**Bit Nozzle Selection — Optimized Hydraulics**

These series of formulas will determine the correct jet sizes when optimizing for jet impact or hydraulic horsepower and optimum flow rate for two or three nozzles.

1. Nozzle area (sq in)

2. Bit nozzle pressure loss, psi (Pb):

3. Total pressure losses except bit nozzle pressure loss, psi (Pc):

*Pc1 & Pc2 = circulating pressure (psi) – bit nozzle pressure loss (psi)*

4. Determine slope of line M :

5. Optimum pressure losses (Popt)

a. For impact force :

b. For hydraulic horsepower

6. For optimum flow rate (Qopt):

a. For impact force :

b. For hydraulic horsepower :

7. To determine pressure at the bit (Pb):

*Pb = Pmax — Popt*

8. To determine nozzle area (sq in.):

9. To determine nozzles, 32nd in. for three nozzles :

10. To determine nozzles, 32nd in. for two nozzles :

Sample Case : Optimize bit hydraulics on a well with the following :  
 Select the proper jet sizes for impact force and hydraulic

horsepower for two jets and three jets :

DATA : Mud weight = 13.0 ppg  
 Jet sizes = 17-17-17  
 Maximum surface pressure = 3000 psi  
 Pump pressure 1 = 3000 psi  
 Pump rate 1 = 420 gpm  
 Pump pressure 2 = 1300 psi  
 Pump rate 2 = 275 gpm

1. Nozzle area. sq in.:

2. Bit nozzle pressure loss, psi (Pb):

3. Total pressure losses except bit nozzle pressure loss (Pc), psi:

Pc1  = 3000 psi — 478 psi

= 252.2 psi

Pc2 = l300 psi — 205 psi

= 1095 psi

4. Determine slope of line (M):

5. Determine optimum pressure losses, psi (Popt):

a. For impact force :

b. For hydraulic horsepower

6. Determine optimum flow rate (Qopt):

a. For impact force :

b. For hydraulic horsepower

7. Determine pressure losses at the bit (Pb):

a. For impact force

Pb = 3000 psi — l511 psi

= 1489 psi

b. For hydraulic horsepower

Pb = 3000 psi — 1010 psi

= 1990 psi

8. Determine nozzle area, sq in.:

a. For impact force :

b. For hydraulic horsepower

9. Determine nozzle size, 32nd in.:

a. For hydraulic horse power :

Note : Ussually the nozzle size will have a decimal fraction. The

fraction times 3 will determine how many nozzles should be

larger than that calculated.

1. For impact force :

0.76 x 3 = 2.28 rounded to 2

So : 1 jets = 10/32nd

2 jets = 11/32nd

10. Determine nozzles 32nd in for two nozles :

1. For impact force :

1. For hydraulic horse power :