




ELLISON
FLUID CALIPERS

A Case Study Comparing Fluid Caliper
Results To Their Cement Reports

Permian Basin
Midland County & Howard County, Texas

Prologue

This case study will show several oil wells drilled in the Permian Basin, Texas. The Ellison Fluid Calipers (EFC) fluid caliper report will be shown, followed by the corresponding cement report from the cementer. There will be a summary page with calculations for each well to demonstrate the accuracy of fluid calipers.

- The first photo for each well will show Ellison Fluid Calipers' fluid caliper report and invoice. This report was left on location with the E&P company man. The report was also emailed to the designated E&P employees, including the petroleum engineers.
- The second photo is the cement report from the cementer. It is important to note that this is not the W-15 cement report filed with the Texas Railroad Commission, as those aren't as detailed. Instead this is the actual cement report that the cementer provided to the E&P.

It is important to note that EFC advises customers that our results have a margin of error of +/-10% of actual annular volume. Oftentimes, we are much more accurate than 10%, but there are many factors that come into play. These can include hole conditions, geology, drilling methods and human factors.

Additionally, the cement volumes that EFC gives on the report is for the actual annular volume. The E&P will add their desired circulation volumes to our reported volumes. Any amount of excess cement for circulation is determined solely by the E&P and in accordance with their corporate policies. EFC is not privy to that information in advance.

Well #1: EFC Fluid Caliper Report

ELLISON
FLUID CALIPERS L.L.C.
 DELIVERED TO:

P.O. Box 66
 Allen, TX 75013
 24 Hours 432-634-0500

INVOICE

LEASE _____ WELL NO. _____
 ORDERED BY _____
 ORDER NO. _____

DATE 5-31-2019
 RIG _____
 VIA _____

DEPTH	DESCRIPTION OF CHARGES	CHARGES	TOTAL
	TO RUN FLUID CALIPER TO A DEPTH OF <u>1045</u> FEET TO DETERMINE THE VOLUME IN CUBIC FEET REQUIRED TO CIRCULATE CEMENT BEHIND YOUR <u>13 3/8</u> CASING.		
<u>0/1045</u>	ANNULAR VOLUME TO PRESENT DEPTH <u>1117</u> CU. FT.	BASE CHARGE	895.00
<u>0/1170</u>	ANNULAR VOLUME TO TD <u>1251</u> CU. FT.	DEPTH CHARGE <u>1045</u> FT. X <u>.12</u> / FT.	125.40
	ANNULAR VOLUME TOP STAGE _____ CU. FT.	DEPTH CHARGE _____ FT. X _____ / FT.	300.30
	ANNULAR VOLUME BTM STAGE _____ CU. FT.	MILEAGE <u>151</u> MILES X <u>.195</u> / MILE	
	AVERAGE HOLE SIZE <u>19 1/4</u> INCHES	ROUND TRIP FROM <u>Odessa Tx</u>	
	WASHOUT <u>54</u> % O.T.H. ANNULAR VOLUME	STAND BY TIME _____ HR. X _____ / HR.	
		TOTAL	1320.70

*Thank You
 Mike Calley*

DELIVERED BY Mike Calley RECEIVED & ACCEPTED BY _____

TERMS: 30 Days Net. A finance Charge of 1 1/2% per month, which is an annual percentage rate of 18% will be added on past due accounts.
 Any claims arising in connection with this invoice must be made within 30 days from the receipt thereof.

EFC determined that the annular volume of the hole to TD was 1251 ft³. Washout was 54% over true hole annular volume.

Customers very often request for EFC to run the fluid caliper on the last stand or joint before TD. Fluid calipers can be run while drilling or after TD. Our marker can be run as little as 5 minutes before or after a bottoms-up sweep.

Well #1: Cement Report

JOB SUMMARY

	COMPANY	JOB NAME/TYPE	FIELD RECEIPT	CUSTOMER REPRESENTATIVE
	RIG CONTRACTOR	DATE	API NUMBER	CUSTOMER REP CELL PHONE
	LEASE NAME / NUMBER		COUNTY	STATE
		Howard		TX

DATE	CALLED OUT	REQUESTED TIME	ON LOCATION	JOB START	JOB COMPLETE
	06/01/19	06/01/19	06/01/19	06/02/19	06/02/19
TIME	4:00 PM	10:00 PM	10:00 PM	11:15 PM	2:30 AM

WELL INFORMATION

MUD WT/TYPE	8.4# Spud Mud	MD (FT)	1195'	BHST/BHCT (deg-F)	90 / 82
PERFORATION/SQUEEZE DEPTH		SHOE LENGTH	43.63'	DV TOOL DEPTH	
TOP PLUG	WTC 13 3/8" TOP PLUG	PACKER DEPTH		LINER TOP DEPTH	
BOTTOM PLUG	N/A	RETAINER DEPTH			

PREVIOUS PIPE (SIZE/WT/THREAD/DEPTH) 20" 94# CSG to 80
 OPEN HOLE (SIZE/DEPTH) 17.5" OH to 1195'

CASING/INJECTION DOWN (SIZE/WT/THREAD/DEPTH) 13.375" 54.5# J55/BTC to 1195.86'

ADDITIONAL REMARKS 200# SUGAR LOADED ONTO BT-8

CEMENT

SACK VOLUME	DESCRIPTION	DENSITY	YIELD	MIX H2O
450-SX	100% Class C+5% SALT+2% SuspendaCem 6201+0.25PPS Pol-E-Flake+0.005GPS NoFoam V1A	12-dpg	2.55-cf/sx	15.1-gps
380-SX	100% Class C+1% CaCl2+0.005GPS NoFoam V1A	14.8-dpg	1.34-cf/sx	6.37-gps

SUMMARY

STAGE 1	STAGE 2	CALC. TOC
CEMENT VOL 295 BBL	CEMENT VOL	FINAL PSI
DISPLACEMENT VOL 178 BBL	DISPLACEMENT VOL	BUMP?
TTL VOL 493 BBL	TTL VOL	RETURNS?
VOLUME (BBL) CEMENT RETURNS	VOLUME (BBL) CEMENT RETURNS	

JOB LOG

TIME HH:MM	FLUID	RATE (BPM)	VOLUME (BBL)	PRESSURE (PSI)		JOB DESCRIPTION / REMARKS
				CSG	TBG	
10:00 PM						ARRIVED TO LOCATION/ 6/1/2019
10:10 PM						SPOT IN & RIG UP
						RIG RUNNING PIPE
11:15 PM						SAFETY MEETING
11:50 PM	H2O	2.0	2	2000		FILL & TEST LINES@ 2000PSI
11:55 PM	H2O	5.0	20	157		SPACER AHEAD
11:59 PM	CEMENT	6.0	204	270		LEAD@ 12.0H/ 450 SACKS
12:37 AM	CEMENT	6.0	91	285		TAIL@ 14.8H/ 380 SACKS
12:57 AM						SHUT DOWN/ DROP PLUG
12:59 AM	H2O	8.0	1	135		START DISPLACEMENT
1:09 AM	H2O	8.0	60	270		CAUGHT CEMENT
1:23 AM	H2O	8.0	165	670		PRESSURE BEFORE SLOW DOWN
1:23 AM	H2O	3.0	165	377		SLOW DOWN
1:26 AM	H2O	3.0	178	400		PRESSURE BEFORE LAND THE PLUG
1:26 AM	H2O	3.0	178	930		LAND THE PLUG
1:30 AM						BLEED OFF/ 1/2 BARREL BACK
						FLOATS HELD? YES
						WE HAD 100% CIRCULATION BACK TO SURFACE
						CEMENT BACK TO SURFACE/ 75bbl=165 SACKS
						WE USED A WTC 13 3/8" TOP PLUG

CUSTOMER SIGNATURE: _____

Cementer pumped 295 bbl or 1656 ft³

Circulation returned 75 bbl or 421 ft³, meaning the fluid caliper was +16 ft³ over actual annular volume

Well #1: Summary

As seen on the previous pages:

- The fluid caliper calculated the actual cement needed to circulate behind the 13 3/8" casing was 1251 ft³. This equated to a 54% washout.
- Upon receiving the fluid caliper report, the E&P instructed the cementer to pump 295 bbl (295 bbl x 5.6146 ft³ /bbl = 1656 ft³). This equates to an excess of 32% over the fluid caliper volume.*
- The cementer circulated 75 bbls back to the surface (75 bbl x 5.6146 ft³ /bbl = 494 ft³).
- Pumped: 1656 ft³
Circulated: 421 ft³
Actual Hole Volume: 1235 ft³
- These results show the fluid caliper of 1251 ft³ being off of the actual hole volume by only 16 ft³ or 2.8 bbl. **The difference was +1.3%.**

* It is important to note that every E&P and petroleum engineer has a different philosophy regarding appropriate excess amounts for circulation.

Well #2: EFC Fluid Caliper Report

ELLISON
FLUID CALIPERS L.L.C.

P.O. Box 66
 Allen, TX 75013
 24 Hours 432-634-0500

INVOICE

DELIVERED TO:

DATE 7-26-2019

LEASE _____ WELL NO. _____

RIG _____

ORDERED BY _____

VIA _____

ORDER NO. _____

DEPTH	DESCRIPTION OF CHARGES	CHARGES	TOTAL
	TO RUN FLUID CALIPER TO A DEPTH OF <u>1998</u> FEET	[REDACTED]	[REDACTED]
	TO DETERMINE THE VOLUME IN CUBIC FEET REQUIRED		
	TO CIRCULATE CEMENT BEHIND YOUR <u>13 3/8</u> CASING.		
<u>0/1798</u>	ANNULAR VOLUME TO PRESENT DEPTH <u>2112</u> CU. FT.		<u>895.00</u>
<u>0/1850</u>	ANNULAR VOLUME TO TD <u>*2198*</u> CU. FT.		
	ANNULAR VOLUME TOP STAGE _____ CU. FT.		
	ANNULAR VOLUME BTM STAGE _____ CU. FT.		
	AVERAGE HOLE SIZE <u>20</u> INCHES		
	WASHOUT <u>71</u> % O.T.H. ANNULAR VOLUME		
		DEPTH CHARGE <u>1998</u> FT. X <u>.12</u> /FT.	<u>213.36</u>
		DEPTH CHARGE _____ FT. X _____ /FT.	(
		MILEAGE <u>54</u> MILES X <u>1.95</u> /MILE	<u>105.30</u>
		ROUND TRIP FROM <u>Odessa Tx.</u>	(
		STAND BY TIME _____ HR. X _____ /HR.	
		TOTAL	<u>1213.66</u>

*Thank You &
 Mike Calby*

DELIVERED BY Mike Calby RECEIVED & ACCEPTED BY _____

TERMS: 30 Days Net. A finance charge of 12% per month, which is an annual percentage rate of 18% will be added on past due accounts. Any claims arising in connection with this invoice must be made within 30 days from the receipt thereof.

EFC determined that the annular volume of the hole to TD was 2198 ft³. Washout was 71% over true hole annular volume.

Well #2: Cement Report

JOB SUMMARY

	COMPANY	JOB NAME / TYPE	FIELD RECEIPT	CUSTOMER REPRESENTATIVE
	RIG CONTRACTOR	DATE	API NUMBER	CUSTOMER REP CELL PHONE
	LEASE NAME / NUMBER	07/26/19	COUNTY	STATE
		Midland	TX	

DATE	CALLED OUT	REQUESTED TIME	ON LOCATION	JOB START	JOB COMPLETE
TIME			11:30 AM	07/26/19 2:20 PM	07/26/19 6:30 PM

WELL INFORMATION

MUD WT / TYPE	8.4# Spud Mud	MD (FT)	1850	BHST / BHCT (deg-F)	95 / 88
PERFORATION / SQUEEZE DEPTH		SHOE LENGTH	40	DV TOOL DEPTH	
TOP PLUG		PACKER DEPTH		LINER TOP DEPTH	
BOTTOM PLUG		RETAINER DEPTH			

PREVIOUS PIPE (SIZE / WT / THREAD / DEPTH)
20" 94# CSG to 100

CASING / INJECTION DOWN (SIZE / WT / THREAD / DEPTH)
13.375" 54.5# J55 / STC to 1850

ADDITIONAL REMARKS

CEMENT

SACK VOLUME	DESCRIPTION	DENSITY	YIELD	MIX H2O
1000-SX	100% Class C+5% SALT+2% SMS+0.25PPS Pol-E-Flake+0.005GPS NoFoam V1A	12-ppg	2.54-cf/sk	15.07-gps
490-SX	100% Class C+1% CaCl2+0.005GPS NoFoam V1A	14.8-ppg	1.34-cf/sk	6.37-gps

SUMMARY

STAGE 1	CALC. TOC	SURFACE	STAGE 2	CALC. TOC
CEMENT VOL	569	BINAL PSI	CEMENT VOL	FINAL PSI
DISPLACEMENT VOL	279	BUMP?	DISPLACEMENT VOL	BUMP?
FTL VOL	848	RETURNS?	FTL VOL	RETURNS?
VOLUME (BBL) CEMENT RETURNS	167 bbbls = 369 sk			

JOB LOG

TIME	FLUID	RATE (BPM)	VOLUME (BBL)	PRESSURE (PSI)	JOB DESCRIPTION / REMARKS
HH:MM				CSG TBG	
11:30 AM					ARRIVED
12:00 PM					RIG UP
2:00 PM					SAFETY MEETING
2:15 PM					FILL / TEST LINES
2:20 PM	F/W	4.0	20	2000	F/W SPACER
2:30 PM	CMT	6.5	452	364	LEAD 1000 SK @ 12.0 #
3:35 PM	CMT	6.0	117	750	TAIL 490 SK @ 14.8#
4:00 PM					SHUT DOWN / DROP PLUG
4:03 PM	F/W	3.0	5	70	START DISPLACEMENT
4:14 PM	F/W	7.5	50	272	PSI @ 50 BBLS
4:30 PM	F/W	8.0	150	533	PSI @ 150 BBLS
4:41 PM	F/W	8.0	230	748	PRESSURE BEFORE SLOW DOWN
4:44 PM	F/W	4.0	275	520	SLOW DOWN
4:50 PM	F/W	4.0	275	550	PRESSURE BEFORE LAND PLUG
4:52 PM	F/W	4.0	279	1100	LAND PLUG
4:56 PM					BLEED OFF 1 1/2 bbbls back
5:00 PM					FOATS HELD ? Yes
					CEMENT BACK 167 bbbls back = 369 sacks
6:30 PM					RIG DOWN

CUSTOMER SIGNATURE: _____

Cementer pumped 569 bbl or 3195 ft³

Circulation returned 167 bbl or 938 ft³, meaning the fluid caliper was -59 ft³ under actual annular volume

Well #2: Summary

As seen on the previous pages:

- The fluid caliper calculated the actual cement needed to circulate behind the 13 3/8" casing was 2198 ft³. This equated to a 71% washout.
- Upon receiving the fluid caliper report, the E&P instructed the cementer to pump 569 bbl (569 bbl x 5.6146 ft³ /bbl = 3195 ft³). This equates to an excess of 45% over the fluid caliper volume.*
- The cementer circulated 167 bbls back to the surface (167 bbl x 5.6146 ft³ /bbl = 938 ft³).
- Pumped: 3195 ft³
Circulated: 938 ft³
Actual Hole Volume: 2257 ft³
- These results show the fluid caliper of 2198 ft³ being off of the actual hole volume by only 59 ft³ or 10.5 bbl. **The difference was -2.6%.**

* It is important to note that every E&P and petroleum engineer has a different philosophy regarding appropriate excess amounts for circulation.