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WRAITH™ Frac Ball

Third Party Test

PURPOSE

To determine the differential pressure capabilities of the Wraith Frac Ball seated using a 30° entry angle and 0.090" seat interference.

OVERVIEW

Perform a total of 9 separate differential pressure tests utilizing 3 different versions of the Wraith Frac Ball.

- 3.50" Solid, Compound A
- 3.50" Hollow, Compound A
- 2.50" Solid, Compound A

PROCEDURE

1. Load Wraith Frac Ball on ball seat of test fixture.
2. Pressure up test fixture to 5000 psi and hold until stabilized.
3. Increase pressure in 1000 psi increments and hold until stabilized.
4. Repeat Step 3 (above) until 10,000 psi is achieved or ball fails.
5. When 10,000 psi is achieved, reverse differential pressure and document pressure required to unseat the ball.
6. Remove ball from the test fixture and document any deformations to the ball.

Contact Information

To request additional info please email:
info@phenom-us.com

WRAITH™ Frac Ball

Third Party Test (Cont'd.)

PARAMETERS: TESTS 1 - 3

Frac Ball	Ball Seat	Frac Fluid	Ambient Temp
3.50" Solid *Compound A*	**3.410"**	**Fresh H_2O**	**75° F**

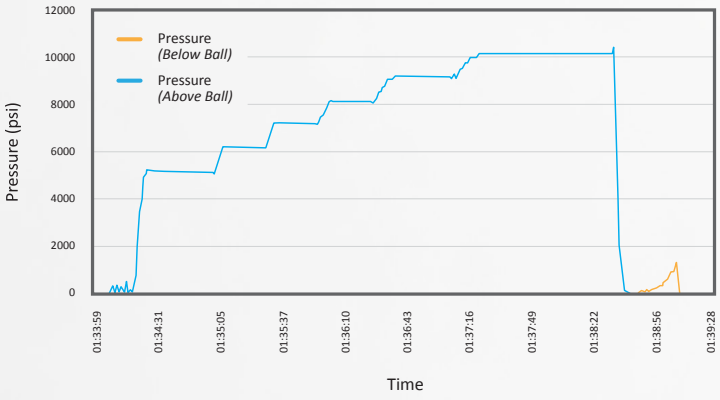
RESULTS

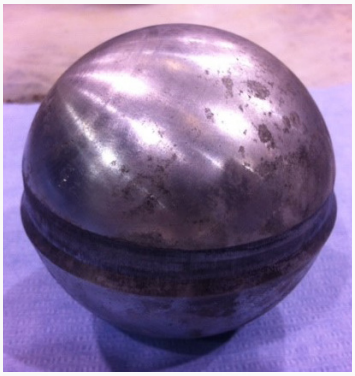
Test	Differential Pressure ≥ 10,000 psi	Unseating Pressure
1	10,150 psi (starting) 10,121 psi (ending)	1321 psi
2	10,125 psi (starting) 10,106 psi (ending)	1882 psi
3	10,075 psi (starting) 10,050 psi (ending)	2340 psi

PROCEDURE

1. Wraith Frac Ball loaded into test fixture and seated on 3.410" diameter ball seat with 30° lead angle.
2. Test fixture moved into test cell and high pressure water lines secured to fixture.
3. Data acquisition started and pressure above the ball increased to 5000 psi with lower area below the ball venting to atmosphere. 5000 psi differential is held on the ball until data acquisition chart stabilizes.
4. Pressure above the ball is increased in increments of 1000 psi and held until data acquisition chart stabilizes.
5. Upon reaching a stable differential pressure reading of 10,000 psi above the ball, pressure area above the ball is opened to atmosphere.
6. Pressure is applied below the ball to unseat it.
7. Fixture is removed from test cell and disassembled noting ball extrusion.

DETAILS: TEST 1



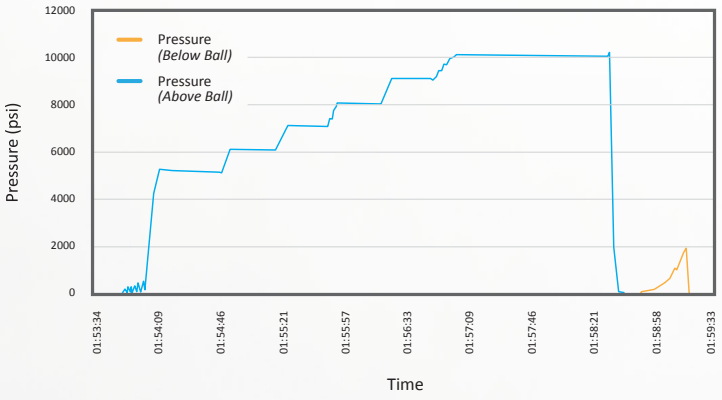


Fixture is removed from test cell and disassembled noting ball extrusion.

WRAITH™ Frac Ball

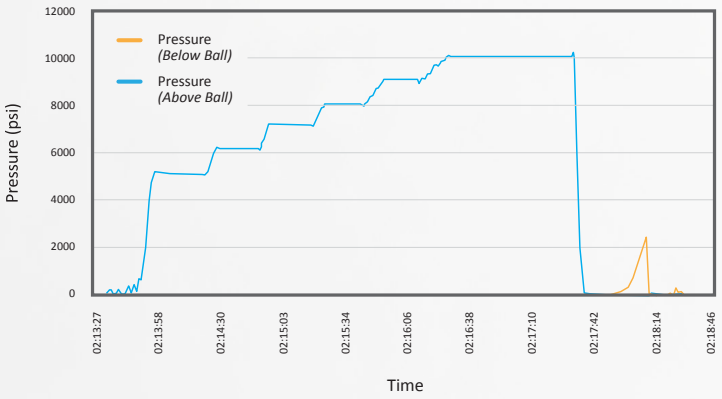
Third Party Test (Cont'd.)

DETAILS: TEST 2



Fixture is removed from test cell and disassembled noting ball extrusion.

DETAILS: TEST 3



Fixture is removed from test cell and disassembled noting ball extrusion.

WRAITH™ Frac Ball

Third Party Test (Cont'd.)

PARAMETERS: TESTS 4 - 6

Frac Ball	Ball Seat	Frac Fluid	Ambient Temp
3.50" Hollow *Compound A*	**3.410"**	**Fresh H_2O**	**75° F**

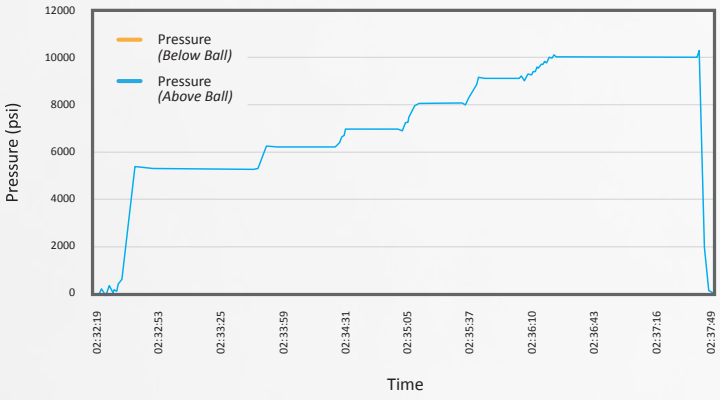
RESULTS

Test	Differential Pressure ≥ 10,000 psi	Unseating Pressure
4	10,065 psi (starting) 10,040 psi (ending)	2503 psi
5	10,162 psi (starting) 10,137 psi (ending)	2212 psi
6	10,250 psi (starting) 10,220 psi (ending)	2237 psi

PROCEDURE

1. Wraith Frac Ball loaded into test fixture and seated on 3.410" diameter ball seat with 30° lead angle.
2. Test fixture moved into test cell and high pressure water lines secured to fixture.
3. Data acquisition started and pressure above the ball increased to 5000 psi with lower area below the ball venting to atmosphere. 5000 psi differential is held on the ball until data acquisition chart stabilizes.
4. Pressure above the ball is increased in increments of 1000 psi and held until data acquisition chart stabilizes.
5. Upon reaching a stable differential pressure reading of 10,000 psi above the ball, pressure area above the ball is opened to atmosphere.
6. Pressure is applied below the ball to unseat it.
7. Fixture is removed from test cell and disassembled noting ball extrusion.

DETAILS: TEST 4

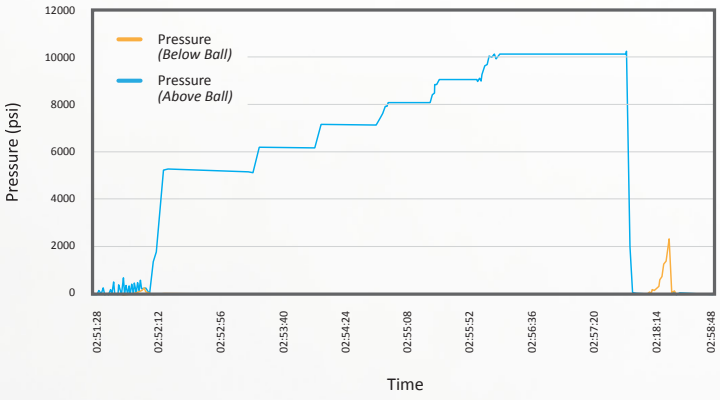


Fixture is removed from test cell and disassembled noting ball extrusion.

WRAITH™ Frac Ball

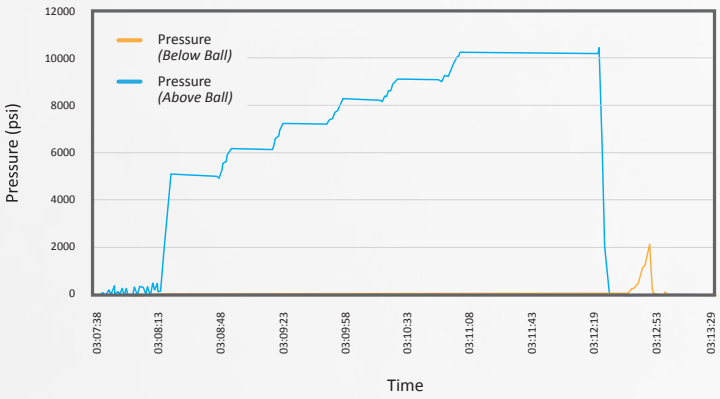
Third Party Test (Cont'd.)

DETAILS: TEST 5



Fixture is removed from test cell and disassembled noting ball extrusion.

DETAILS: TEST 6



Fixture is removed from test cell and disassembled noting ball extrusion.

WRAITH™ Frac Ball

Third Party Test (Cont'd.)

PARAMETERS: TESTS 7 - 9

Frac Ball	Ball Seat	Frac Fluid	Ambient Temp
2.50" Solid *Compound A*	**2.410"**	**Fresh H_2O**	**75° F**

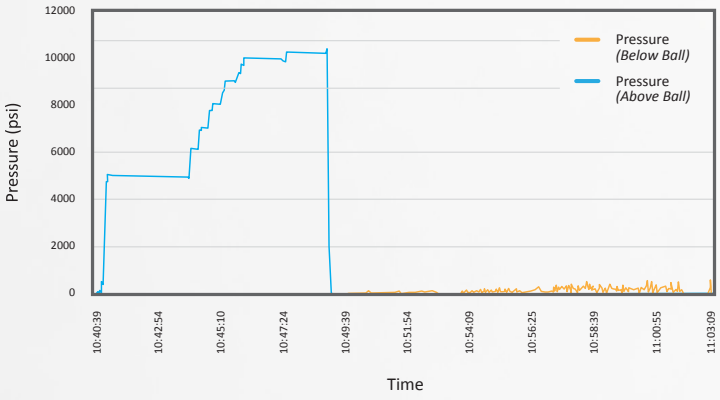
RESULTS

Test	Differential Pressure ≥ 10,000 psi	Unseating Pressure
7	10,212 psi (starting) 10,192 psi (ending)	482 psi
8	10,150 psi (starting) 10,121 psi (ending)	712 psi
9	10,242 psi (starting) 10,200 psi (ending)	809 psi

PROCEDURE

1. Wraith Frac Ball loaded into test fixture and seated on 2.410" diameter ball seat with 30° lead angle.
2. Test fixture moved into test cell and high pressure water lines secured to fixture.
3. Data acquisition started and pressure above the ball increased to 5000 psi with lower area below the ball venting to atmosphere. 5000 psi differential is held on the ball until data acquisition chart stabilizes.
4. Pressure above the ball is increased in increments of 1000 psi and held until data acquisition chart stabilizes.
5. Upon reaching a stable differential pressure reading of 10,000 psi above the ball, pressure area above the ball is opened to atmosphere.
6. Pressure is applied below the ball to unseat it.
7. Fixture is removed from test cell and disassembled noting ball extrusion.

DETAILS: TEST 7

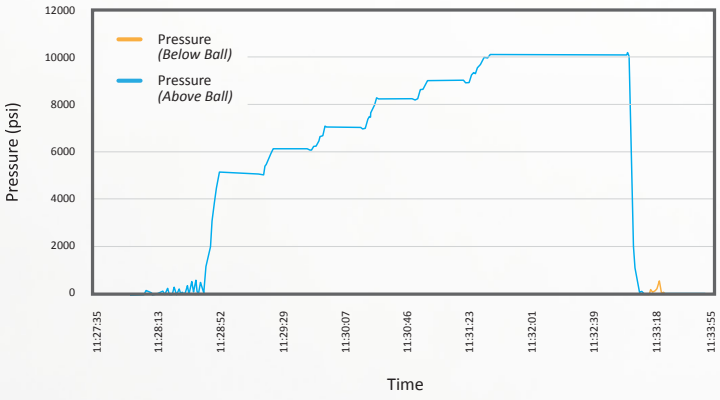


Fixture is removed from test cell and disassembled noting ball extrusion.

WRAITH™ Frac Ball

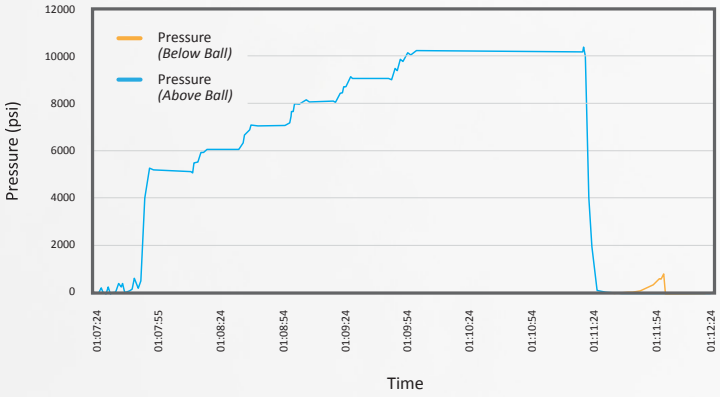
Third Party Test (Cont'd.)

DETAILS: TEST 8



Fixture is removed from test cell and disassembled noting ball extrusion.

DETAILS: TEST 9



Fixture is removed from test cell and disassembled noting ball extrusion.