

Bit Calculations

Reference



Units

Where:

PD	=	Bit Pressure Drop (lbs/in ²)
WT	=	Mud Weight (ppg)
Q	=	Flow Rate (gpm)
AN	=	Total Nozzle Area (in ²)
Vn	=	Nozzle Velocity (ft/sec)
HHP	=	Horse Power at bit (hp)
HSI	=	Horse Power per inch (hp/in ²)
D	=	Bit Diameter (in)
Ab	=	Area of Bit (in ²)
lfb	=	Impact Force at bit (lbf)

V	=	Cross Flow Velocity (ft/sec)
N	=	Number of Nozzles
E	=	Specific Energy (psi)
μ	=	Coefficient of Friction
ROP	=	Rate of Penetration (ft/hr)
WOB	=	Weight on Bit (lbf)
T	=	Torque (ft-lbs)
Ah	=	Area of Hole (in ²)
MSE	=	Mechanical Specific Energy (psi)
Cd	=	Nozzle discharge coefficient

Pressure Drop Across Bit (psi)

Calculated From Flow Rate, assumes Cd=1.0:

$$PD = \frac{(WT)(Q)}{(12,032)(AN^2)}$$

Calculated From Velocity:

$$PD = \frac{(WT)(V^2)}{(1,239)}$$

Bit Nozzle Velocity (ft/sec)

Calculated From Flow Rate:

$$Vn = (0.321) \frac{(Q)}{(AN)}$$

Calculated From Pressure Drop:

$$Vn = \left[\frac{(1,239)(PD)}{WT} \right]^{1/2}$$

Total Bit Nozzle area (in²)

Calculated From Bit Pressure Drop:

$$AN = \left[\frac{(WT)(Q^2)}{(12,031)(PD)} \right]^{1/2}$$

$$AN = \sum (AN_1 + AN_2 + \dots + AN_x)$$

Impact of Jet Nozzles on Hole Bottom (lbf)

Calculated From Velocity:

$$lfb = \frac{(WT)(Q)(Vn)}{(1,930)}$$

Calculated From Pressure Drop:

$$lfb = 0.0173Q(PD * WT)^{1/2}$$

Cross Flow Velocity under the Bit (ft/sec)

$$V = \left[\frac{(108.5)(Q)(Vn)}{(N * D)} \right]^{1/2}$$

Mechanical Specific Energy using μ (psi)

$$MSE = WOB \left[\frac{1}{Ab} + \frac{(13.33)(\mu)(RPM)}{(ROP)(D)} \right]$$

Bit Aggressiveness/Coefficient of Friction

$$\mu = \left[\frac{36 (T)}{(WOB)(D)} \right]$$

Mechanical Specific Energy using Torque (psi)

$$MSE = \frac{480(T)(RPM)}{ROP(D)^2} + \frac{1.274(WOB)}{(D)^2}$$