	311-341 315-345	415-445	515-545	615-645	715-745	815-835
13-3/4 to 16-1/2	650 - 1000	650 - 1000	600 - 900	650 - 1000	650 - 1000	600 - 950	600 - 900	600 - 900
17 to 28	750 - 1200	750 - 1200	700 - 1100	750 - 1200	750 - 1200	750 - 1200		

*Highest weight on bit (WOB) value corresponds to the lowest RPM and the lowest WOB value corresponds to highest RPM. The highest WOB value is the maximum operating value (WOB) at the lowest RPM value for that given IADC code and should not be exceeded.

**To convert WOB use this formula:
 lb. x .445 = decaNewtons
 lb. ÷ 2205 = tonnes

***Recommended Flow Rates are general guidelines only and actual flow rate should be determined based on the best operational parameters for a specific application. Industry guidelines often recommend "flow volume/inch of bit diameter", but variances in application and bit selection typically require more specific flow rates.