HOW DOES IT HANDLE SOLIDS

- Fluid moves two directions allowing higher percentage solids
- Patented design allows high fluid volumes for greater carrying capacity of solids
- Latest in anti-erosion / corrosion properties enabling longer service life
- Increase in production with less maintenance costs
- Flow ports can move high sand capacity in heavy oil bitumen wells
- The design features allow for movement in the annulus helping keep solids in solution

Clark Downhole Tool
Sand Testing

Well:	Test Unit Nisku Shop
Rig:	Pump Jack Simulator
AFE #:	TR-003-2020
CDHT Job #:	Trial # 3
Date In Hole:	February 6, 2020
NCR #:	N/A
NCR Title:	N/A
BHA #:	N/A
Tool Run #:	1
Effect to Client:	Confirmation of sand content
Total NPT: **(Date and Time from Diagnosis to Resolution)**	N/A

1. Scope

This document details the results encountered on the fore mentioned job as well as the resolutions and analysis.

2. Description Of Trial And Equipment Used

The purpose of this trial was to test the newly engineered parts and confirm their viability on a commercial level and prove up the claims of high solids handling capacity.

This was a water test @ 20C indoors at the Clark Downhole Tools (CDHT) Nisku Facility February 6, 2020. Using 3' stroke with a 20lb spring installed the height of the lower piston was level to the bottom edge of the inlet port.

Hydraulic unit was a 13.5hp Honda motor with a 19GPM HPU, 15 Gal res tank with filter and a high flow equalizing/combining valve with 2" hydraulic rams with a max pressure rating of 1100PSI working pressure.

The water was filled into the annulus of the casing from the top and draw in from the tool inlet ports. It was then circulated up the tubing through the fill rite flow meter and Omega transducer back through the hose to the bottom of the casing thus refilling the annulus. The control test was set as a 20 stoke session at a rate of 10 strokes per minute.

Figure 2.1 – Shows the top of the testing unit/pumpjack simulator.

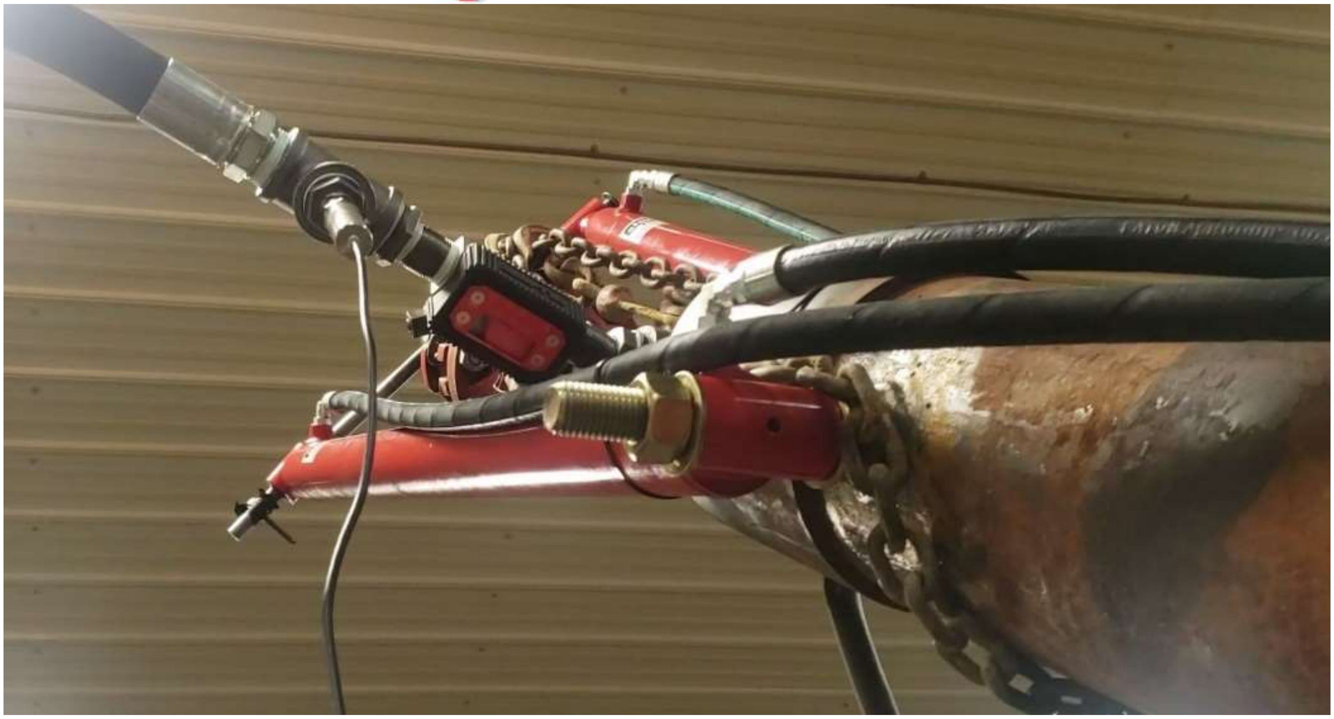

Figure 2.2 – Flow rite flow meter and Omega Pressure Transducer installed on flow line.

Figure 2.3 – Hydraulic system set up.

Figure 2.3 – Return line with valve and pressure gauge.

3. Results

The results from the test confirmed what we had suspected after using hydraulic fluid modeling software using the new components. The revised design was working very well.

Test # 6 was done with H_2O with a fluid viscosity of 180 sec/L and 72 kg of sand in solution, the hose connected back to the 7” casing thus closing the loop in the system. The lower return valve was in the 100% open position allowing circulation.

The annulus volume was topped up, close to the top to balanced position. We did 20 strokes and recorded the total flow and observed pressures. This has been our base line test. Calibration was set to # 4 on the flow meter for the highest viscosity possible.

Result was 13.4 Gallon on 20 strokes. 0.67375gal/stk. The makeup water was turned on at the start to ensure we had maximum flow.

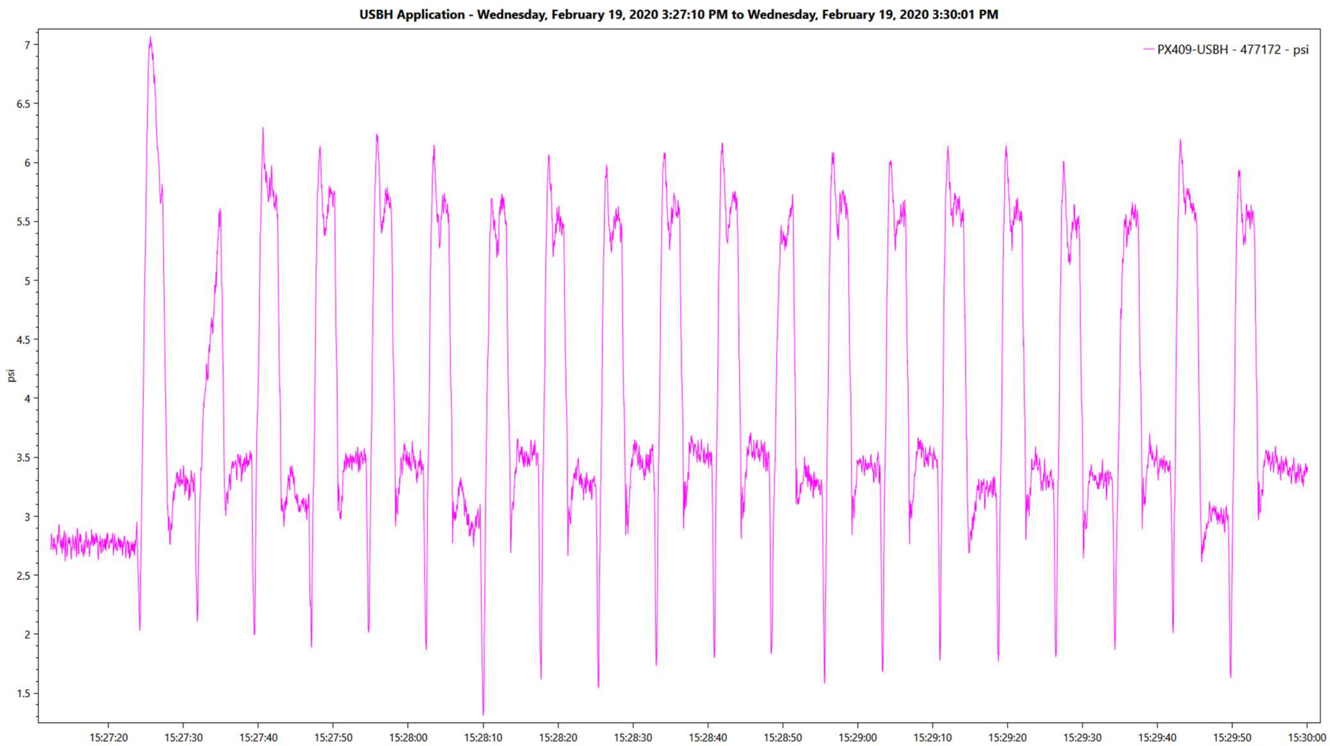

Figure 3.1 - Test # 6 Pressure Transducer output with 10 strokes /min with 3' stroke. Note the very mild increase in pressure when pulling off bottom after sand settling. The high flow of the tool allowed the continued pumping even after letting the sand settle for 30 minutes between tests.

Figure 3.2 – Shows a close up view of the sand in solution concentration of 80%.

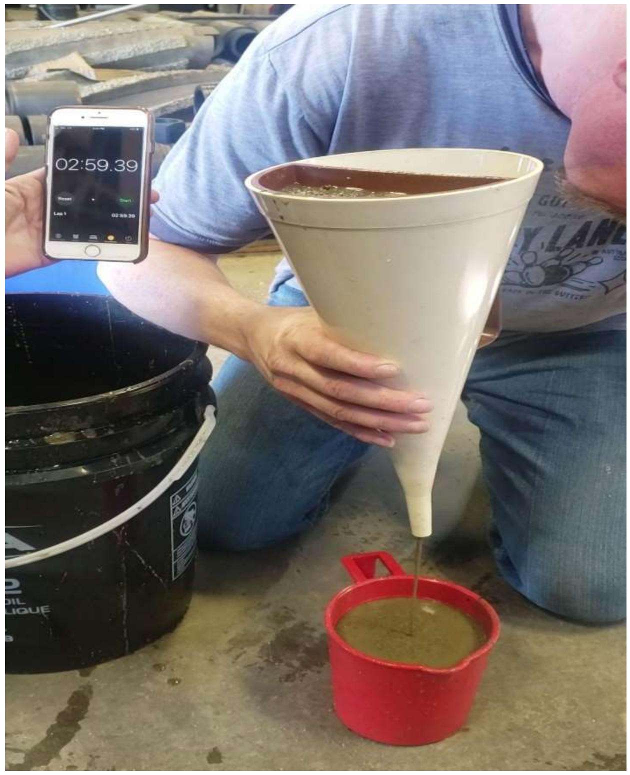

Figure 3.3 – Shows the viscosity being measured. The time shown translates to 180sec/L viscosity and a density of 1922kg/m^3.

Figure 3.4 –Sand concentration.

Figure 3.5 - Illustrating high concentration of sand. The sand content on this particular test was 78% sand in solution.

Figure 3.6 - Demonstrating how thick the fluid being pumped is.

4. Review

Several tests were done throughout the day using various materials. The final corrected volume calculations of water and sand came out to 78% sand in solution.

A noted pressure increase was seen in the operation of this test. This is due to the high density and viscosity and aligns with typical pressure gradient increases from high density and viscosity fluids.

We let the sand settle in between tests for 30 minutes to simulate the surface unit (i.e. Pumpjack or hydraulic unit) shutting down for various field reasons. What we saw was only a mild increase in the initial lift as the tool overcame the weight of the sand that settled above the upper piston.

The CDHT design benefits from only having to lift the sand in the barrel versus a traditional rod or plunger pump that must lift the entire volume of sand in the tubing. This benefit allows the operator to start up wells that have been shut down with a higher percentage of success without having to call out secondary services like a rig or flushby unit.

Nordstef Consulting

February 28, 2020

Attention: **Clark Downhole Tools Inc.**

RE: **Fluid/Sand Testing**

At the request of Clark Downhole Tools Inc, a series of fluid compliance tests were carried out to confirm, with real time operational data, the functional reliability of its design.

The achieved results of the fluid testing showed 78% sand in solution with 180sec/L viscosity while still maintaining full mechanical function with 95% of theoretical pump output.

These numbers align with tests TR-001-2020 and TR-002-2020.

Yours Truly,

X

Steve Nordhagen P.Eng.
Nordstef Consulting

PROFESSIONAL ENGINEER ALBERTA
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Clark Downhole Tool
Field Trial Testing

Well:	NLSD 6-13-61-6W4
Rig:	Aurora # 69
AFE #:	TR-001-2020, TR-002-2020
CDHT Job #:	Trial # 1, Trial # 2
Dates In Hole:	Jan 23rd and Feb 24 2020
NCR #:	N/A
NCR Title:	N/A
BHA #:	1
Tool Run #:	1
Effect to Client:	Positive affirmation
Total NPT: **(Date and Time from Diagnosis to Resolution)**	N/A

1. Scope

This document details the results encountered on the fore mentioned job as well as the resolutions and analysis.

2. Description Of Trial And Equipment Used

The purpose of this trial was to test the newly engineered parts and confirm their viability on a commercial level. The reason for testing was due to an underperforming trial run in India with ONGC (see ONGC Trial #1 LNW-177 document). We were to install the tool in 7" casing using 2 7/8 tubing with 7/8 sucker rod to a depth of 120Md. Fresh water was used in all tests. The tubing was circulated through a return line back into the annulus creating a closed loop system. A digital flow meter and pressure transducer were used to capture the well data. The rig was a Crown WTD-00350 Mobile Free -Standing Single Class II Description. The well was under the control of Clark Downhole Tools (CDHT). Multiple days were spent on location performing a various array of testing.

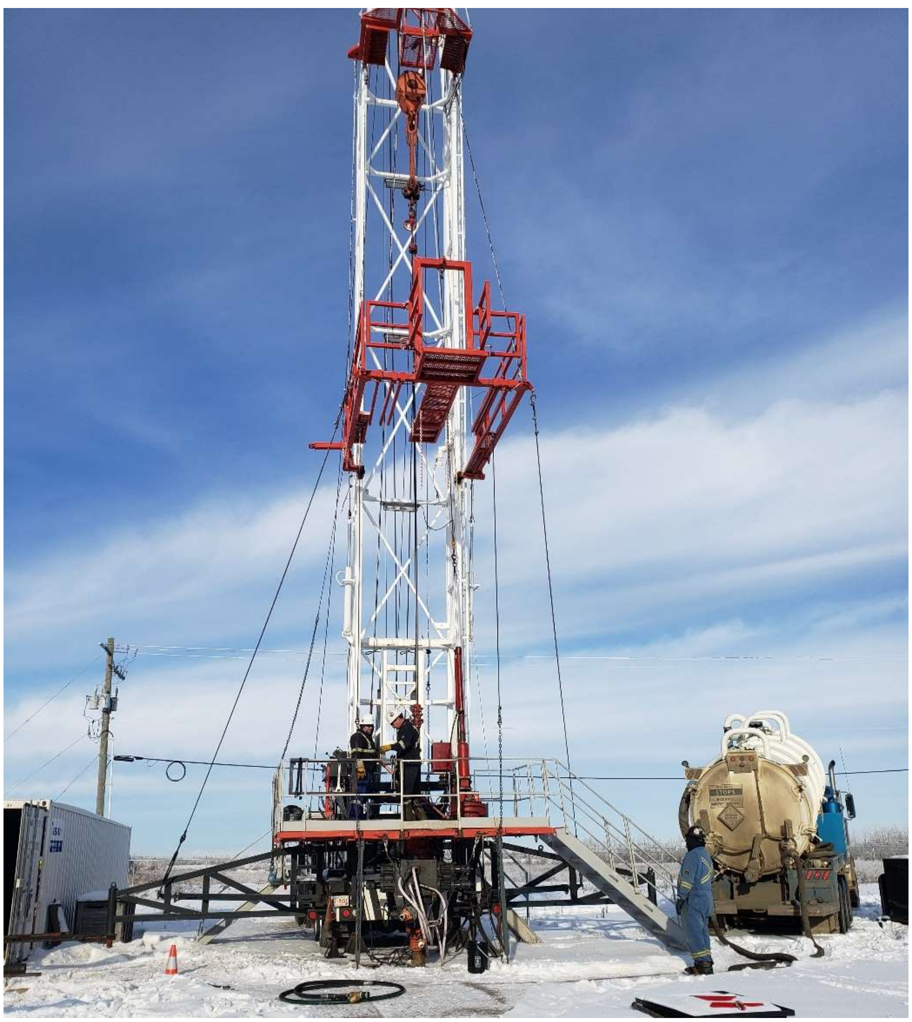

Figure 2.1 – Worksite showing the rig and related services.

Figure 2.2 – Digital flow meter and pressure transducer installed on flow line.

Figure 2.3 – Stuffing box installed on tubing with 1 ½ polish rod.

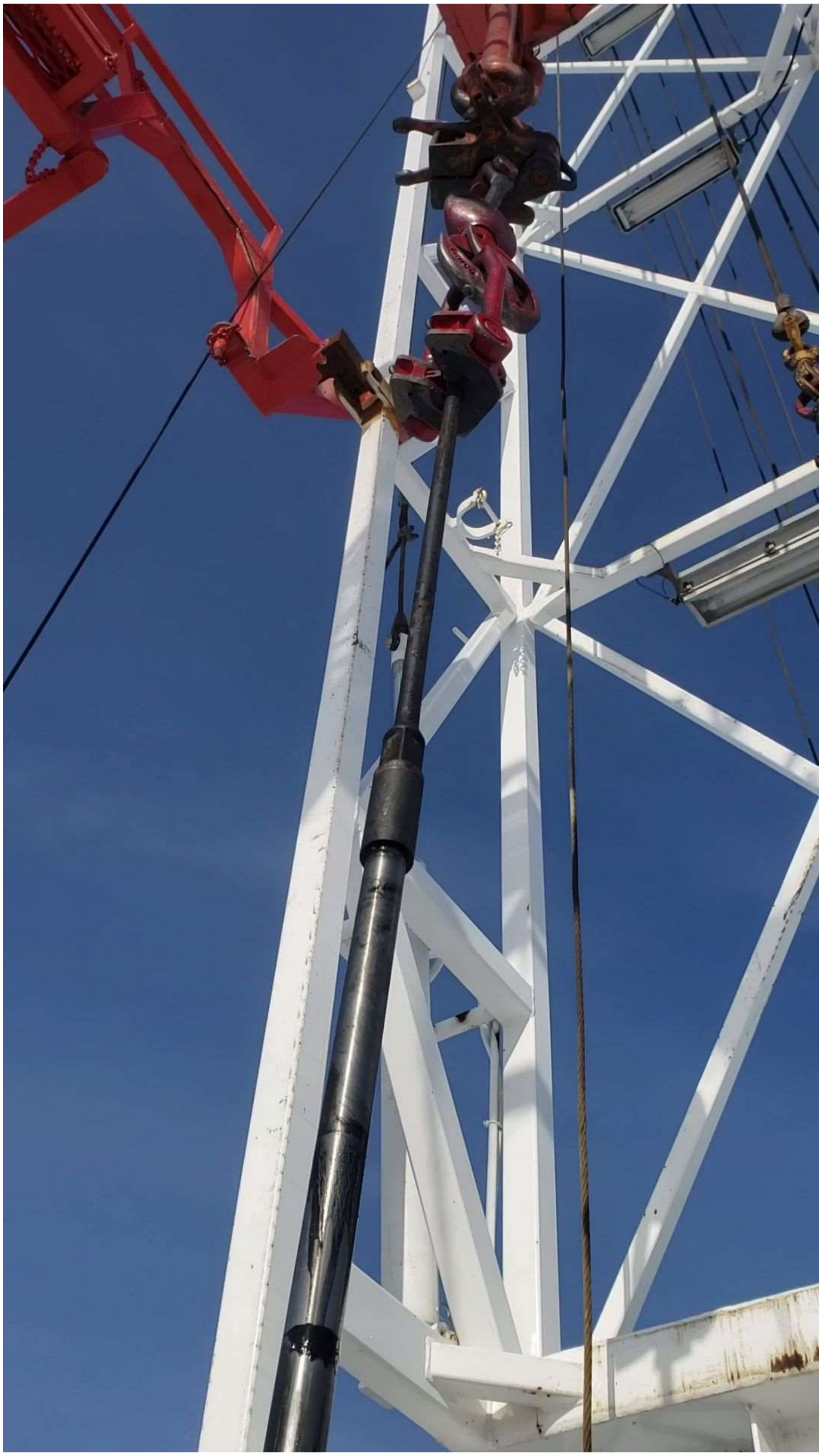

Figure 2.4 – Traveling block with rod hook and elevators stroking the pump.

Nordstef Consulting

Figure 2.5 – Tubing set in air slips with power tongs over top.

3. Results

The results from the test confirmed what we had suspected after using hydraulic fluid modeling software using the new components. The revised design was working very well.

Once we had installed the rods and reverse circulated the tubing to fill it, we stroked the pump and immediately had fluid coming out the end of the test line. We stroked the tool five times to rid the well of any trapped air and collected the fluid in 5-gallon pails for observation purposes.

After removing the air from the well, the hose was hooked up to the BOP stack on the annulus side for re-circulation. The tool was then set through a series of tests using a benchmark set of testing procedures over a 20 stroke timeframe. The results from the testing are as follows: On 20 strokes using water at 10 strokes per min the tool produced 80.15 gal to surface. A test using 20 strokes with water at a rate of 5 strokes per min yielded 80.08 gal to surface. Both tests showed similar pressures.

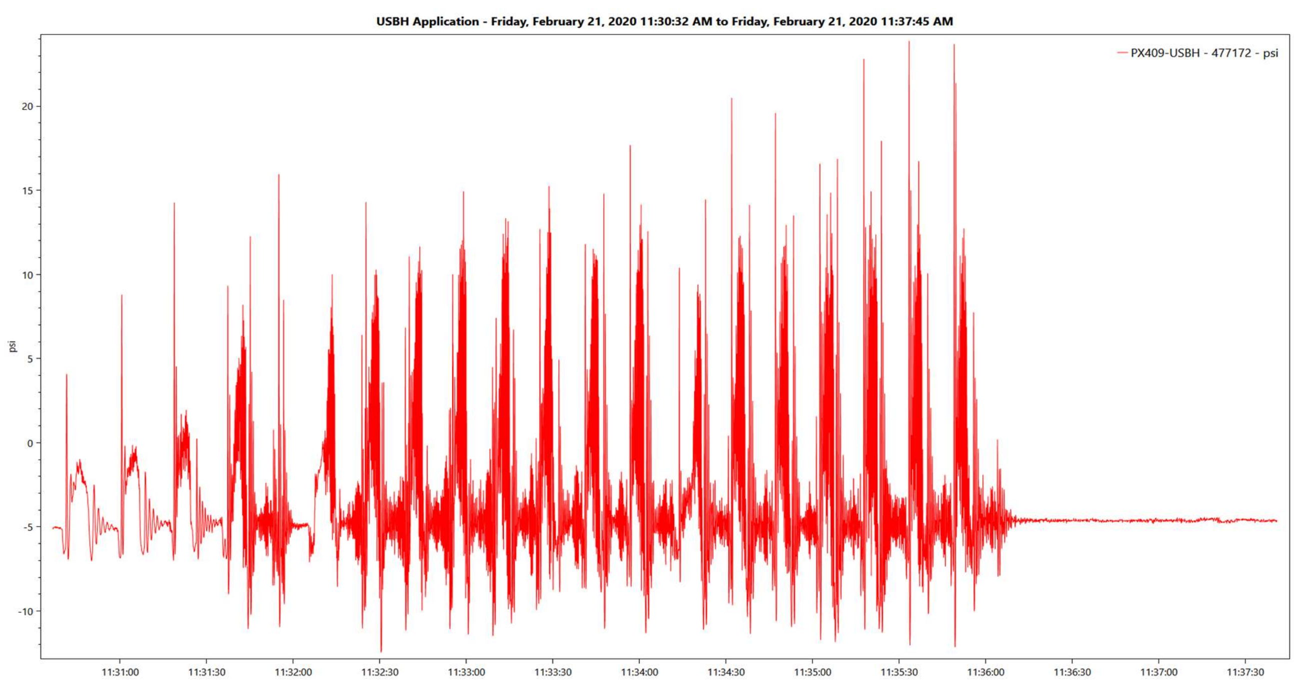

Figure 3.1 - Test # 1 Pressure Transducer output @ 10 strokes /min with 16' stroke.

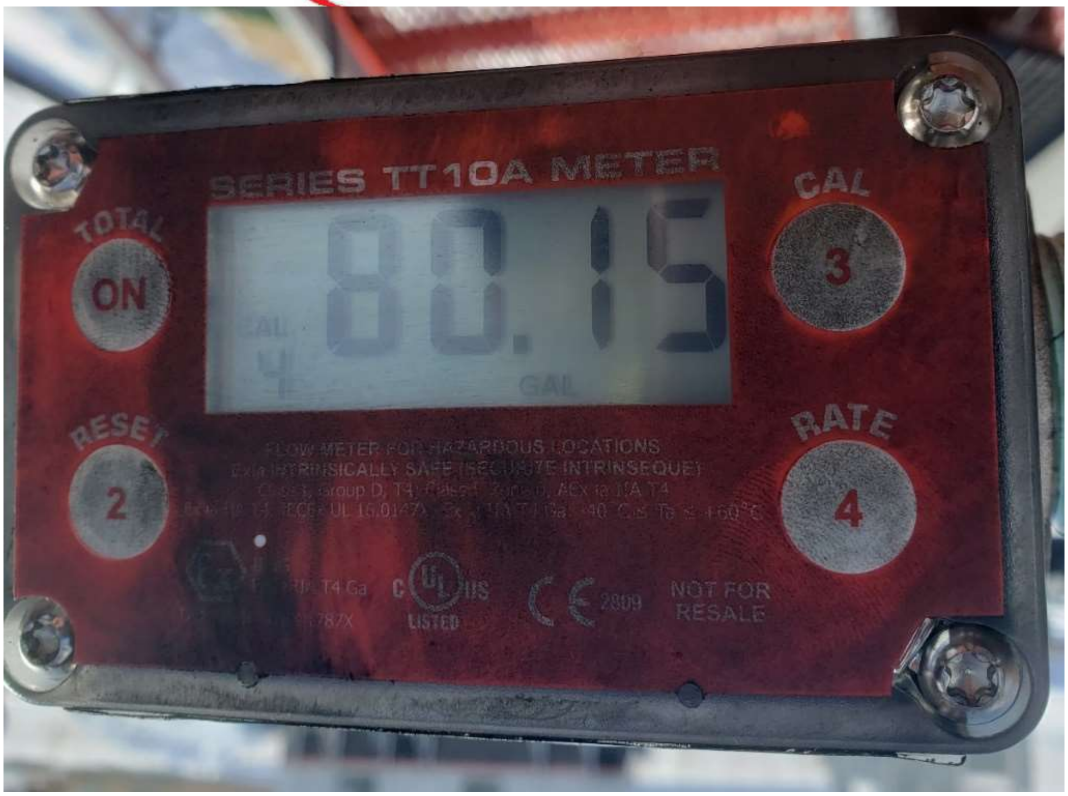

Figure 3.2 – Test # 1 Digital flow meter read out after 20 strokes @ 10 strokes /min with 16’ stroke.

Figure 3.3 – Bleeding air out of the lines prior to circulating a closed loop. Hose size is 1 1/2”.

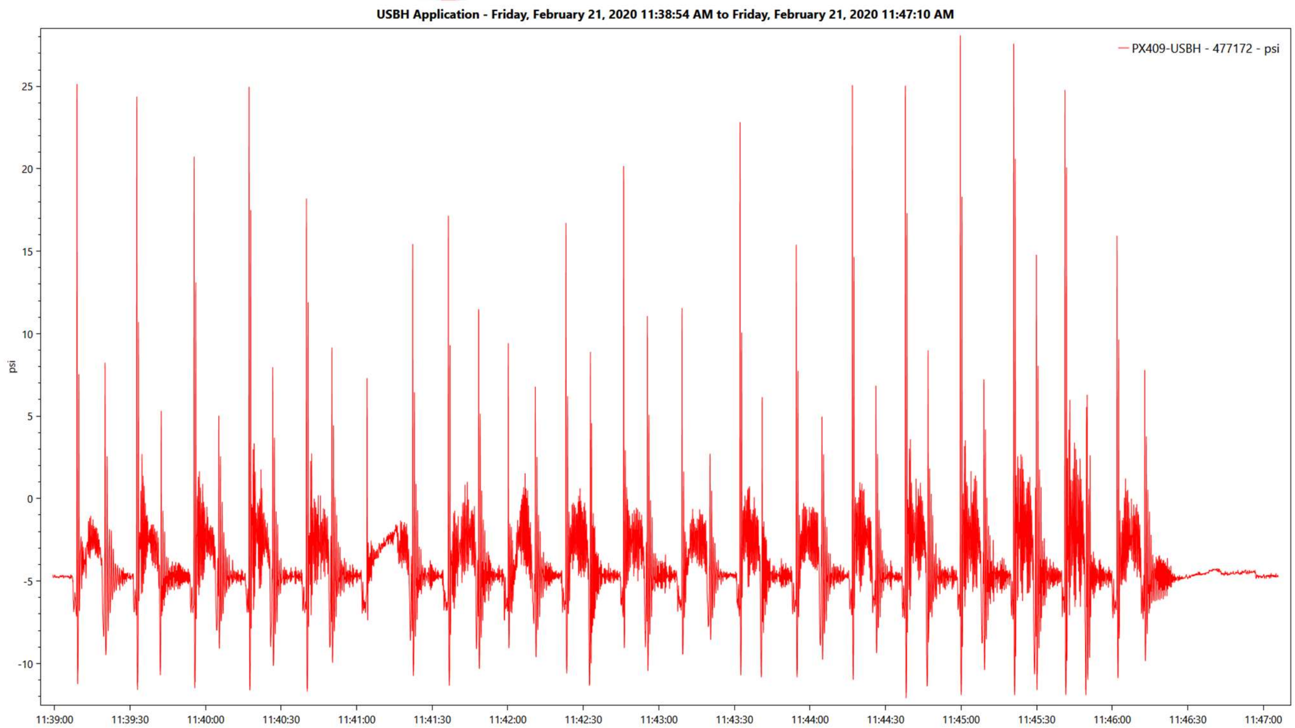

Figure 3.4 – Test # 2 Pressure Transducer output @ 5 strokes /min with 16’ stroke.

Figure 3.5 - Test # 2 Digital flow meter read out after 20 strokes @ 5 strokes /min with 16’ stroke.

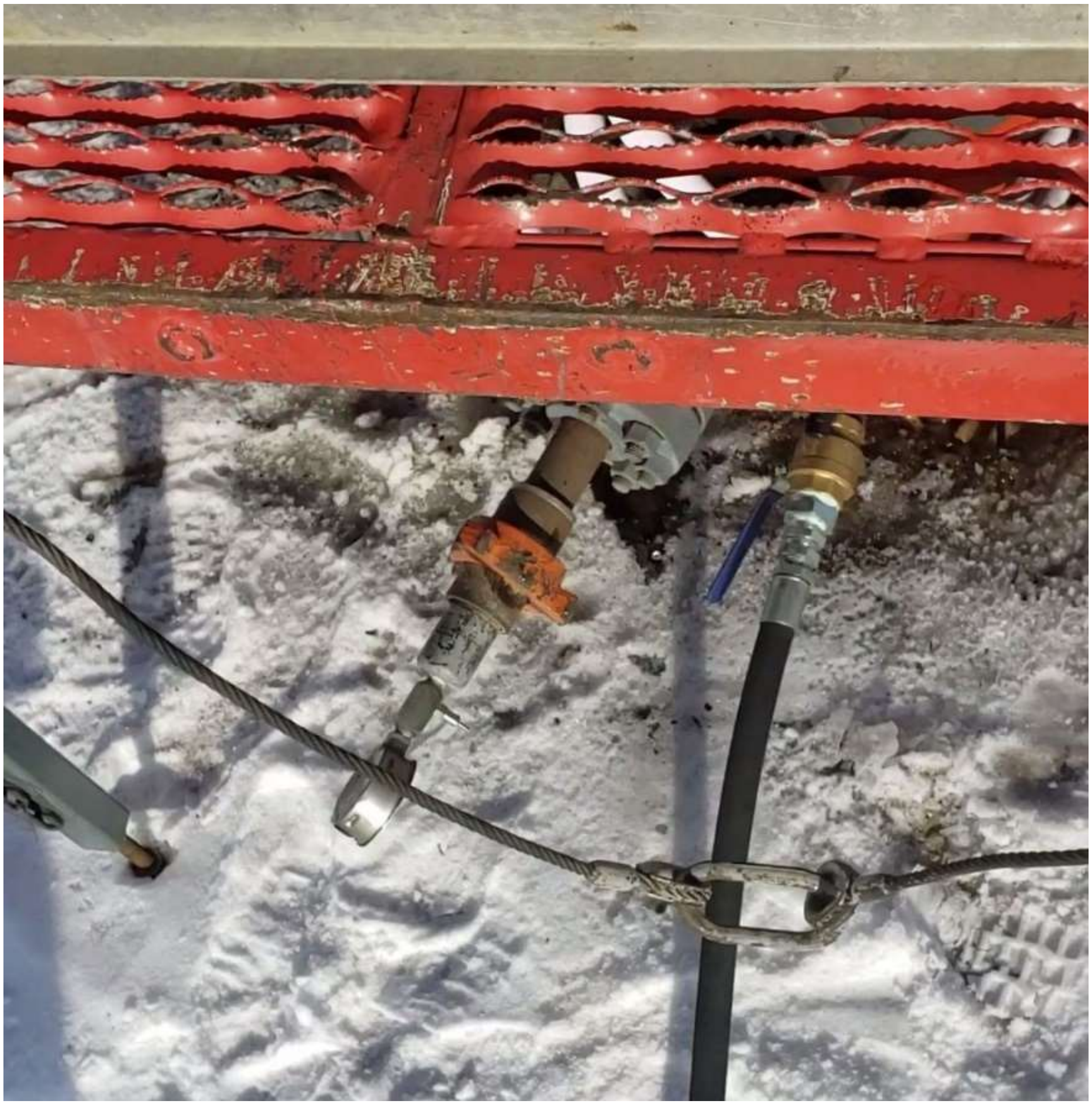

Figure 3.6 – Flow line tied into the annulus to create a closed loop system.

4. Review

After taking what we learned from the India trial and doing an engineering re-design to the upper piston component of the tool we were able to take the tool from 25% efficient to over 95% efficient.

The output values that were recorded match to the theoretical values for displacement outputs. This confirmed without a doubt that the new design is ready for production.

The following charts and graphs show the actual velocities created during the test scenario that prove the functionality of the newly designed components.

	Side Port Open/Closed	Flow Up gpm	Flow out ports each - gpm	Max Flow Velocity in/s	Theoretical Flow gpm
5 strokes per minute	Closed	19.4	0.2	55	20

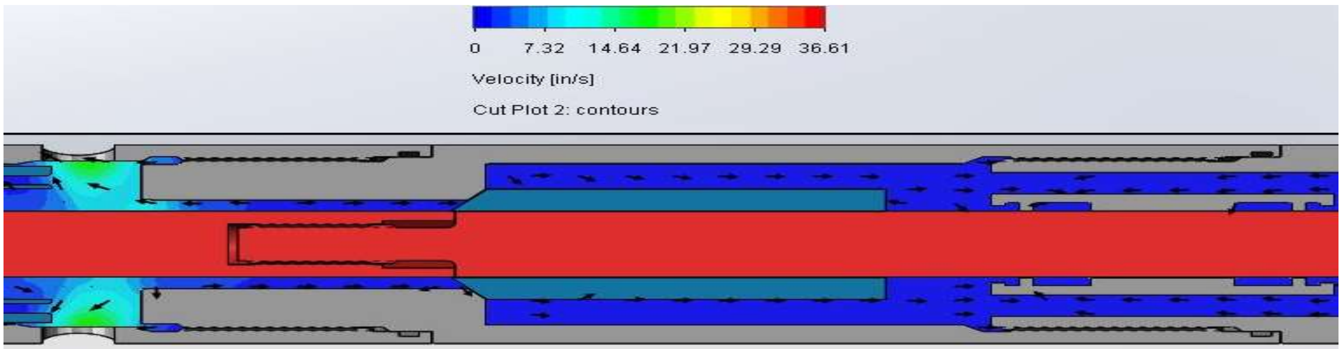

Figure 4.1 - Intake Holes Open – 5 spm – Flow Velocities

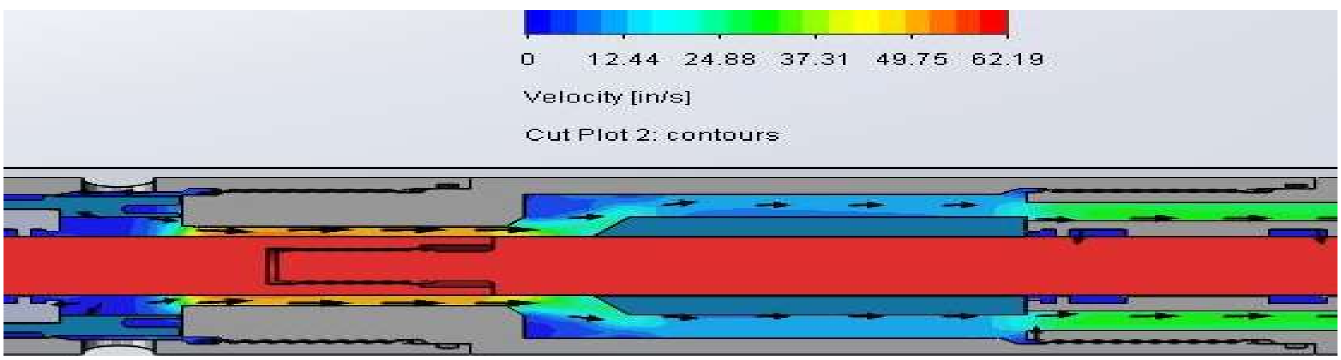

Figure 4.2 – Intake Holes Blocked – 5 spm – Flow Velocities

	Side Port Open/Closed	Flow Up gpm	Flow out ports each - gpm	Max Flow Velocity in/s	Theoretical Flow gpm
10 strokes per minute	Closed	38	0.5	55	40

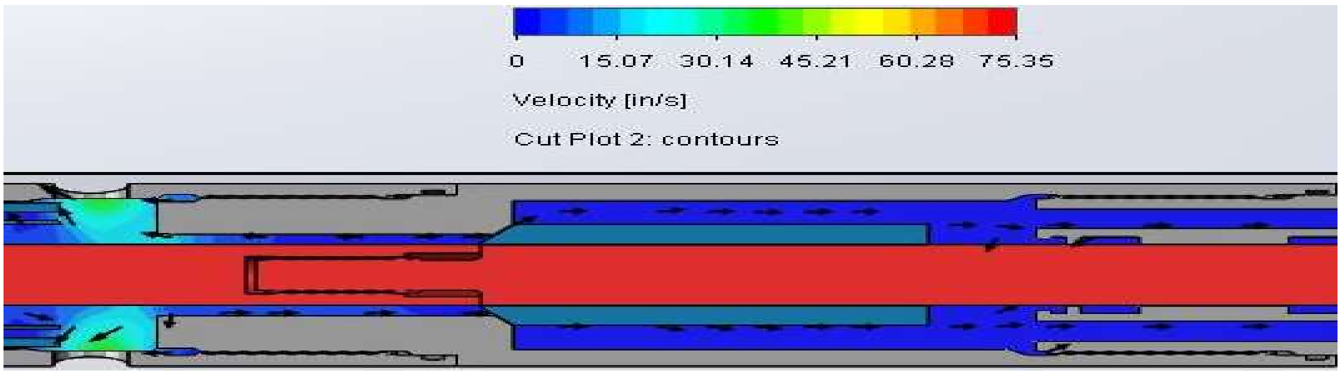

Figure 4.3 – Intake Holes Open – 10 spm – Flow Velocities

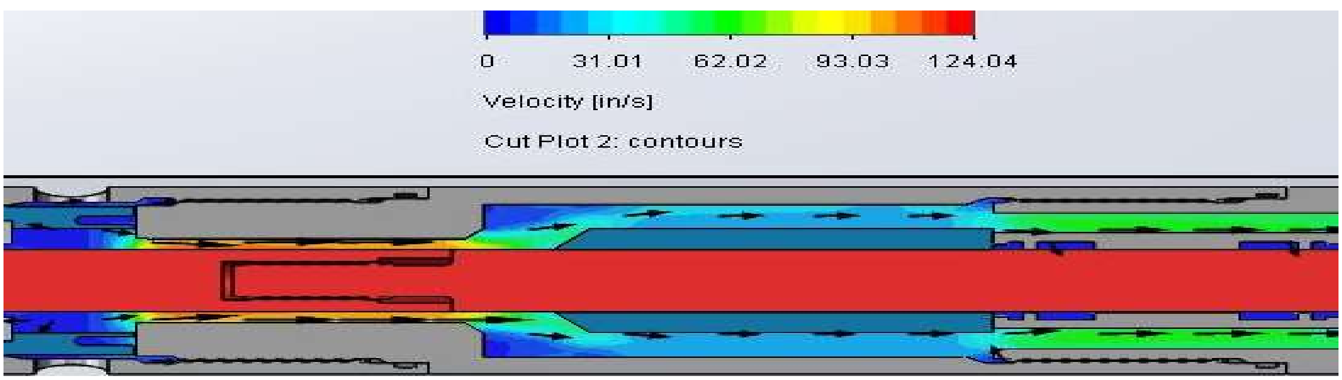

Figure 4.4 – Intake Holes Blocked – 10 spm – Flow Velocities

February 28, 2020

Attention: **Clark Downhole Tools Inc.**

RE: **Mechanical Compliance Testing**

At the request of Clark Downhole Tools Inc, a series of component examinations and mechanical compliance tests were carried out to confirm, with real time data in a live well scenario, the functional reliability of its design.

Based on the component drawings, the data collected during the mechanical compliance test is in line with the data from the component examinations using simulation software.

The theoretical outputs calculated using the design software match the actual values that are represented in the two tests. The numbers posted in the tests are the as pumped values and show 95% of actual.

Yours Truly,

X

Steve Nordhagen P.Eng.
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