**Slug Calculations**

Barrels of slug required for a desired length of dry pipe

**Step 1**

Hydrostatic pressure required to give desired drop inside drill pipe :

HP (psi) = mud wt (ppg) x 0,052 x ft of dry pipe

**Step 2**

Difference in pressure gradient between slug weight and mud weight :

psi/ft = (slug wt (ppg) — mud wt (ppg)) x 0.052

**Step 3**

Length of slug in drill pipe :

Slug length (ft) = pressure (psi)÷ difference in pressure gradient (psi/ft)

**Step 4**

Volume of slug, barrels :

Slug volume (bbl) = slug length (ft) x drill pipe capacity (bbl/ft)

Sample Case : Determine the barrels of slug required for the following :

Desired length of dry pipe (2 stands) = 184 ft   
Mud weight = 12.2 ppg  
Slug weight = 13.2 ppg  
Drill pipe capacity = 0.01422 bbl/ft  
4-l/2 inch — 16.6 lb/ft

**Step l**

Hydrostatic pressure required :

HP (psi) = 12.2 ppg x 0.052 x 184 ft

= ll7 psi

**Step 2**

Difference in pressure gradient (psi/ft):

psi/ft = (13.2 ppg -. 12.2 ppg) x 0.052

= 0.052

**Step 3**

Length of slug in drill pipe (ft) :

Slug length(ft) = 117 psi ÷ 0.052

= 2250 ft

**Step 4**

Volume of slug (bbl) :

Slug volue (bbl) = 2250 ft x 0.01422 bbl/ft

= 32.0 bbl

**Weight of slug required for a desired length of dry pipe with a set volume of slug**

**Step 1**

Length of slug in drill pipe (ft):

Slug length (ft) = slug volume (bbl) ÷ drill pipe capacity (bbl)

**Step 2**

Hydrostatic pressure required to give desired drop inside drill pipe :

HP (psi) = mud wt.(ppg) x 0.052 x ft of dry pipe

**Step 3**

Weight of slug (ppg):

Slug wt (ppg) = HP (psi) ÷ 0.052 ÷ slug length (ft) + mud wt.(ppg)

Sample Case : Determine the weight of slug required for the following :

Desired length of dry pipe (2 stands) = 184 ft  
Mud weight = 12.2 ppg  
Volume of slug = 25 bbl

Drill pipe capacity = 0.01422 bbl/ft  
4-1/2 inch — 16.6 lb/ft

**Step 1**

Length of slug in drill pipe (ft):

Slug length (ft) = 25 bbl ÷ 0.01422 bbl/ft

= 1758 ft

**Step 2**

Hydrostatic pressure required :

HP (psi) = 12.2 ppg x 0.052 x 184 ft

= ll7 psi

**Step3**

Weight of slug (ppg):

Slug wt (ppg) = 117 psi ÷ 0.052 ÷ 1758 ft + 12.2 ppg

= 1.3 ppg + 12.2 ppg

= 13.5 ppg

**Volume, height, and pressure gained because of slug :**

a. Volume gained in mud pits after slug is pumped, due to U-tubing :

Volume (bbl) = ft of dry pipe x drill pipe capacity (bbl/ft)

b. Height (ft) that the slug would occupy in annulus :

Height (ft) = annulus vol (ft/bbl) x slug volume (bbl)

c. Hydrostatic pressure gained in annulus because of slug :

Sample Case : Feet of dry pipe (2 stands) = 184 ft  
 Slug volume = 32.4 bbl  
 Slug weight = 13.2 ppg  
 Mud weight = 12.2 ppg  
 Drill pipe capacity = 0.01422 bbl/ft  
 4-1/2 inch — 16.6 lb/ft  
 Annulus volume (8-1/2 inch by 4-1/2 inch) = 19.8 ft/bbl

a. Volume gained in mud pits after slug is pumped due to U-tubing :

Volume (bbl) = 184 ft x 0.01422 bbl/ft

= 2.62 bbl

b. Height (ft) that the slug would occupy in the annulus :

Height (ft) = 19.8 ft/bbl x 32.4 bbl

= 641.5 ft

c. Hydrostatic pressure gained in annulus because of slug :

HP(psi) = 641.5 ft (13.2 – 12.2) X 0.052

= 641.5 ft x 0.052

= 33.4 psi

**Accumulator Capacity — Useable Volume Per Bottle**

NOTE : The following will be used as guidelines :

Volume per bottle = 10 gal  
Pre-charge pressure = 1000 psi  
Minimum pressure remaining after activation = 1200 psi  
Pressure gradient of hydraulic fluid = 0.445 psi/ft  
Maximum pressure = 3000 psi

Boyle’s Law for ideal gases will be adjusted and used as follows :

P1 V1 = P2 V2

**Surface Application**

**Step 1**

Determine hydraulic fluid necessary to increase pressure from pre-charge to minimum :

P1 V1 = P2 V2

NOTE : This is dead hydraulic fluid. The pressure must not drop below this

minimum value

**Step 2**

Determine hydraulic fluid necessary to increase pressure from pre-charge to maximum :

P1 V1 = P2 V2

**Step 3**

Determine useable volume per bottle :

**Subsea Applications**

In subsea applications the hydrostatic pressure exerted by the hydraulic fluid must be compensated for in the calculations :

Sample Case : Same guidelines as in surface applications :

Water depth = 1000 ft  
 Hydrostatic pressure of hydraulic fluid = 445 psi

**Step 1**

Adjust all pressures for the hydrostatic pressure of the hydraulic fluid :

Pre-charge pressure = 1000 psi + 445 psi = 1445 psi  
Minimum pressure = 1200 psi + 445 psi = 1645 psi  
Maximum pressure = 3000 psi + 445 psi = 3445 psi

**Step 2**

Determine hydraulic fluid necessary to increase pressure from pre-charge to minimum :

**Step 3**

Determine hydraulic fluid necessary to increase pressure from pre-charge to

maximum :

**Step 4**

Determine useable fluid volume per bottle :

**Accumulator Pre-charge Pressure**

The following is a method of measuring the average accumulator pre-charge pressure by operating the unit with the charge pumps switched off :

Where ;

P = avenge pro-charge pressure (psi)  
Pf = final accumulator pressure (psi)  
Ps = starting accumulator pressure (psi)

Sample Case : Determine the average accumulator pre-charge pressure using the following data :

Starting accumulator pressure (Ps) = 3000 psi  
Final accumulator pressure (Pf) = 2200 psi  
Volume of fluid removed = 20 gal  
Total accumulator volume = 180 gal