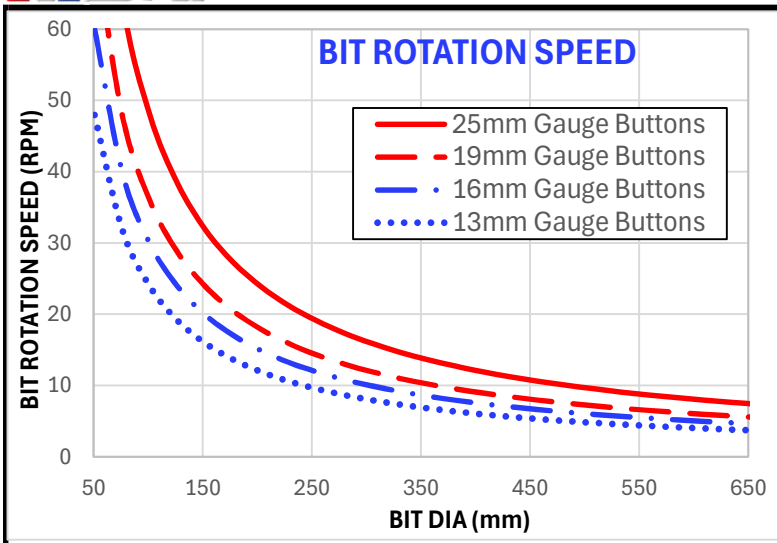
DRILLER CHEAT SHEET - METRIC



START DRILLING WITH VALUES FROM CHART. MARK LINE ON DRILL PIPE.
ADJUST RPM UNTIL MARK ADVANCES 10-20mm PER REVOLUTION.

HAMMER WEIGHT	
SIZE (in)	WEIGHT (kg)
2	13
3	24
4	38
5	62
6	91
8	181
10	363
12	635
15	1225
18	1588
24	2359

WEIGHT OF TOOL

	DRILLING TORQUE		TARGET WOB	
BIT DIA (mm)	STEADY (N·m)	SPIKE (N·m)	MIN (kg)	MAX (kg)
102	500	2000	1100	2200
152	1100	4125	1400	2700
203	2000	7000	1900	3600
254	2700	8775	2000	4100
305	3500	10500	2400	4900
406	6800	13600	3300	6500
508	10200	20400	3400	7300
610	16300	32600	4100	8700
762	23700	47400	4400	9500
914	33900	67800	4900	11400

TORQUE SPIKES IN HARD NON-UNIFORM ROCK. RIG CAPACITY SHOULD EXCEED SPIKE.

WOB =THRUST+HAMMER+PIPE
PIPE WEIGHT IS CRITICAL IN DEEP HOLES

WATER IN HOLE BACK- PRESSURE	
DEPTH (m)	P (bar)
15	1.5
30	3.0
46	4.5
61	6.0
76	7.5
91	9.0

DEPTH = HEIGHT OF WATER COLUMN.
P DIRECTLY REDUCES HAMMER PERFORMANCE.

ASSEMBLY TORQUE (N·m)	
API REG CONNECT	PIPE TOP SUB
2-3/8	3400
2-7/8	6100
3-1/2	8100
4-1/2	20300
6-5/8	51500
8-5/8	88100

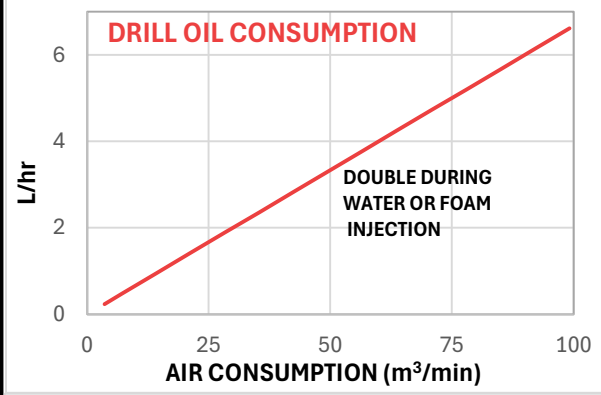
RECOMMENDED MAKE-UP TORQUE FOR DRILL PIPE TO TOP SUB

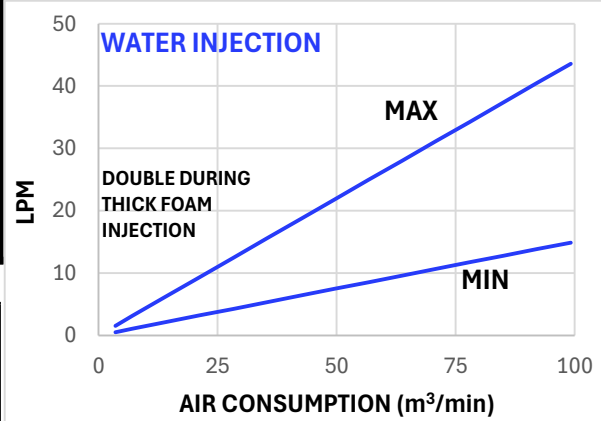
HAMMER SIZE (in)	TOP SUB HAMMER
4	5300
5	6500
6	9100
8	11700
10	14400
12	17600
15	28100
18	30900
24	40000

RECOMMENDED MAKE-UP TORQUE FOR TOP SUB AND CHUCK TO HAMMER

DKI HAMMER AIR CONS. (MAX PRESSURE)		
SIZE (in)	P (bar)	AIR (m³/min)
2	17	3.0
3	24	13.6
4	24	18.1
5	24	20.4
6	24	20.4
8	24	35.8
10	17	36.6
12	17	48.2
15	17	70.8
18	14	89.5
24	14	127.5

CHOKE OPENING ALLOWS THIS MUCH AIR TO "SKIP" THE PISTON





(WATER INJECTION OPTIONAL)

CHOKE FLOW BYPASS (AIR HAMMERS, m3/min)

PRESSURE	ORIFICE SIZE (mm)				
(bar)	3	6	10	13	19
10	0.7	2.9	6.6	11.7	26.4
17	1.2	4.7	10.6	18.8	42.4
24	1.6	6.5	14.6	26.0	58.4

(AIR) ANNULAR / UP-HOLE / BAILING VELOCITY (V)

$$V = \frac{21{,}220Q}{(D^2 - d^2)}$$

V = UP-HOLE VELOCITY (m/s)
Q = AIR FLOW AT SURFACE (m3/min)
D = BIT DIAMETER (mm)
d = DRILL PIPE DIAMETER (mm)

VELOCITY EFFECTS:	
0 - 15 m/s	POOR EVACUATION
15 - 37 m/s	TARGET ZONE
37+ m/s	EROSION / BACKPRESSURE

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DRILLER CHEAT SHEET - METRIC

ALTITUDE & TEMP CORRECTION FACTOR (C_{AT})

ALTITUDE (m)	TEMPERATURE (°C)								
	-40	-20	-10	0	10	20	30	40	50
SEA LEVEL	0.80	0.86	0.90	0.93	0.97	1.00	1.03	1.07	1.10
1000	0.90	0.97	1.01	1.05	1.09	1.13	1.17	1.20	1.24
1500	0.95	1.03	1.08	1.12	1.16	1.20	1.24	1.28	1.32
2000	1.01	1.10	1.14	1.19	1.23	1.27	1.32	1.36	1.41
2500	1.08	1.17	1.22	1.26	1.31	1.36	1.40	1.45	1.50
3000	1.15	1.25	1.30	1.35	1.40	1.45	1.49	1.54	1.59
3500	1.23	1.33	1.38	1.44	1.49	1.54	1.59	1.65	1.70

(AIR DRILLING ONLY)

ALTITUDE AND TEMP CHANGE THE DENSITY OF AIR.

THIS CHANGES HAMMER AND FLUSHING PERFORMANCE:

1. CALCULATE THE AIR FLOW (Q) REQUIRED FOR TARGET UP-HOLE VELOCITY (V)
2. DETERMINE C_{AT} FROM THE TABLE USING THE ALTITUDE AND TEMP OF JOB SITE.
3. FIND Q_c COMPENSATED AIR FLOW NEEDED ON SITE

$$Q_C = Q \times C_{AT}$$

DKI WATER HAMMER INFO

(WATER) ANNULAR / UP-HOLE / BAILING VELOCITY (V)

$$V = \frac{21.22 Q_w}{(D^2 - d^2)}$$

V = UP-HOLE VELOCITY (m/s)
Q_w = WATER FLOW (LPM)
D = BIT DIAMETER (mm)
d = DRILL PIPE DIAMETER (mm)

VELOCITY EFFECTS:

0 - 0.7 m/s	POOR EVACUATION
.7 - 2.0 m/s	TARGET ZONE
2.0+ ft/s	EROSION / BACKPRESSURE

CHOKE FLOW BYPASS (WATER HAMMERS, LPM)

PRESSURE (bar)	ORIFICE SIZE (mm)				
	3	6	10	13	19
50	30	120	272	483	1086
100	42	170	382	679	1529
150	52	208	467	831	1869
200	60	240	539	959	2157

DKI HAMMER WATER CONS. (MAX PRESSURE)

SIZE (in)	P, (bar)	NEW (LPM)	WORN (LPM)
3	169	150	299
4	169	224	374
5	183	299	449
6	148	318	542
8	148	468	748

WATER QUALITY: **MAX TOTAL SUSPENDED SOLIDS (TSS) = 150 mg/L.** **MAX PARTICLE SIZE: 50µm**

TIPS & TRICKS

1. STORAGE: SHORT TERM - BLOW DRY AIR 5MIN, POUR 1GAL ROCK OIL DIRECTLY IN PIPE, BLOW AIR
   LONG TERM - BREAK DOWN AND FULLY CLEAN/DRY ALL COMPONENTS. APPLY ROCK OIL, ASSEMBLE. STORE VERTICAL.
2. MAX ROP: RUN MAX P + START WITH RPM CHART, SLOWLY INCREASE UNTIL ROP PLATUES AND THEN MAINTAIN (MAY INCREASE WEAR)
3. IF HOLE IS DRY, CHECK VALVE CAN BE REMOVED FOR 3-5% INCREASE IN ROP
4. REPLACE SEAL KIT ANY TIME HAMMER IS DISASSEMBLED
5. KEEP LIGHTLY WORN BITS. USE THEM TO FINISH A HOLE AFTER BIT FAILURE. BRAND NEW BITS MAY NOT FIT.
6. REGRIND BUTTON FLATS TO INCREASE ROP AND INCREASE DURABILITY OF BIT AND HAMMER
7. WATER INJECTION → DUST SUPPRESSION, CLAY | FOAM INJECTION → CHIP EVACUATION, HOLE INTEGRITY, CLAY | OIL ONLY → DEFAULT
8. THRUST AND TORQUE GAUGES READING PRESSURE (PSI, BAR) ARE RIG-SPECIFIC. SEE RIG MANUAL FOR CONVERSION TO (lbf) OR (ft·lb)

TROUBLESHOOTING

1. HAMMER SUDDENLY STOPPED FIRING - CHECK EXHAUST TUBE AND PISTON
2. BREAKING EXHAUST TUBES - INCREASE WOB & FEED RATE. REDUCE OPERATING PRESSURE AND ROP. REPLACE CHUCK.
3. CARBIDES WEAR: ON TRAILING SIDE - DECREASE RPM / ON LEADING SIDE - INCREASE RPM / EXTREME GAUGE WEAR - DECREASE RPM
4. DEBRIS IN HAMMER - WATER IN HOLE AND CHECK VALVE NOT WORKING. USE RUBBER CHECK VALVE FOR DEEP WATER APPLICATIONS
5. ROP DECREASING OVER TIME - WATER IN HOLE, DULL BUTTONS, OR POOR CHIP EVACUATION
6. HAMMER FIRING BUT ROP NEAR 0: POOR HOLE CLEANING (SOFT ROCK) - INC. AIR FLOW / OPEN CHOKE/ LARGER DRILL PIPE / USE FOAM
   FAILING TO BREAK (HARD ROCK) - INCREASE PRESSURE / REGRIND BUTTONS/ REPLACE BIT
7. HAMMER FIRING SPORADICALLY - HOLE COLLAPSING, POOR HOLE CLEANING
8. CHUCK AND BACK OF BIT MUSHROOMING/DEFORMING - POOR HOLE CLEANING, DEBRIS FILLING HOLE. SEE #6 & 7.
9. BIT SPLINES WEARING UNEVENLY/BREAKING IN SPLINES - BIT RUNNING AHEAD OF CHUCK OR WORN CHUCK. ADD WOB / REPLACE CHUCK

THIS SHEET IS A GENERAL GUIDE - SOME NEEDS WILL VARY BY GEOLOGY/APPLICATION. CALL FOR ASSISTANCE.

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