Intertek Formula Sheet

Pressure Calculations (psi):

1.	Pressure Gradient, psi/ft	=	Mud Weight, ppg X 0.052
2.	Hydrostatic Pressure, psi	=	Mud Weight, ppg X 0.052 X True Vertical Depth, ft
3.	Formation Pressure, psi	=	Hydrostatic Pressure in Drill String, psi + SIDPP, psi
4.	Initial Circulating Pressure, psi	=	SIDPP, psi + Slow Circulating Rate Pressure (SCRP), psi
5.	Final Circulating Pressure, psi	=	(Kill Weight Mud, ppg ÷ Original Mud Weight, ppg) X SCRP, psi
6.	Shut In Casing Pressure, psi	=	SIDPP, psi + [Influx Height ft X (Mud Gradient, psi/ft - Influx Gradient, psi/ft)]
7.	Pump Pressure/Pump Stroke Relationship, psi	=	(New SPM ÷ Old SPM)^2 X Present Pressure, psi
8.	Bottom Hole Pressure (static)	=	Hydrostatic Pressure
9.	Bottom Hole Pressure (circulating)	=	Hydrostatic Pressure + Annular Pressure Loss
10.	Bottom Hole Pressure (reverse circ.)	=	Hydrostatic Pressure + Tubular Pressure Loss

Fluid Weight Calculations (ppg):

11.	Mud Weight, ppg	=	Pressure Gradient, psi/ft ÷ 0.052
12.	Equivalent Mud Weight, ppg	=	Pressure, psi ÷ 0.052 ÷ True Vertical Depth, ft
13.	Kill Weight Mud, ppg	=	(SIDPP, psi ÷ 0.052 ÷ T.V.D., ft) + Original Mud Weight, ppg
14.	Equivalent Circulating Density, ppg	=	(Annular Pressure Loss, psi ÷ 0.052 ÷ TVD, ft) + OMW, ppg

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Shoe/MASP Calculations:

15. Max. Allowable Mud Weight, ppg (Fracture Mud Weight, ppg) = (Surface Leak-Off Pressure psi ÷ 0.052 ÷ Casing Shoe, TVD ft) + **Test** Mud Weight, ppg

Note: If Fracture Gradient given: **MAMW = Fracture Gradient ÷ 0.052**

16. New MAASP, psi = (Max Allowable MW, ppg - Current MW, ppg) X 0.052 X Casing Shoe TVD ft

17. FIT Pressure to Test = (FIT, ppg - Current MW, ppg) X 0.052 X Casing Shoe TVD ft

Influx Calculations:

18. Height of Influx, ft = Kick Size, bbls ÷ Open Hole or Annular Capacity, bbl/ft

19. Gradient of Influx, psi/ft = (Mud Weight, ppg X 0.052) - $\left(\frac{\text{SICP, psi - SIDPP, psi}}{\text{Influx Height, ft}} \right)$

20. Gas Migration Rate, ft/hr = Casing Pressure Increase psi/hr ÷ Fluid Gradient, psi/ft

Subsea Calculations:

21. Loss of Hydrostatic Pressure Due to Loss or Unlatch of Riser, psi = (Riser MW X .052 X Riser Length) - (Water Gradient X Water Depth)

22. Riser Margin, ppg = (Loss of HP Due to Disconnect) ÷ .052 ÷ (TVD - Air Gap - Water Depth)

23. Mud Weight Needed for Planned Disconnect, ppg = Riser Margin + Current MW (note: round up like kill mud)

24. Dynamic Casing Pressure = SICP - Choke Line Friction

25. Dynamic MASP = MASP - Choke Line Friction

Volumetric Calculations:

26. Hp/bbl, psi/bbl = Pressure Gradient, psi/ft ÷ Annular Capacity, bbl/ft

27. Volume to Bleed per Cycle, bbls = Working Pressure Range, psi ÷ Hp/bbl , psi/bbl

Lubrication Calculations – Volume Method:

28. Volume Lubricated, bbls = Strokes pumped X Pump output, bbl/stk

29. HP Increase, psi = Volume Lubricated, bbls X Hp/bbl, psi/bbl

30. Pressure to Bleed Off, psi = SICP, psi - Working Pressure, psi - HP Increase, psi

Lubrication Calculations – Pressure Method:

31. $P_3 = \frac{(P_1)^2}{P_2}$

P_1 = The original Shut-in Casing Pressure

P_2 = The increased Casing Pressure due to lubricating fluid into the well.

P_3 = Pressure to bleed down to.

Tripping Calculations:

32. Additional Mud Returned By Slug, bbls = [(Slug Wt, ppg ÷ MW, ppg) - 1] X Slug Volume, bbls

33. Total Mud Returned By Slug, bbls = (Slug Wt, ppg ÷ MW, ppg) X Slug Volume, bbls

34. Press Drop/ft Tripping **Dry** Pipe, psi/ft = $\frac{\text{Mud Gradient, psi/ft x Metal displacement, bbl/ft}}{\text{Drill Pipe Capacity, bbl/ft + Annular Capacity, bbl/ft}}$

35. Press Drop/ft Tripping **Wet** Pipe, psi/ft = $\frac{\text{Mud Gradient psi/ft x (Pipe Capacity bbl/ft + Metal Displacement bbl/ft)}}{\text{Annular Capacity bbl/ft}}$

36. Level Drop for Pulling Collars Out of the Hole, ft = $\frac{\text{Length of Collars , ft x Metal Displacement,}}{\text{Casing Capacity, bbl/ft}}$

37. Length of Pipe to Pull Before Well Starts to Flow, ft. = $\frac{\text{Overbalance, psi x (Casing Capacity, bbl/ft - Pipe Displacement, bbl/ft)}}{\text{Mud Gradient, psi/ft x Pipe Displacement, bbl/ft}}$

38. New Casing Pressure, psi (Stripping Back to Bottom) = Old Casing Pressure, psi + $[(Hi_{BHA} - Hi_{OH}) \times (G_M - G_I)]$

39. Level Drop after Pumping Slug = [(Slug Weight,ppg ÷ Mud Weight,ppg) - 1] X Slug Volume,bbls ÷ Drill Pipe Cap., bbls/ft

Bullheading Calculations:

40. Kill Weight Fluid, ppg :

KWF, ppg = Reservoir Pressure, psi ÷ 0.052 ÷ Depth to Top-Perfs, ft

Or use = [SITP, psi ÷ 0.052 ÷ TVD to Top-Perfs, ft] + Original Fluid Weight, ppg

41. Maximum Initial Surface Pressure at pump start-up:

Psi = (Fracture mud density, ppg - Current fluid density, ppg) X 0.052 X TVD to Top-Perfs, ft

Or use = Formation Fracture Pressure, psi - Initial Hydrostatic Pressure, psi

42. Maximum Final Surface Pressure with KWF at the perforations:

Psi = (Fracture mud density, ppg - Kill weight fluid, ppg) X 0.052 X TVD to Top-Perfs, ft

Or use = Formation Fracture Pressure, psi - (Kill weight fluid, ppg X 0.052 X TVD to Top-Perfs, ft)

43. Volume to Bullhead = Surface Lines, bbls + Tubing Length, bbls + (Bottom of Perfs – Tubing Length), bbls

44. Formation Fracture Pressure, psi = Formation Fracture Gradient, psi/ft X TVD to Top-Perfs, ft

45. Initial Hydrostatic Pressure, psi = Formation Pressure, psi - SITP, psi

46. Initial Average Fluid Density, ppg = Initial Hydrostatic Pressure, psi ÷ 0.052 ÷ TVD to Top-Perfs, ft

47. Bullhead SPM to Exceed Gas Migration = (Gas Migration Rate per hour ÷ 60) X Tubing Capacity, bbl/ft ÷ Pump Output

Temperature Correction Formula for Brines:

48. Fluid Denstiy to Mix, ppg = Fluid Density at Surface Temp, ppg + [(Avg. Downhole Temp - Surface Temp) X Weight Loss, ppg/degree]

Example Weight Loss Chart:
(Note: Values will vary based on type of fluid, etc.)

Brine weight (ppg)	Weight loss (ppg/°F)
8.4 – 9.0	0.0017
9.1 – 11.0	0.0025
11.1 – 14.5	0.0033
14.6 – 17.0	0.0040
17.1 – 19.2	0.0048

Miscellaneous Calculations:

49. Tubular Internal Capacity = $ID^2 \div 1029.4$

50. Volume Delivered gals = Bottle Volume, gals x $\left(\frac{\text{Precharge psi}}{\text{Final psi}} - \frac{\text{Precharge psi}}{\text{System psi}} \right)$

51 Boyle's Law = $P_1 \times V_1 = P_2 \times V_2$ $P_2 = \frac{P_1 \times V_1}{V_2}$ $V_2 = \frac{P_1 \times V_1}{P_2}$

52. Barite, lb/bbl = $\frac{1500 \times (W_2 - W_1)}{35.8 - W_2}$

53. Force, lbs = Presssure, psi x Diameter² x 0.7854

54. Pressure, psi = Force, lbs ÷ Diameter² ÷ 0.7854

55. Tubular Metal Displacement = $(OD^2 - ID^2) \div 1029.4$

56. Tubular Closed End Displacement = $OD^2 \div 1029.4$

57. Annular Capacity, bbls/ft = $(D^2 - d^2) \div 1029.4$ (D = Hole Diameter or Casing ID, d = Outside Diameter of Tubular)

IADC ROUNDING RULES:

- When calculating Kill Mud Weight, **ROUND UP** to one decimal place (for example: round up 10.73 ppg to 10.8 ppg; round up 11.03 ppg to 11.1 ppg).
- When calculating Leak Off Test Equivalent Mud Weight, **ROUND DOWN** to one decimal place (for example: round down 11.76 ppg; to 11.7 ppg; Round down 13.89 ppg to 13.8 ppg). In other words, take it to only one decimal place with no rounding.
- When calculating Pressure Reduction Schedule, **ROUND DOWN** to a whole number (for example: round down 21.6 psi/100 stks to 21 psi/100 stks).
- If the Kill Mud Weight or Leak Off values are to be used in subsequent calculations, use the rounded value in the future calculation. Do not use the unrounded calculated value.