

Shoe Pressure Calculations March, 2019

Noble performed a leak-off-test (LOT) during the drilling operations of 9 horizontal wells that are spread throughout the DJ Basin. A LOT is usually conducted immediately after drilling below a new casing shoe; for these 9 wells, the LOTs were performed at the depth the surface casing was set (i.e., the shoe depth). During the test, the well is shut in and fluid is pumped into the wellbore to gradually increase the pressure that the formation experiences. At some pressure, fluid will enter the formation, (or “leak off”), either moving through permeable paths in the rock or by creating a space by fracturing the rock. The pressure at which the well begins to “leak off” is then the maximum pressure that may be applied to the formation before fracturing occurs; this pressure is divided by the depth of the well to determine the pressure gradient.

To calculate the breakdown pressure for a well of interest, Noble used the closest available LOT well and assumed the well of interest would have a similar frac gradient. This is the best-available method Noble has for estimating surface casing shoe breakdown pressures, because it is based on actual test results.

The following table provides the LOT data from the 9 horizontal wells.

Well Name	S	T	R	LOT EMW (ppg)	Pressure Gradient (psi/ft)
Cougar B02-67-1HN	2	5N	64W	18.7	0.9724
SEYLER B15-69HNM	15	5N	64W	18.1	0.9412
WELLS RANCH AA35-62-1AHNC	35	6N	63W	21.8	1.1336
WELLS RANCH AE30-64HNC	30	6N	62W	30.9	1.6068
OSCAR Y10-77-1HC	10	2N	64W	30.1	1.5652
SATER CC18-74-1HN	18	4N	63W	28.8	1.4976
RICO LC29-78-1HNC	29	9N	59W	32.4	1.6848
ROMERO PC G10-79HN	10	4N	65W	19.1	0.9932
SANDAU STATE K25-62-1HNL	25	4N	66W	19.2	0.9984

The breakdown pressure at the shoe is calculated by multiplying the Pressure Gradient in psi/ft by the Depth of the Surface Casing in ft. The pressure gradient for the Alva Shale 2-4 was calculated as follows:

API	Well Name	Surface Casing Depth (ft)	Pressure Gradient to Breakdown Shoe (psi/ft)	Surface Casing Shoe Breakdown Pressure (psi)
05-123-29998	STROH O02-17	636	0.9984	635