

IPS 2024



IPS 24-6.1 Surging Jobs – Achieving a Specific Sand Face Drawdown

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# Surging Jobs Achieving a Specific Sand Face Drawdown

**Presented by:**  
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# Perforating and Surge - Objectives

- What is a Single Trip Surge
- Model design and outputs
- Data gathering and validation
- Sensitivities

# Single Trip Surge

- Perforate and surge in single trip, saving rig-time cost.
- Surge without risking sanded-in guns from produced sand.
- Adjustable atmospheric chamber that produces the desired drawdown at the sand face.

# BHA – Surge Chamber, Tubing, Gauges

#	Tool	Description	Tensile Rating	Working Pressure	Diameter		Threads		Length feet
			Klb	psi	OD	ID	Top	Bottom	
					in.				
1		Flowhead <b>Flow Head</b>			8.00	3.06	CTM-57 Box	CTM-57 Pin	12.63
2		5-7/8" Drill Pipe <b>Drill Pipe</b> Four stands Up from Perf Depth			7.00	3.75	CTM-57 Box	CTM-57 Pin	8020.36
3		5 7/8" Drill Pipe <b>Drill Pipe</b> Stands 47-106 26#			7.00	4.28	CTM-57 Box	CTM-57 Pin	7993.47
4		5-7/8" Drill Pipe <b>Drill Pipe</b> 19-8303			7.43	3.75	CTM-57 Box	CTM-57 Pin	6.18
5		X-Over <b>X-Over</b> 26-11391			7.00	3.25	CTM-57 Box	4-1/2" IF Pin	3.15
6		Tubing Fill Test Valve <b>TFTV-HK</b> 01001 PapL=1226 psi PapH=1640psi	480	20,000	7.00	3.50	4-1/2" IF Box	4-1/2" IF Pin	7.57
7		Pipe Tester Valve <b>PTV-HK Upper</b> 01004 PapL=3262psi PapH=3788psi	480	20,000	7.00	3.50	4-1/2" IF Box	4-1/2" IF Pin	8.18
8		X-Over <b>Crossover</b> 26-5409			7.00	3.25	4-1/2" IF Box	CTM-57 Pin	3.12
9		5 7/8" Drill Pipe <b>Drill Pipe</b> Stand 38-46 6123.07-4923.09			5.88	4.28	CTM-57 Box	CTM-57 Pin	1199.98
10		5-7/8" Drill Pipe <b>Drill Pipe</b> 19-5301 Handling Pup			7.09	4.28	CTM-57 Box	CTM-57 Pin	6.15
11		X-Over <b>X-Over</b> 26-7161			7.00	3.25	CTM-57 Box	4-1/2" IF Pin	3.31
12		Pipe Tester Valve <b>PTV-HK Lower</b> 01003 PapL=1443psi PapH=1857psi	480	20,000	7.00	3.50	4-1/2" IF Box	4-1/2" IF Pin	8.17
13		X-Over <b>X-Over</b> 26-7174			7.00	3.25	4-1/2" IF Box	CTM-57 Pin	3.35
14		5 7/8" 34ppf Pup Joint <b>Pup Joint</b> 19-3483			7.02	4.28	CTM-57 Box	CTM-57 Pin	8.43
15		X-Over <b>X-Over</b> 26-2866			6.50	4.20	CTM-57 Box	4 1/2" IF Pin	2.38
16		McDonald Gauge Carrier <b>MCD</b> 001 1 ID / 1 OD Ported Gauges	944	20,000	6.93	4.20	4 1/2" IF Box	4 1/2" IF Pin	3.58
17		X-Over <b>X-Over</b> 26-5165			7.04	4.20	4 1/2" IF Box	CTM-57 Pin	3.66
18		5 7/8" 26.4ppf Drill Pipe <b>Drill Pipe</b> 37 Stands CTM 57 #26			5.88	4.28	CTM-57 Box	CTM-57 Pin	4923.09
19		X-Over <b>X-Over</b> 26-2694 3-1/2" IF pin X CTM-57 Box			7.13	2.55	CTM-57 Box	3 1/2" IF Pin	3.95

Chamber Length ~ 1200 ft  
Chamber Eff ID = 4.975 in

Upper Gauge Carrier

Tubing Length Below Chamber ~ 5300 ft  
Tubing Eff ID = 4.975 in



# BHA - Perforating and Surge - Gauges

#	Tool	Description	Tensile Rating	Working Pressure	Diameter		Threads		Length
					Klb	psi	OD	ID	
20	X-Over	X-Over 93223			4.76	2.45	3 1/2" IF Box	3 1/2" PH6 Pin	0.73
21	IRIS Dual Valve	IRDV PapL=5005psi PapH=5632psi 1008	320	30,000	5.25	2.25	3 1/2" PH6 Box	3 1/2" PH6 Pin	28.97
22	X-Over	X-Over 23154			4.75	2.50	3 1/2" PH6 Box	3 1/2" IF Pin	0.85
23	3 1/2" IF Pipe	Pup Joint	382	15,000	4.83	2.44	3 1/2" IF Box	3 1/2" IF Pin	9.69
24	X-Over	X-Over			4.72	2.25	3 1/2" IF Box	3 1/2" PH6 Pin	0.73
25	TDRC-D Gauge Carrier	TDRC 2 ID Ported Gauges 702	430	30,000	5.00	2.25	3 1/2" PH6 Box	3 1/2" PH6 Pin	6.39
26	X-Over	X-Over 23153			4.89	2.64	3 1/2" PH6 Box	3 1/2" IF Pin	0.71
27	JAR	JAR-FEA 1007	350	15,000	5.00	2.25	3 1/2" IF Box	3 1/2" IF Pin	8.51
28	Saver Sub	Saver Sub 14010			4.78	2.64	3 1/2" IF Box	3 1/2" IF Pin	1.13
29	3 1/2" IF Pipe	Pup Joint Cut Joint S135 13.3 ppf 19-3189	382	15,000	4.90	2.75	3 1/2" IF Box	3 1/2" IF Pin	15.43
30	Positest LS - 9 7/8" 67.56#	PSPK-LS Dressed in 90-90-90 Config 1195	299	15,000	8.32	2.25	3 1/2" IF Box	3 1/2" EUE Pin	10.92
31	Cross Over	X-Over 21570			4.78	2.44	3 1/2" EUE Box	3 1/2" IF Pin	0.77
32	3 1/2" IF Pipe	Pup Joint 19-2369	382	15,000	4.90	2.44	3 1/2" IF Box	3 1/2" IF Pin	14.97
33	Centralizer	Centralizer 14840			8.25	2.63	3 1/2" IF BOX	3 1/2" IF PIN	2.77

#	Tool	Description	Tensile Rating	Working Pressure	Diameter		Threads		Length
					Klb	psi	OD	ID	
34	Right Hand Release	RHR Fishing Length= 1.39' 14333			4.76	2.68	3 1/2" IF Box	3 1/2" IF Pin	2.44
35	3 1/2" IF Pipe	Drill Pipe 4 Doubles (8 Joints) 382	15,000	4.72	2.44	3 1/2" IF Box	3 1/2" IF Pin	252.09	
36	Long Slot Debris Sub	LSDS Circulation Point Below Packer 438		4.75	2.30	3 1/2" IF Box	3 1/2" IF Pin	2.00	
37	3 1/2" IF Pup	Pup Joint 77387	382	15,000	4.76	2.44	3 1/2" IF Box	3 1/2" IF Pin	5.98
38	Fast Gauge Carrier	MCD-C 08	382	19,400	5.50	2.25	3 1/2" IF Box	3 1/2" IF Pin	3.91
39	3 1/2" Drill Pipe	Drill Pipe 35922	382	15,000	4.77	2.75	3 1/2" IF Box	3 1/2" IF Pin	5.46
40	Cross over reducer	X-Over 95658			4.80	2.44	3 1/2" IF Box	3 1/2" EUE Pin	1.21
41	Dual eFire Fill Sub	eFire/eFire 7.0" OD Fill Sub Connection 284	15,000	4.53		3 1/2" EUE BOX	5.062 SA BOX	21.16	
42	7" 15spf PFM 7015 HMX	7" HSD non-Insidr 600	15,000	7.00		5.062 SA Pin	5" API Pin	129.37	
43	Bullnose	Threaded Bullr Centralizer OD = 8.38" 8.25				5" API Box	2 7/8" EUE Pin	1.16	
44	Cross over reducer	X-Over 4.53				2 7/8" EUE Box	3 1/2" EUE Pin	0.52	
45	Packer Plug Running tool 2.64"	Plug Total Length = 8.0' Eff=2.05' 6.25				3 1/2" EUE Box	- Pin	2.05	
46	Clearance	Clearance -				- Box	- Pin	8.27	
47	Packer	Packer Packer set at -' 8.50				- Box	- Pin	5.42	

# Transient Rapid Underbalance Surge

- RIH, correlate to perforation depth, set packer.
- Open packer bypass, initiate electronic firing head, close packer bypass, fire.
- Unset packer, POOH to clear perforated zones, set packer.
- Open Lower Tester Valve: expose tubing to the atm pressure surge chamber.
- Formation is subject to drawdown while surge chamber volume gets filled.
- Tag TOS or Sump packer, POOH, perform clean-up trip.



# Planning and Logistics

- Planning – Time consuming but key for success
- Predict risks due to gun-shock, optimize BHA
- Select tools to minimize lost time and reduce costs
- Use surging planning software to design surging job:
  - Aim for a desired drawdown at the sand face, controlled by the bottom of the atmospheric surge chamber.
  - Aim for a desired surge volume per perforation, controlled by the total volume of the atmospheric surge chamber.



# Assisted Simulation Workflow for Surging

## INPUTS

In this step the toolstring/gunstring will be moved uphole by an amount that you will specify, all charges from all guns will be removed, and all the reservoir zones covering the current gunstring position will be set to Having Open Perfs.

The gunstring was moved uphole 533 ft, all charges were removed and the reservoir zones were updated.

Specify the expected productivity just before TRUST surging [ BPD/psi ]:

115

This model assumes that most of the tubing/stands between the packer and the lower PTV have the same ID as the TRUST chamber's stands above.

Specify the effective reservoir diameter [m]:

4.975

Specify the effective reservoir length [m]:

40.6

Specify the effective reservoir permeability [Darcy]:

1.0

Before surging, the BHP at the tubing entry point is 11459 psi. Based on the reservoir viscosity, while surging (MD 6870.3 m, the initial change) at the sand face, the initial sand face drawdown at the sand face is 800 psi.

Usually the TRUST chamber volume is proportional to the number of perforations to treat. Typically [0.5-2.0] gallons/perforation or [0.002-0.007] m<sup>3</sup>/perforation. With the TRUST valve at MD 4552.3 m, assuming the chamber top can reach up to MD 118.6 m, and with the defined tubing size ID (4.97 in), the maximum volume of the trust chamber would be 55.50 m<sup>3</sup>. Surge volume per (40.6 m) stand is 0.509 m<sup>3</sup>. Specify the desired TRUST chamber volume [m<sup>3</sup>]:

4.57

OK Cancel



# Assisted Simulation Workflow for Surging

Gun String | Gun String Defaults | Design Information | Comments | Casings | Zones | Gun Summary | Messages | Ext-Vars

**Gunstring Extra Variables (Docum.):**

```
gun_pressure_model=1

#trust-job_9-stands-long-surge-chamber:
trust=1
trust_vol_m3=4.583
trust_tubing_id_m=0.12636
trust_chamber_bottom_md_m=4541.5
trust_chamber_bottom_tvd_m=4150.8
trust_pi_bpd_psi=115
trust_simulate_time_s=33.1
trust_tools_id_m=0.05715
trust_fluid_visc_cp=1
```

**TRUST Results:**

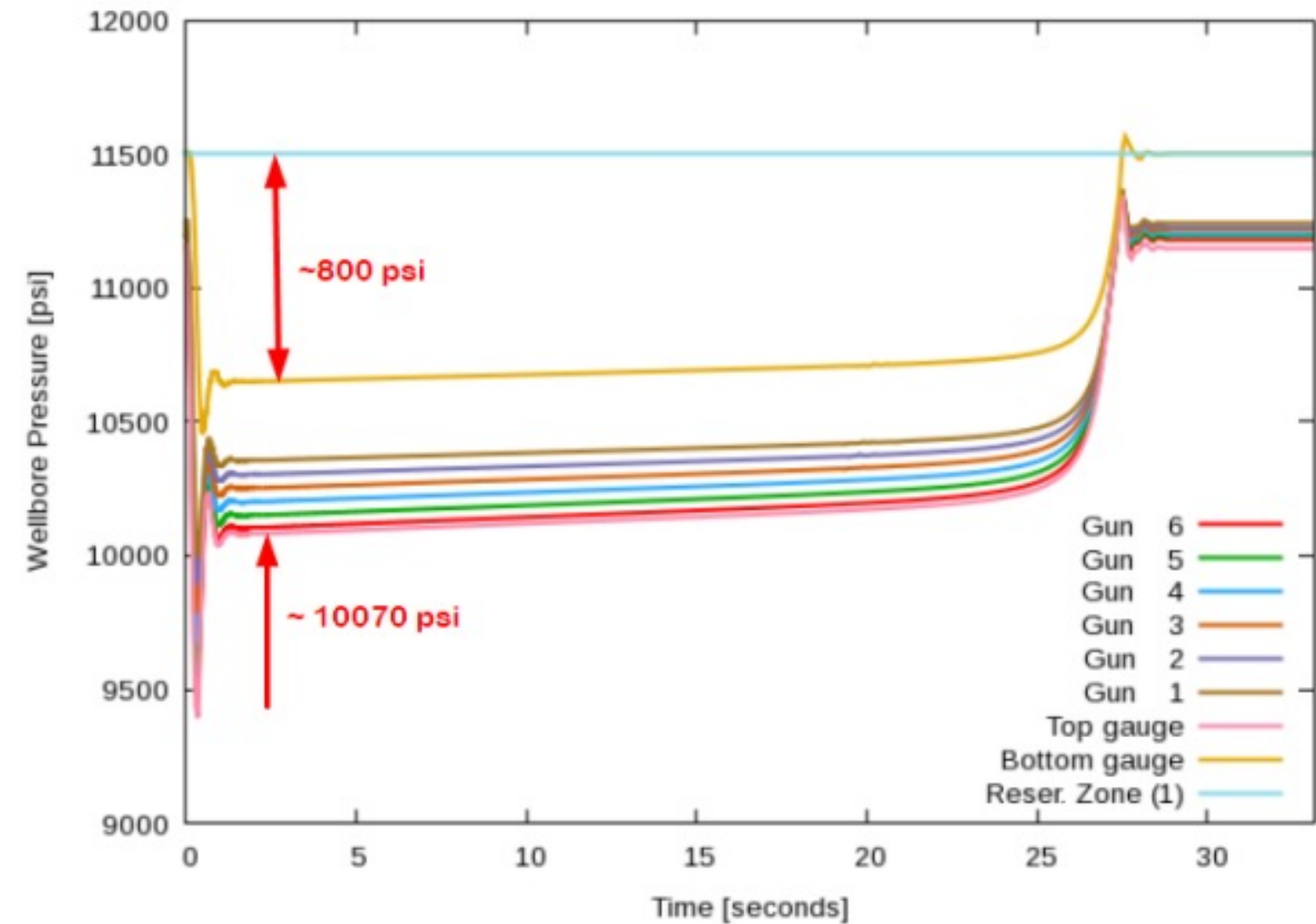
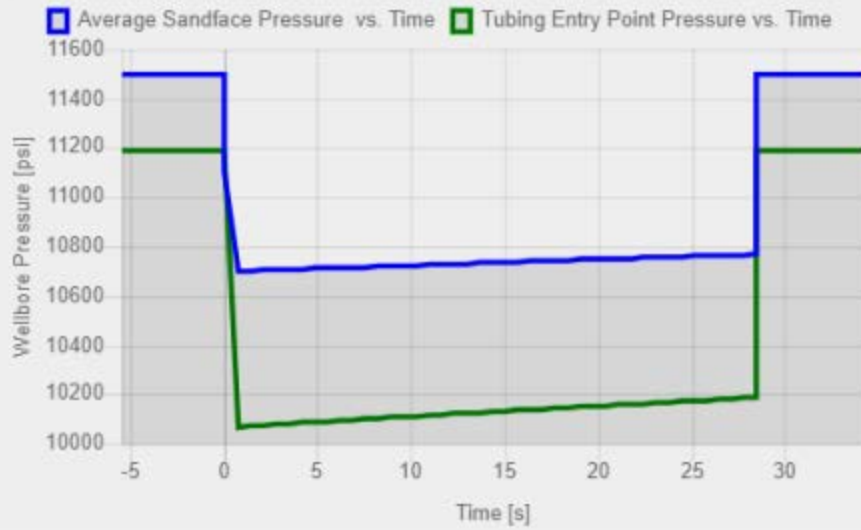
Before surging the average hydrostatic pressure at the tubing entry point is 11186 psi, value estimated from all zones with open perforations.

While surging, the estimated initial/maximum drawdown at the sand face is 800.98 psi, and the average drawdown while surging is 764.21 psi. The estimated initial/minimum wellbore pressure at the tubing entry point is 10068 psi, and the average wellbore pressure while surging is 10130 psi.

It should take ~27.7 sec to fill the ~365.5 m long surge chamber.

Check Command Lines  
Move TRUST String  
Set TRUST Simulation  
Analyze TRUST Performance

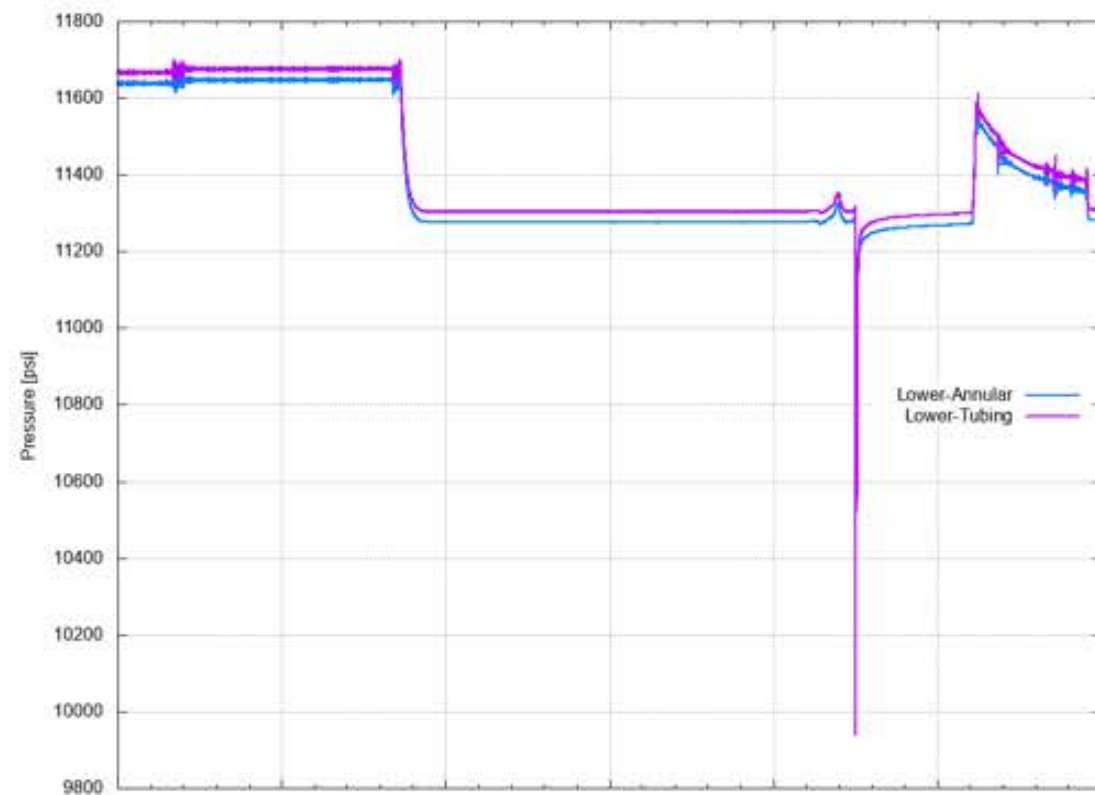
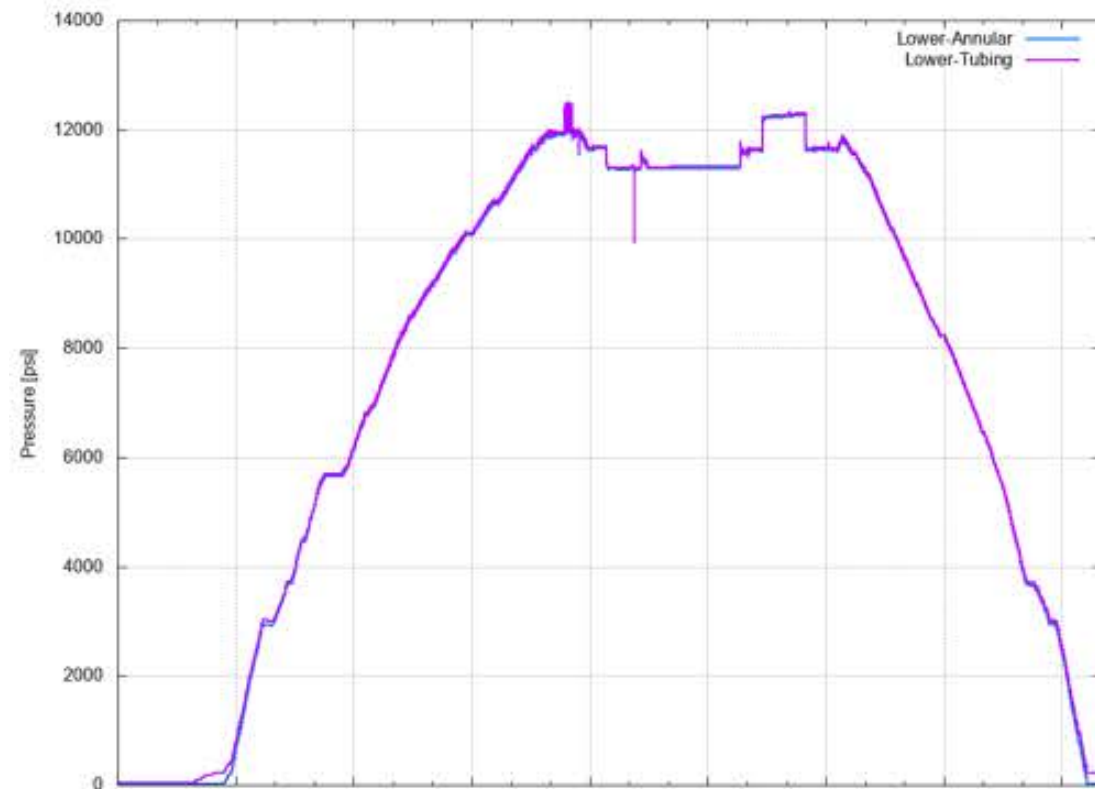
Average Sandface Pressure vs. Time  Tubing Entry Point Pressure vs. Time



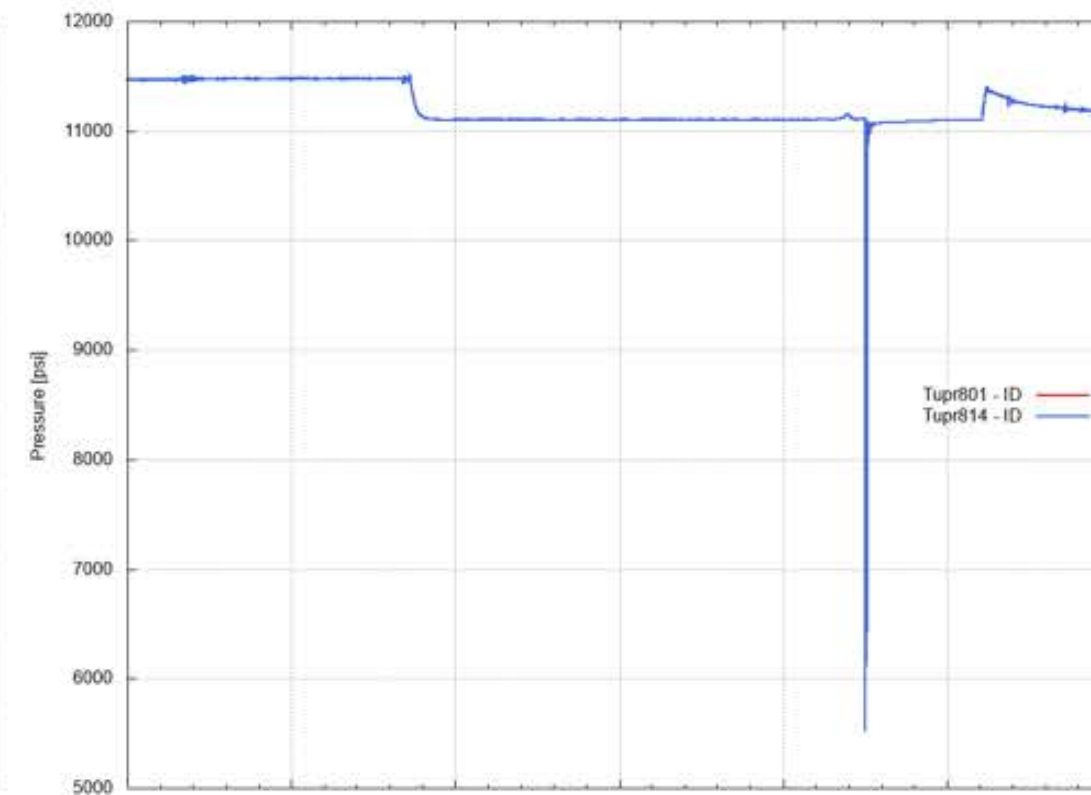
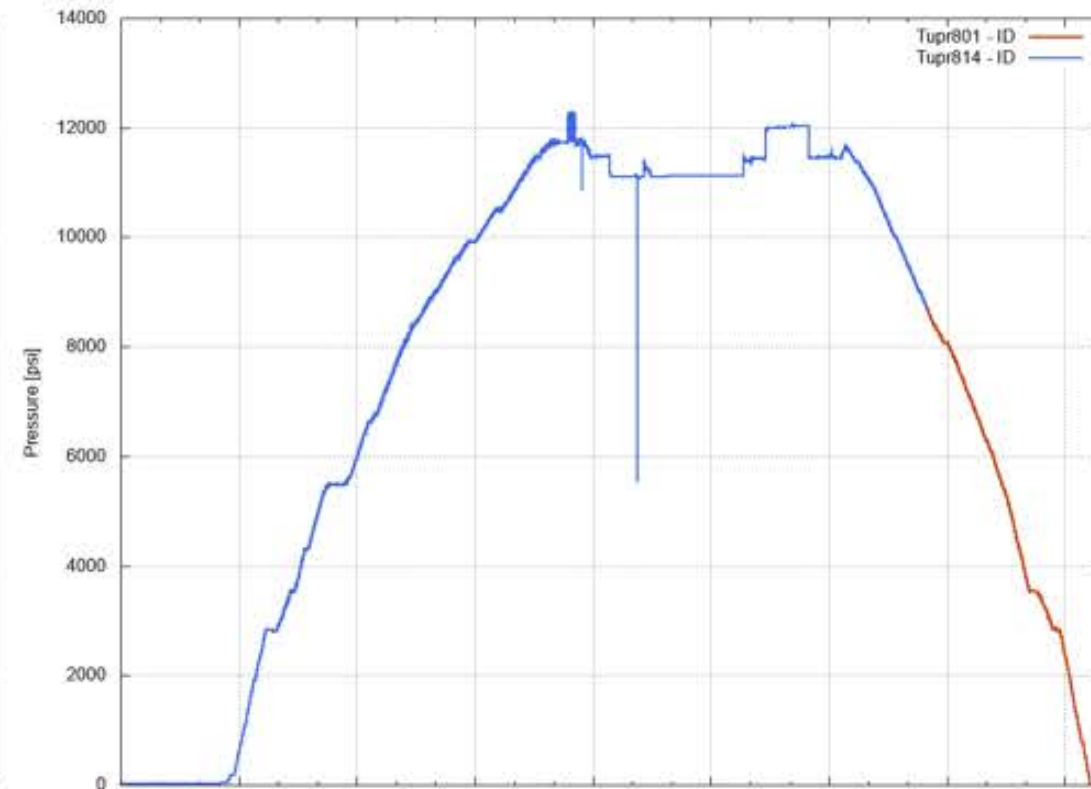
## Outputs

# Pressure Gauges

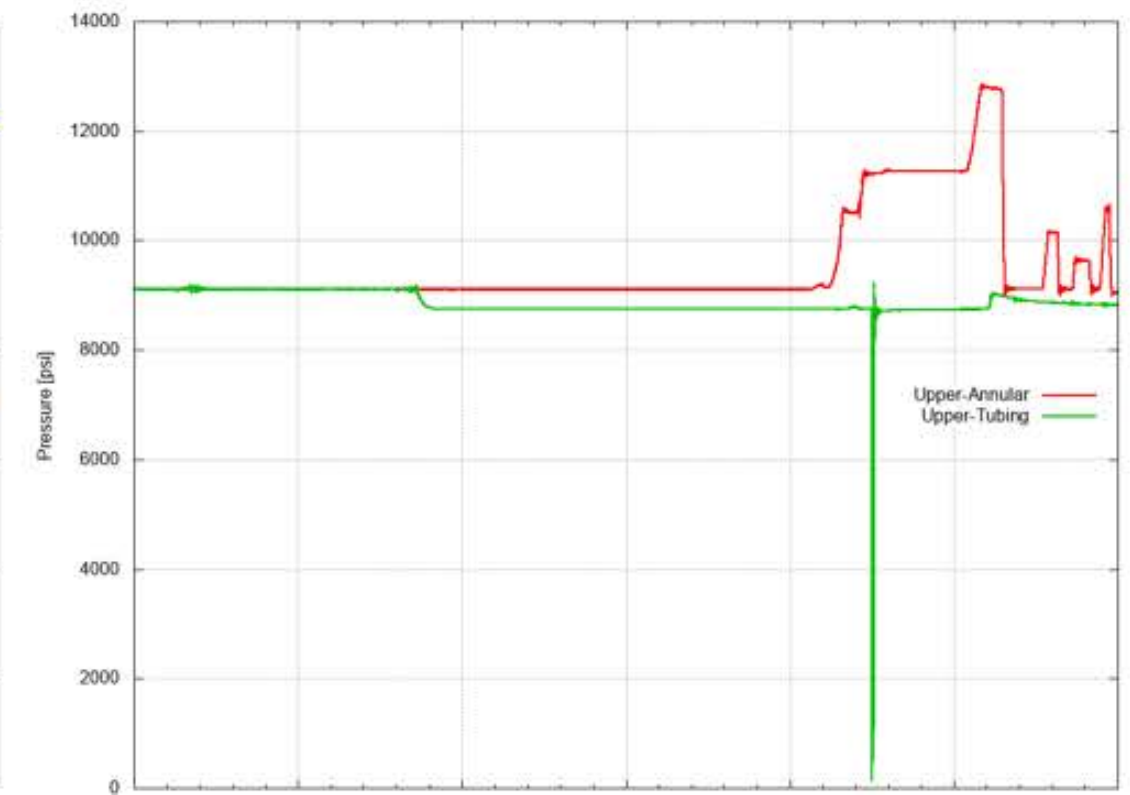
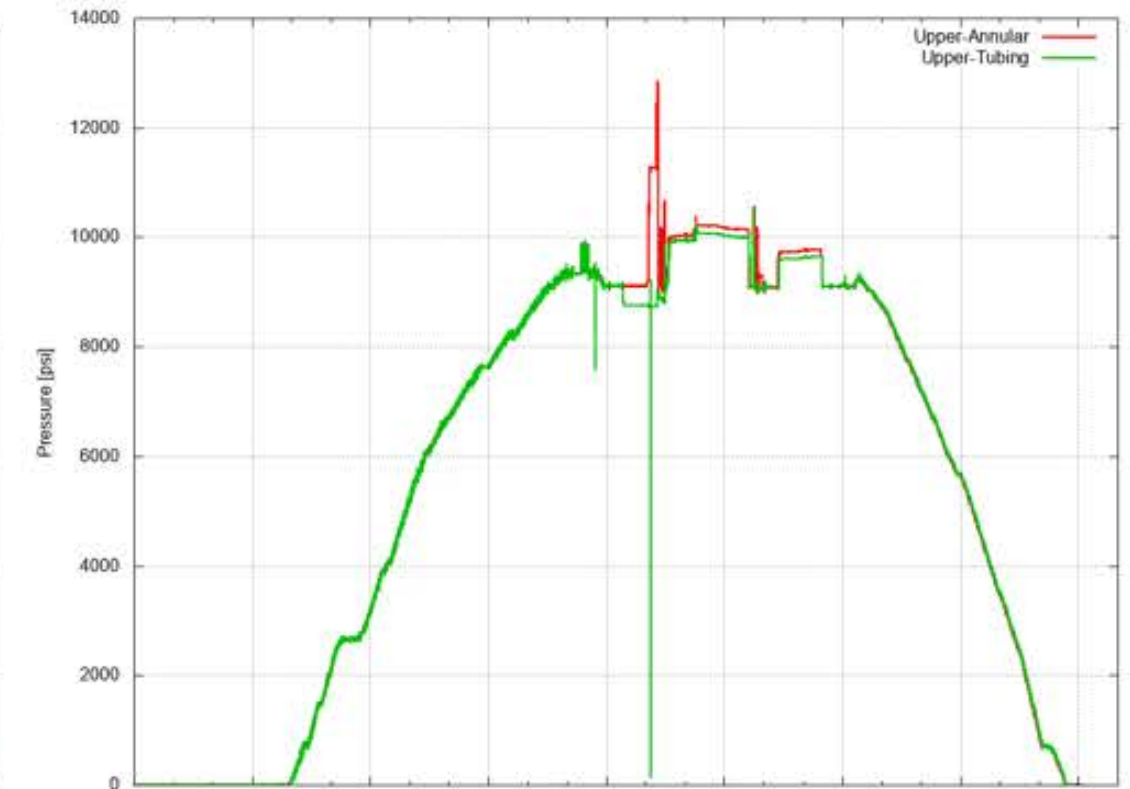
## Lower ID/OD



## Middle ID/ID



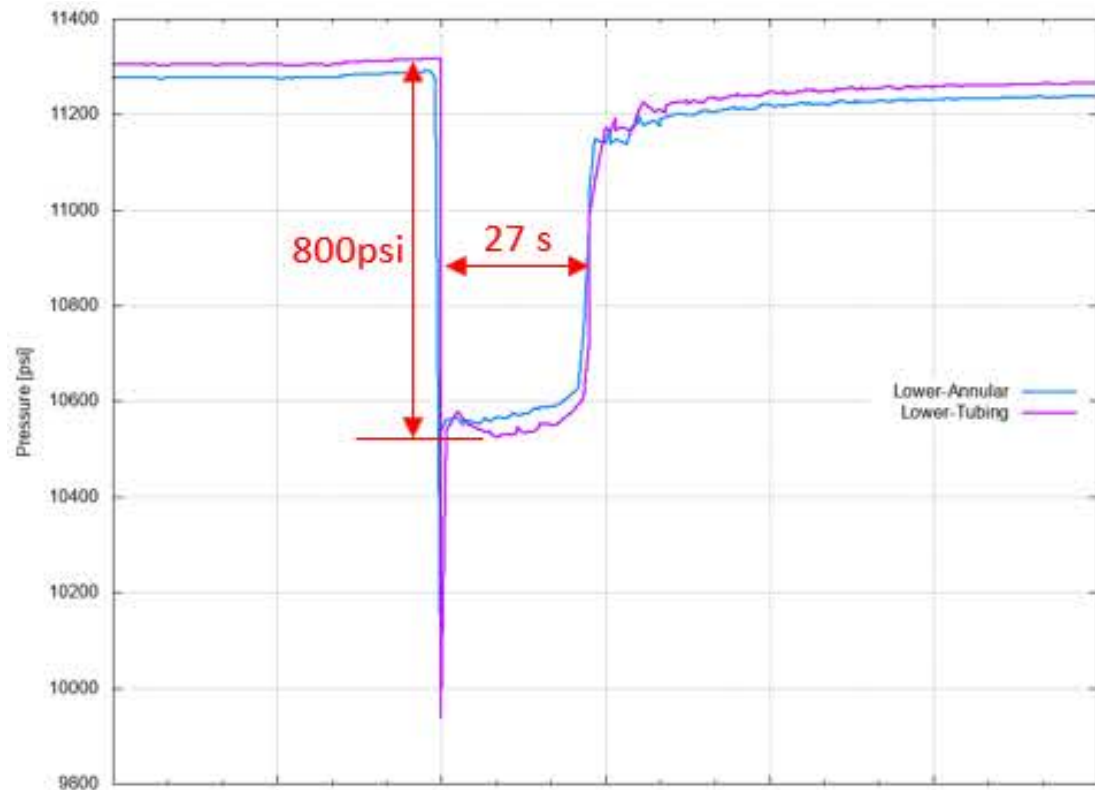
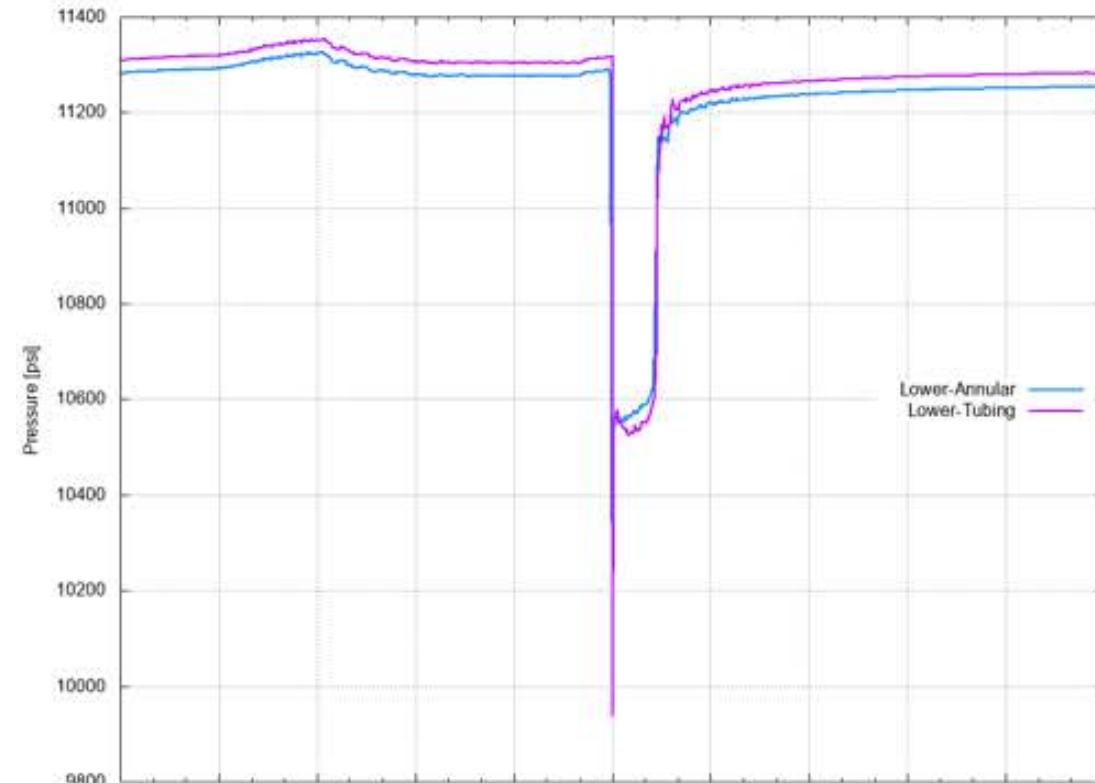
## Upper ID/OD



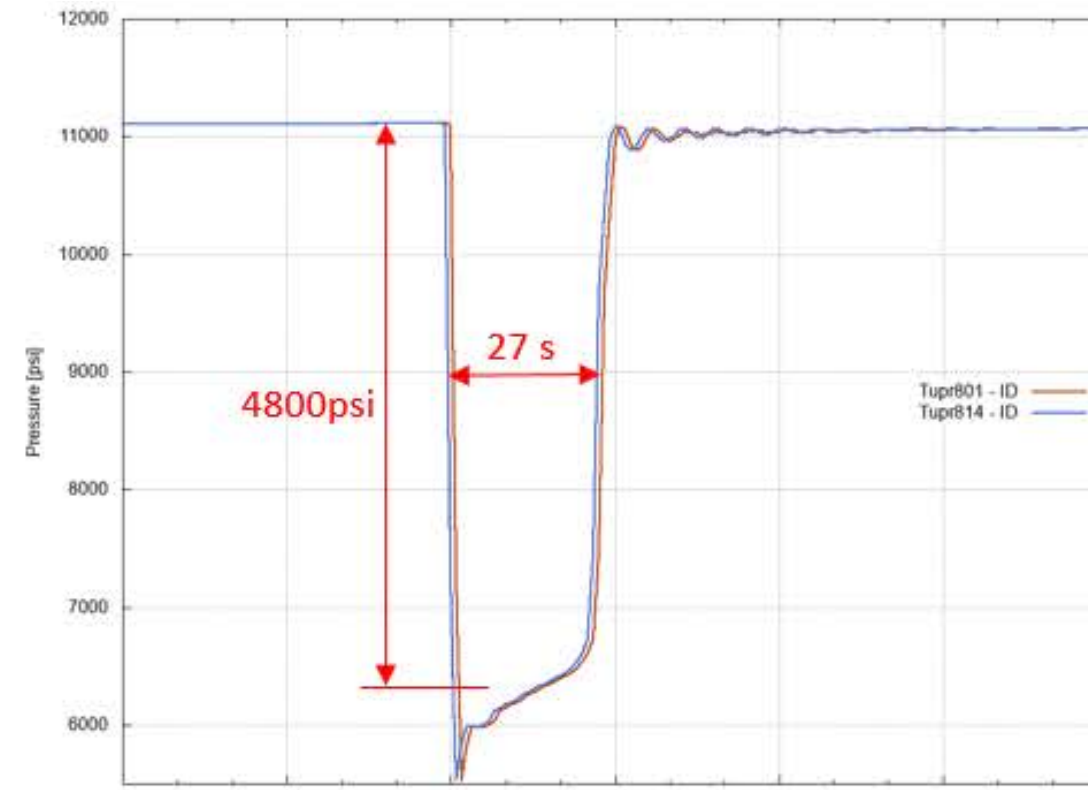
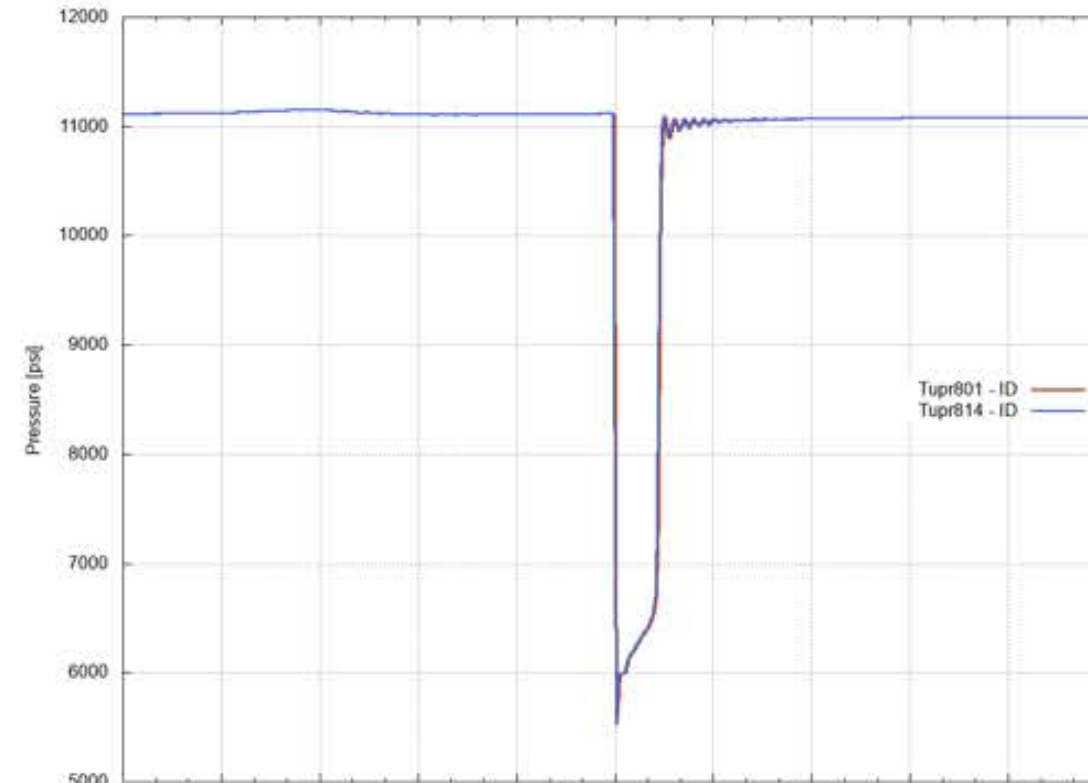


# Pressure Gauges – Cont.

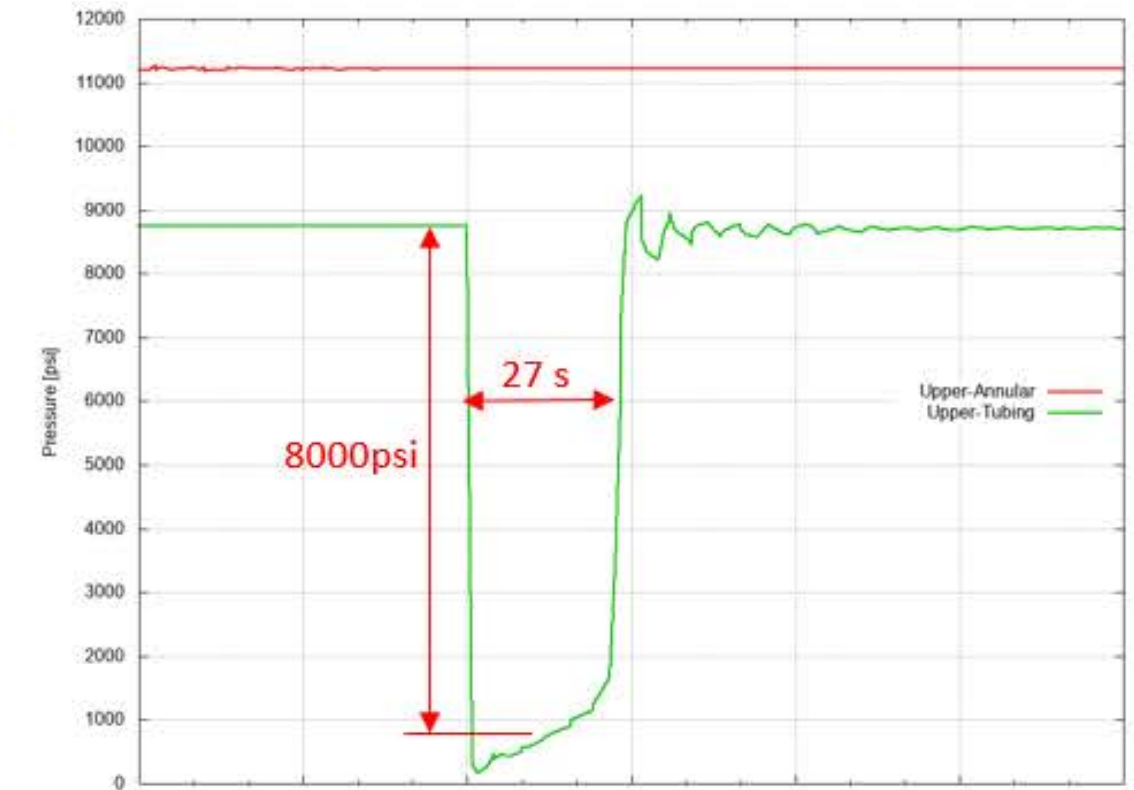
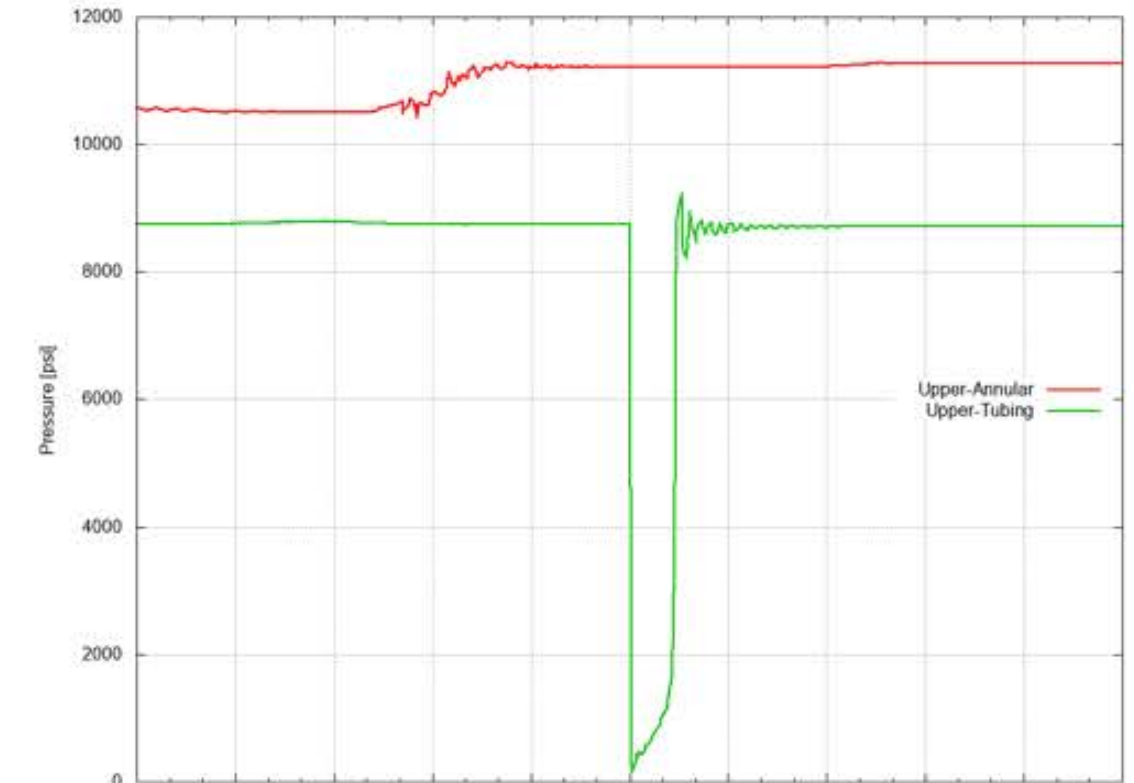
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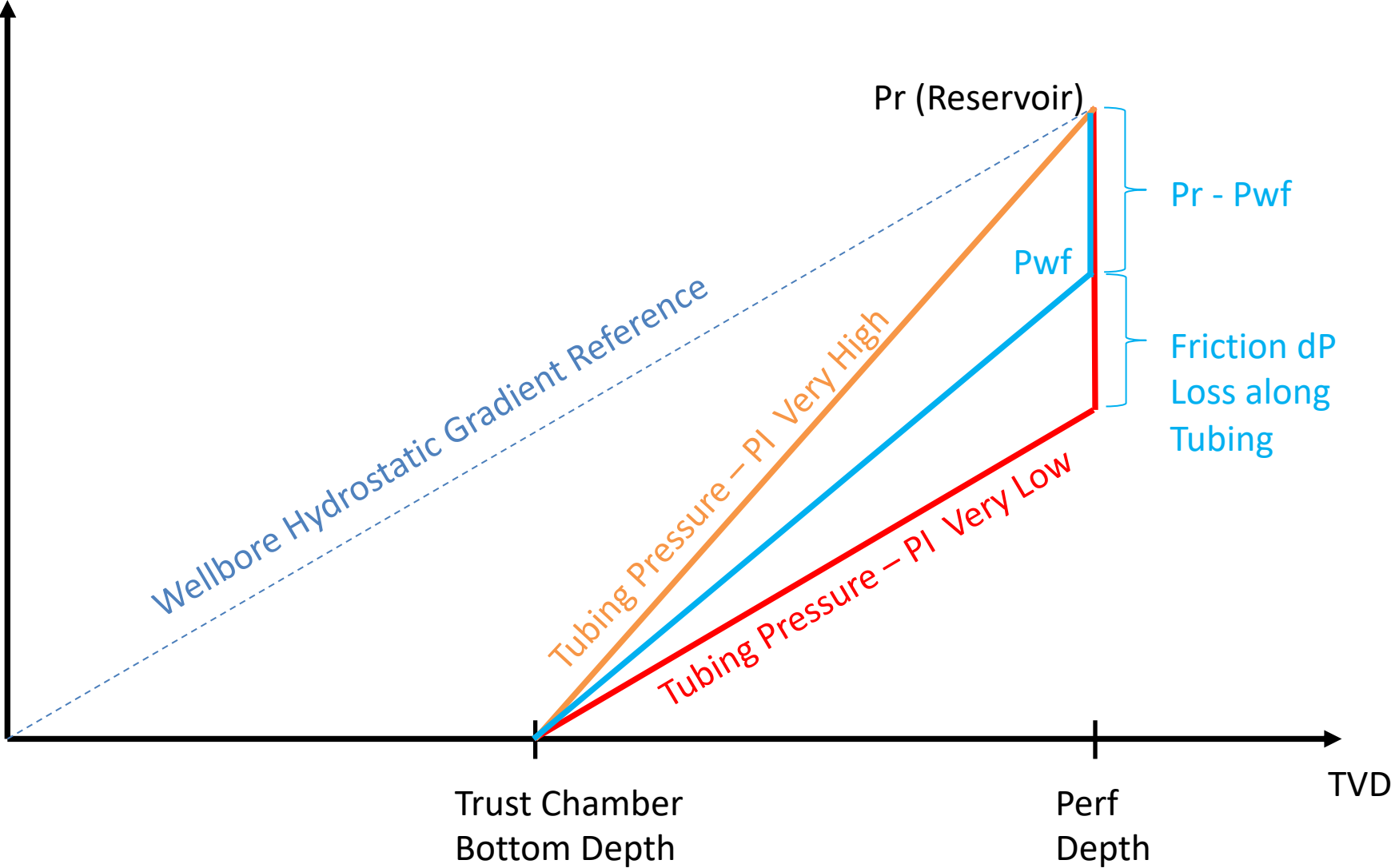
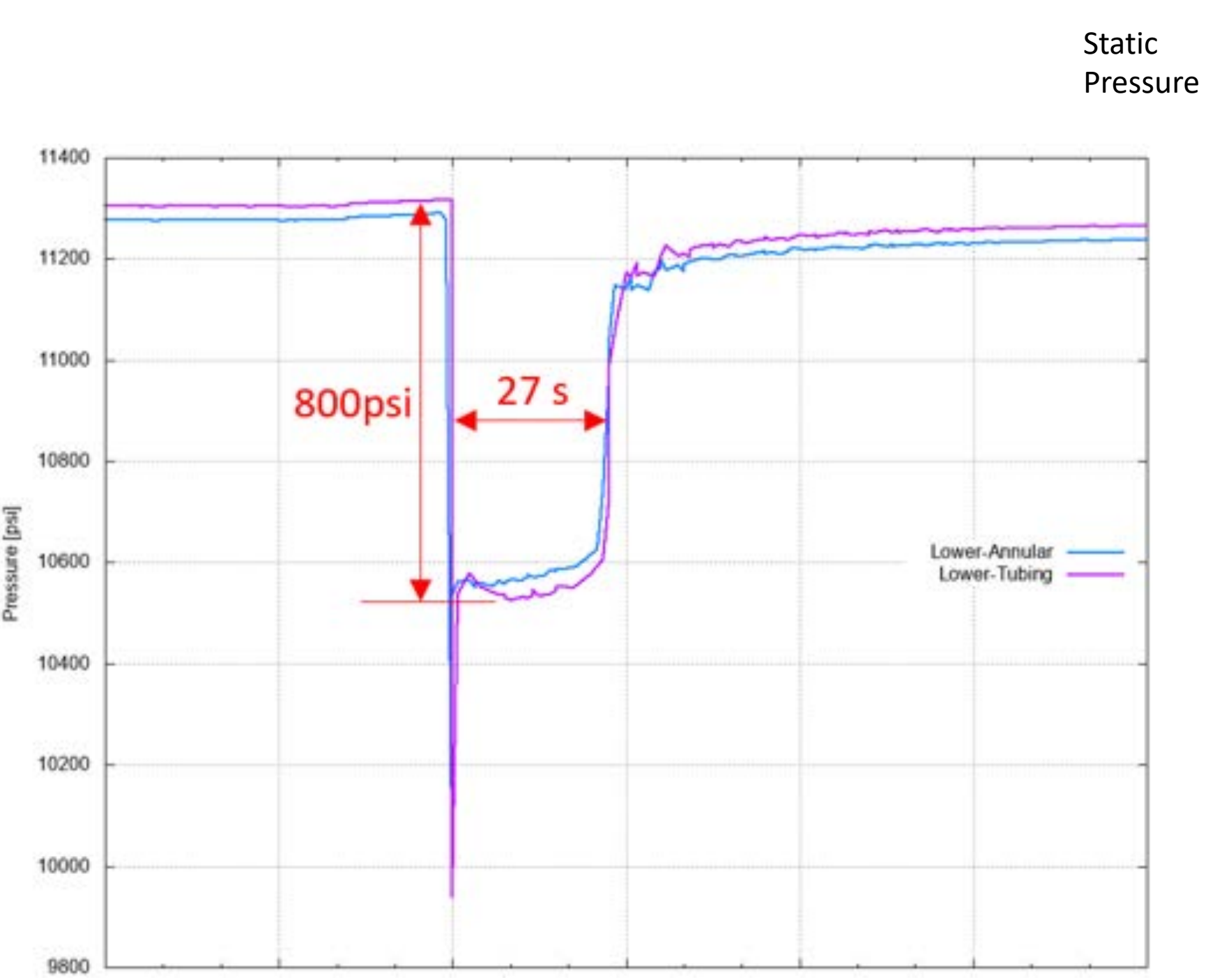
## Middle ID/ID



## Upper ID/OD

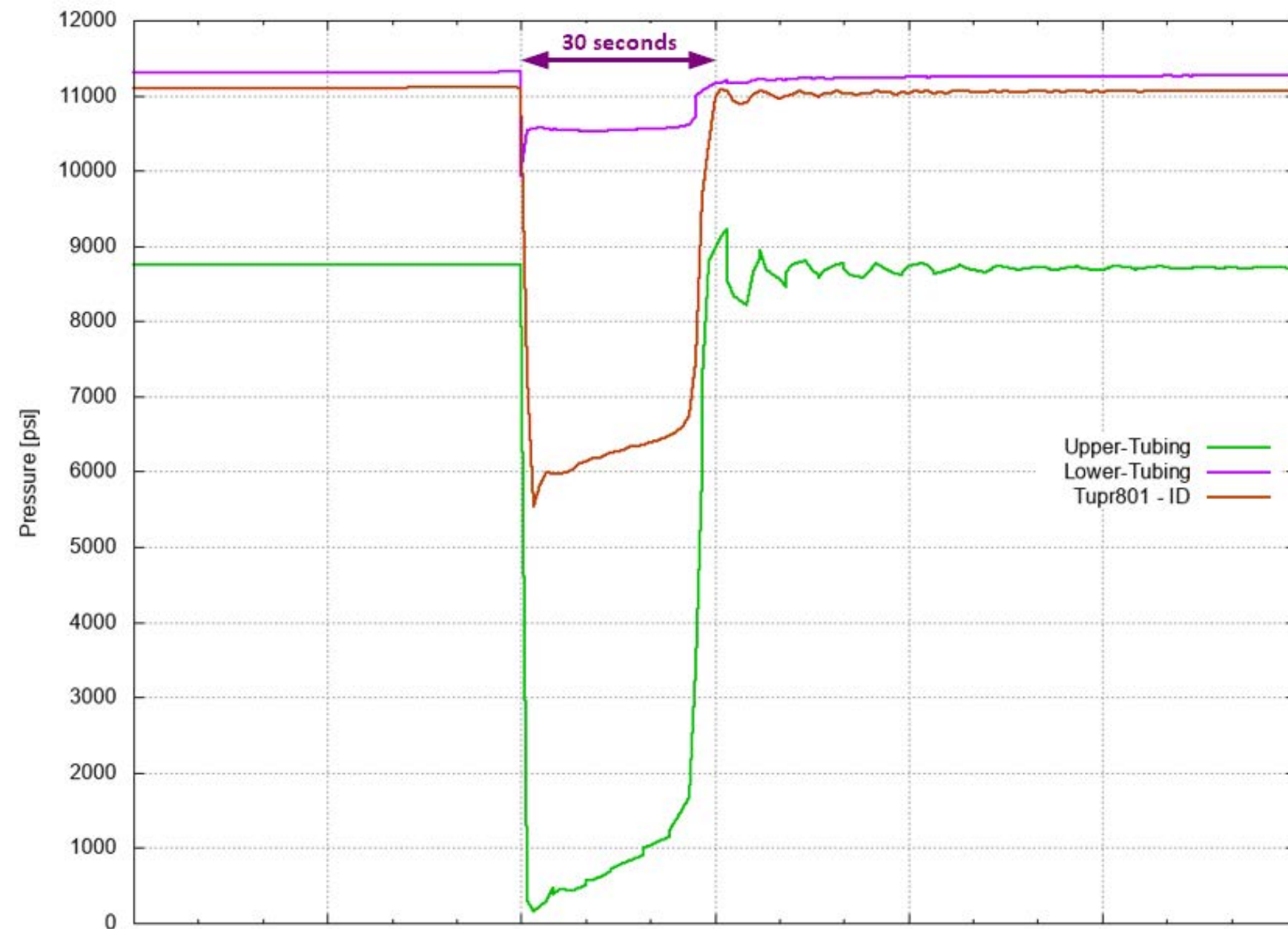


# Effect of well PI while surging





# Gauges – Tubing Transient Pressure

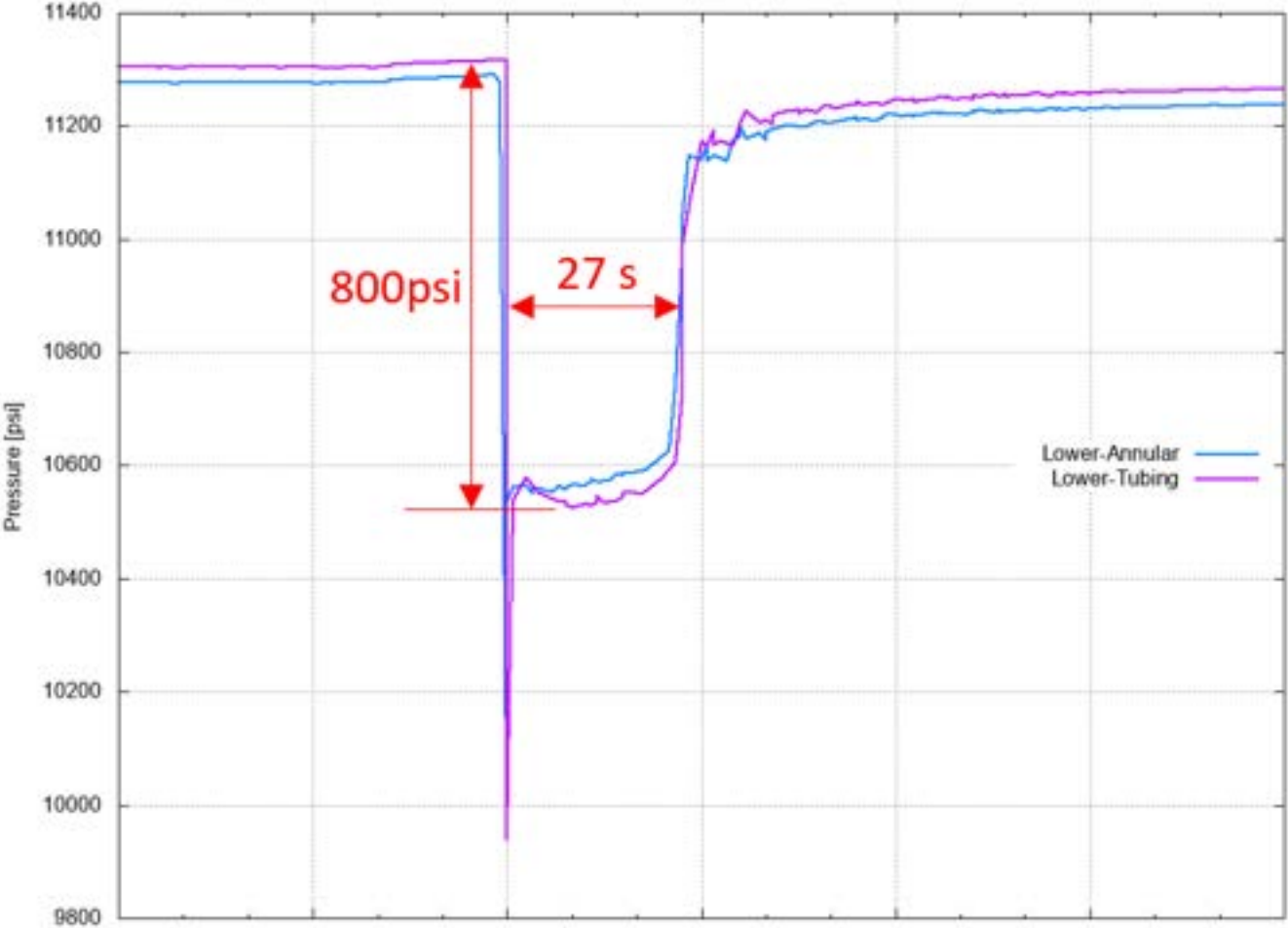
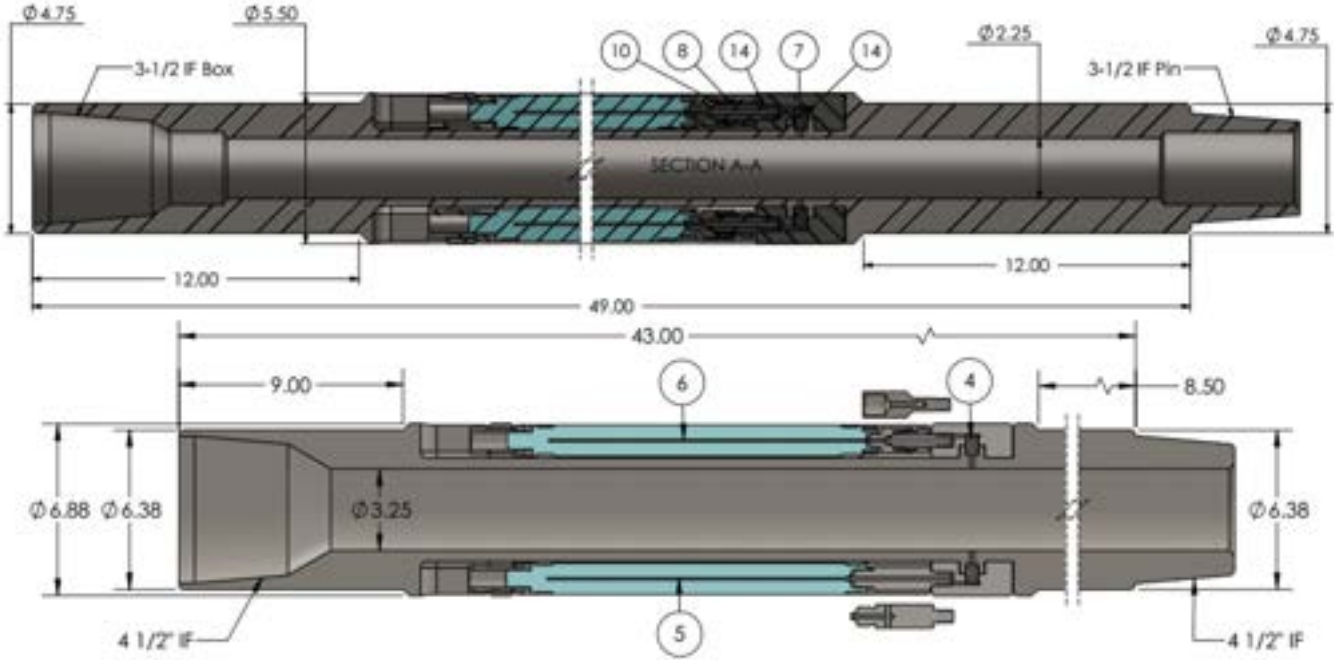


From bottom gauge to top gauge:

- Hydrostatic delta P only ~2,500 psi
- Surging total tubing delta P ~ 9,700 psi
- Turbulent/circulation delta P ~ 7,200 psi
- Large Pressure Losses along the tubing must be properly predicted to obtain the desired drawdown at the sand face.

# Sensitivity to Tubing Length and Localized Pressure Losses

Gauge Carriers - also localized flow contractions/expansions



Reservoir Pressure	11950 psi
Assumed ID Tools Constrac/Expan	2.25 in
Tubing from debris sub to surge chamber	5325 ft
Tubing ID from tools to surge chamber	4.975 in
Density	11.20 ppg
Well Deviation	Well Survey degrees
Drawdown at the sand face	800 psi
Chamber filling time	27 s
Drawdown PI	115 bbl/day/psi

Total	TVHeight	dP_Hydros	(BHP - dP_Hydros - dP_Tubing) [psi] vs. PI [bbl/day/psi]											
Tubing L			5 Localized Contract/Expansions			6 Localized Contract/Expansions			7 Localized Contract/Expansions			8 Localized Contract/Expansions		
[ft]	[ft]	[psi]	110	115	120	110	115	120	110	115	120	110	115	120
4990	4337	2526	898	858	827	876	837	806	852	816	783	833	796	765
5325	4683	2727	872	836	801	849	815	781	828	795	762	809	777	745
5490	4744	2763	862	828	792	841	804	774	820	786	757	804	768	738



# Surging Jobs – Design - Conclusions

- Single Trip Surge design is adjustable and cost-effective solution
- Transient Surge design software helps achieve a more reliable drawdown at the sand face:
  - Surge chamber bottom MD: controls transient sand face pressure
  - Surge chamber length: controls average surge volume / perfo.
- Key components / data needed for more accurate simulation.

MAY 13-15



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# QUESTIONS?

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