

The Windrock logo features a stylized wave graphic in shades of blue and green above the word "Windrock" in a white, sans-serif font, all contained within an orange rectangular box.

Windrock

Users' Group Conference 2018

1st Derivative and PV Card

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The Apergy logo consists of a red triangle pointing upwards, followed by the word "Apergy" in a bold, blue, sans-serif font.**Apergy** | **Unlocking Energy**



Outline

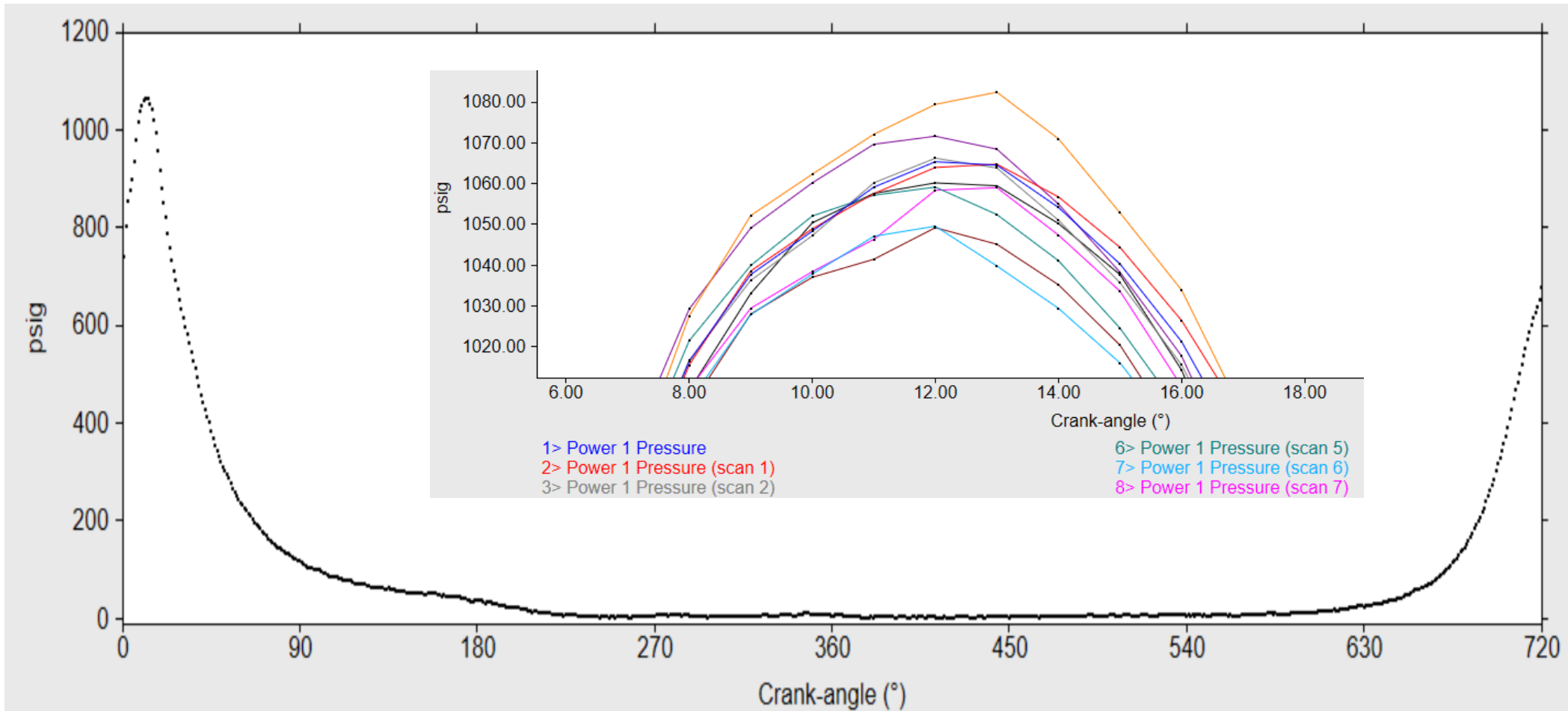
- Basic “Engine Report” Information
- Engine Pressure vs. Time Traces (PT)
- First and Second Derivatives
- Engine PV Cards

Reports

Data From Pressure

Cyl	# of Cycles	Rack Position	MEP (psi)	IHP (hp)	Comb. Start BTDC	Max Rise Rate (psi/deg)	Peak Firing Pressure (psi)					PFP Angle ATDC	Prior Ex 150 ATDC (psi)	Comp Ref 705 ATDC (psi)	TDC 720 ATDC (psi)	Exhaust Temp (°F)
							AVG	STDDEV	MAX	MIN	DELTA					
1	32	44	148	102	3	64	1075	5	1078	1071	19	11.0	54 H	449	739	187 H
2	32	43	139	96	5	65	1034	5	1038	1031	-22 L	10.0	52	436	754	176 L
3	32	44	135	93	5	65	1047	15	1058	1037	-9	8.5	49	447	830 H	182
4	32	45	138	95	4	58	1079	25	1097	1061	23 H	9.5	48	424 L	790	183
5	32	44	131	91	4	62	1040	16	1052	1029	-16	10.0	39 L	427	739 L	185
6	32	44	137	95	5	69	1060	15	1071	1049	4	9.5	50	455 H	818	180
Aux. Power:			0													
Eng. Summary:			138	571	4	64	1056	14			15	9.8	49	440	778	182
Eng. Spread:			12%	12%	2°	17%	4%	150%				2.5°	30%	7%	12%	10

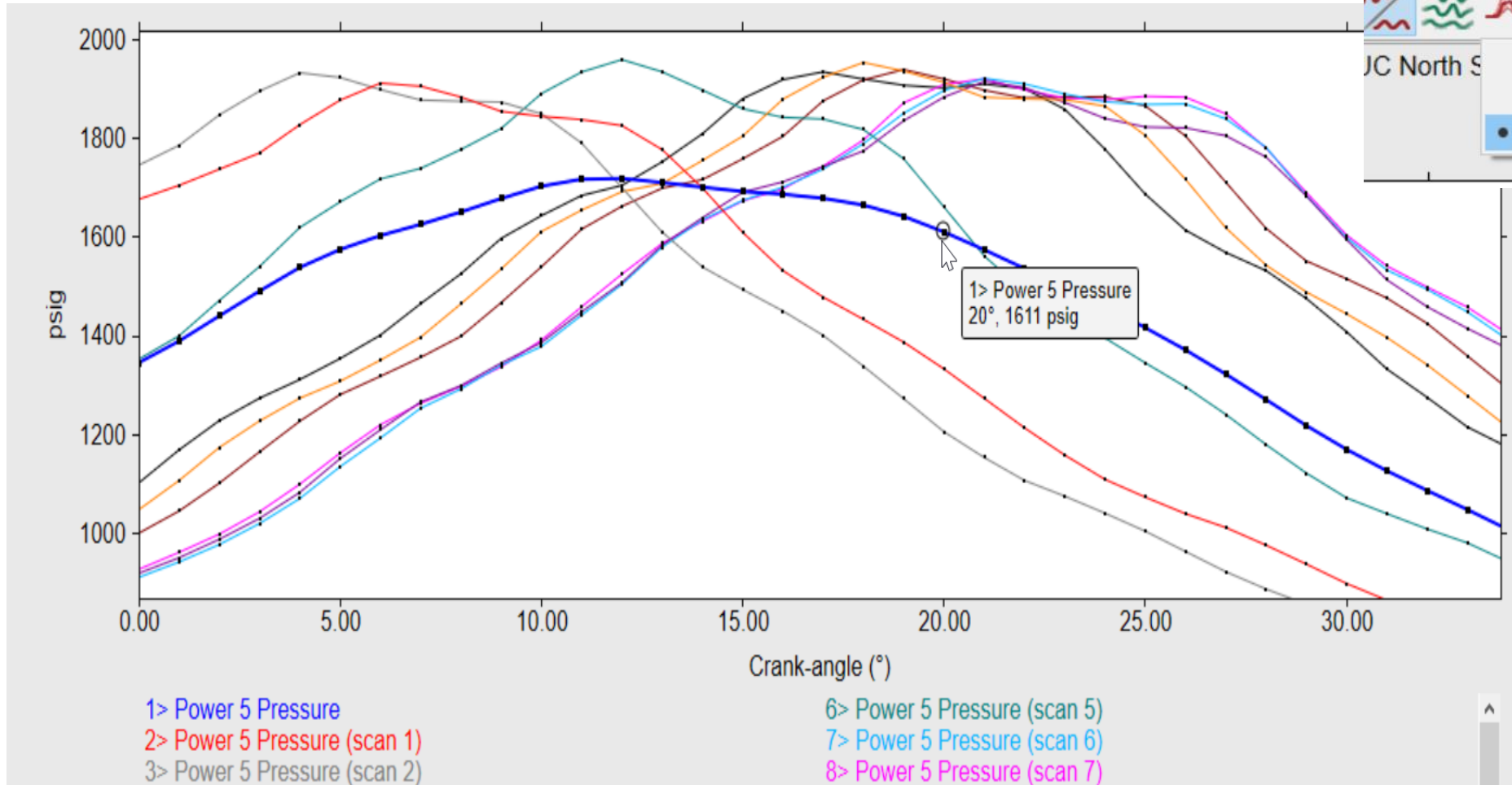
Pressure vs. Time Traces (PT) Averaged - Default



Pressure vs. Time Traces (PT)

Individual Singles Scans

Averaged - Default



Software interface controls including icons for file operations, LOG, LOAD, WEAR, $\frac{dy}{dx}$, and a legend menu. The legend menu is open, showing options: Representative Only, Overlay Single Scans, and Individual Singles Scans (selected).

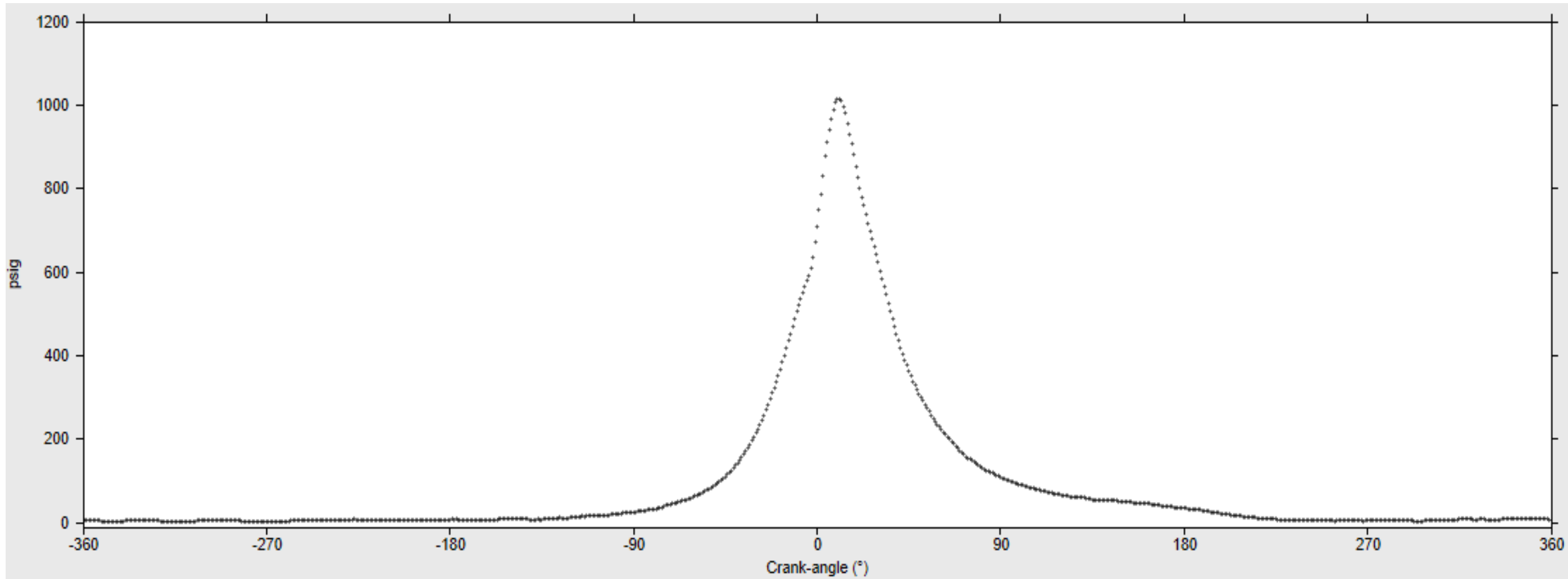
Reports

Modified Data From Pressure

Cyl	# of Cycles	Rack Position	MEP (psi)	IHP (hp)	Comb. Start BTDC	Max Rise Rate (psi/deg)	Peak Firing Pressure (psi)					PFP Angle ATDC	Comp Ref 20 BTDC (psi)	Exp Ref 75 ATDC (psi)	Exp Term 150 ATDC (psi)	Exhaust Temp (°F)	
							AVG	STDDEV	MAX	MIN	DELTA						
L1	9	???	99	344	3	23	576	45	661	495	69	24.4	241 H	131	8	764	
L2	9	???	110	378	1	23	458	50	519	363	-49	28.4	211	153	7	769	
L3	9	???	137	460	3	44	733	51	821	648	226 H	22.0	221	163 H	6	705	
L4	9	???	117	394	1	17	553	142	720	343	46	22.2	203 L	150	3 L	763	
L5	1	???	120	404	1	38	677	- Single Sample No Stats -					24.0	220	147	8	809
L6	9	???	77	262	1	9	432	110	625	331	-75	17.5	227	134	6	721	
R1	9	???	54	178	4	8	361	31	430	332	-146	13.0	220	88	4	857 H	
R2	9	???	108	383	1	10	477	71	613	389	-30	25.8	219	151	4	750	
R3	9	???	106	333	1	8	398	83	551	326	-109	20.6	207	156	5	813	

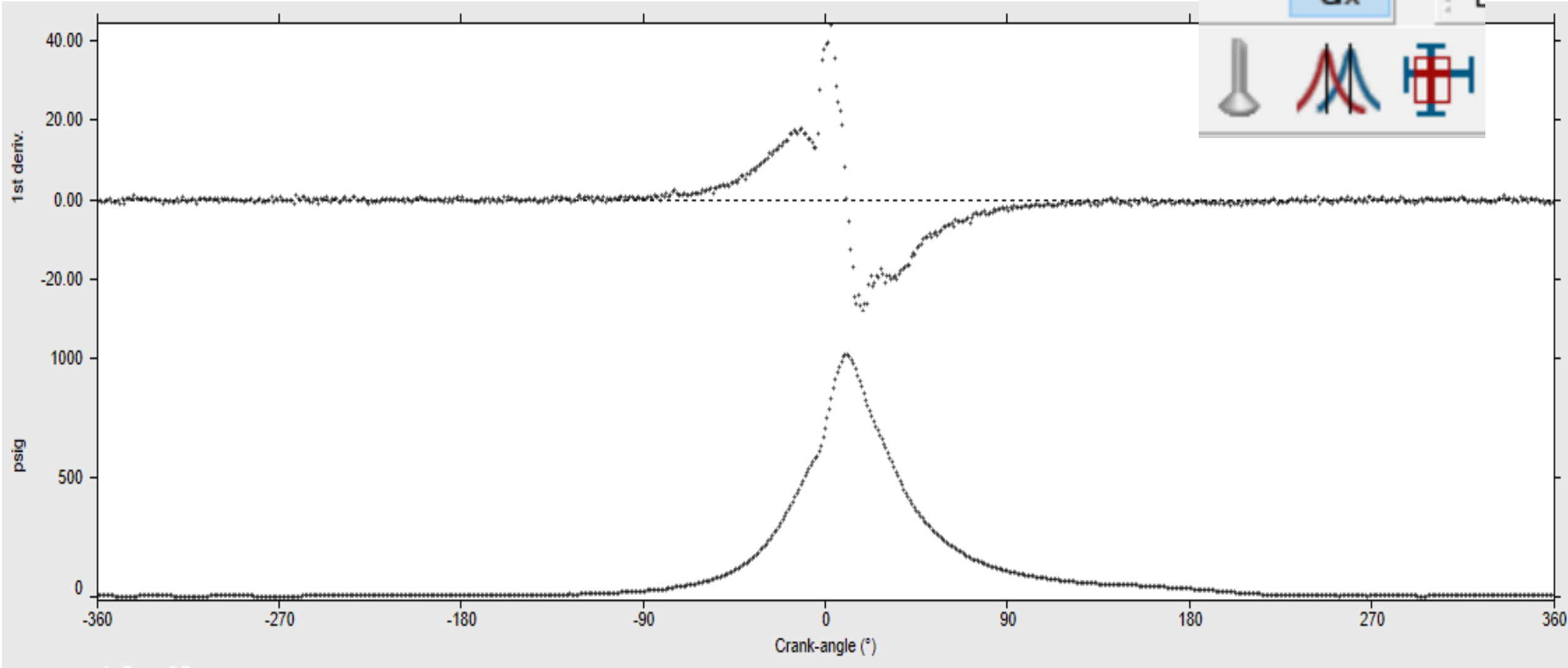

Normal Pressure vs. Time Trace (PT)

Averaged - Default

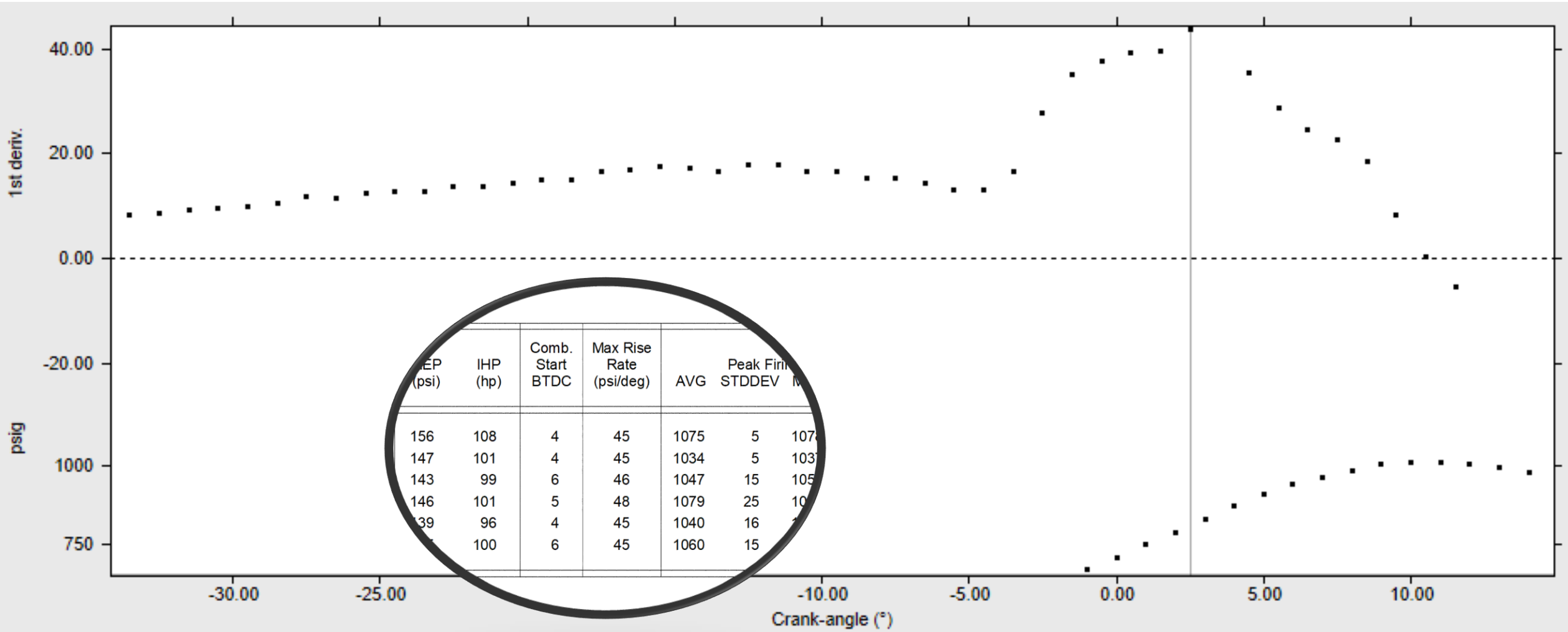


Normal PT and 1st Derivative

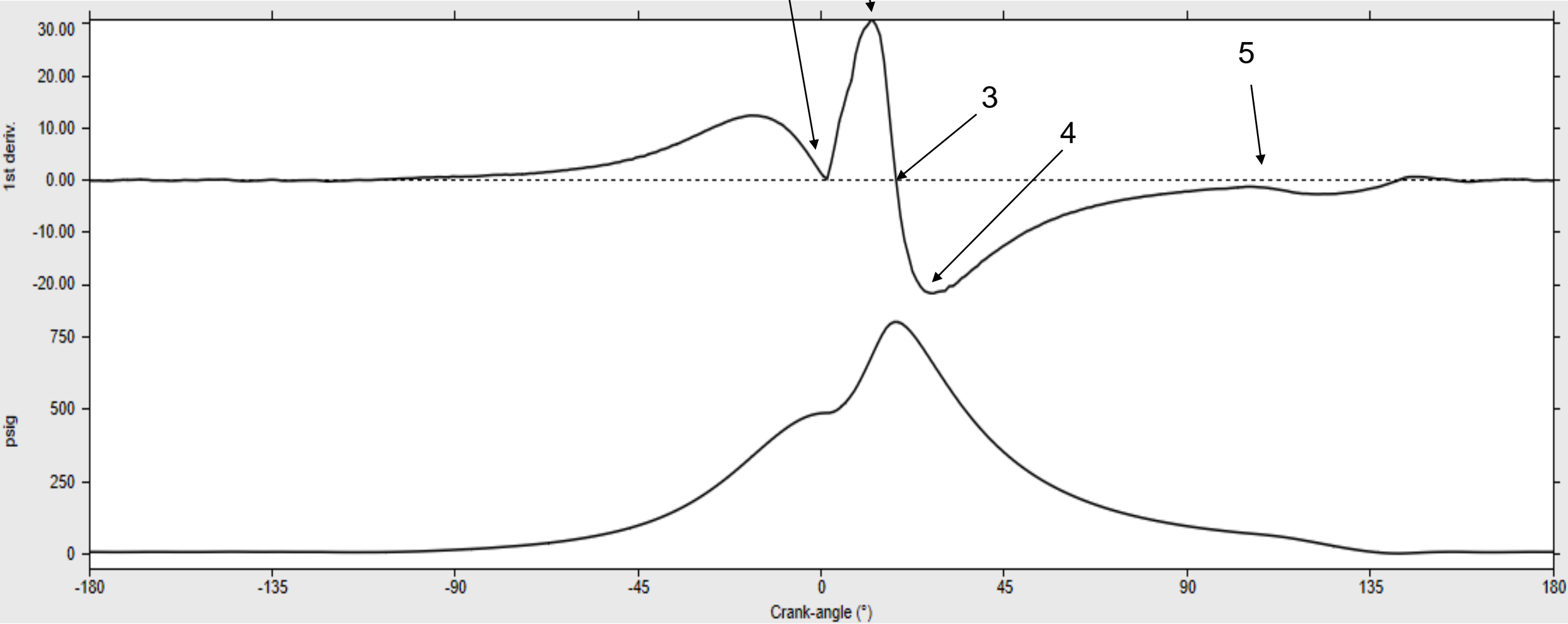
WEAR $\frac{dy}{dx}$



Normal PT and 1st Derivative



Normal PT and 1st Derivative



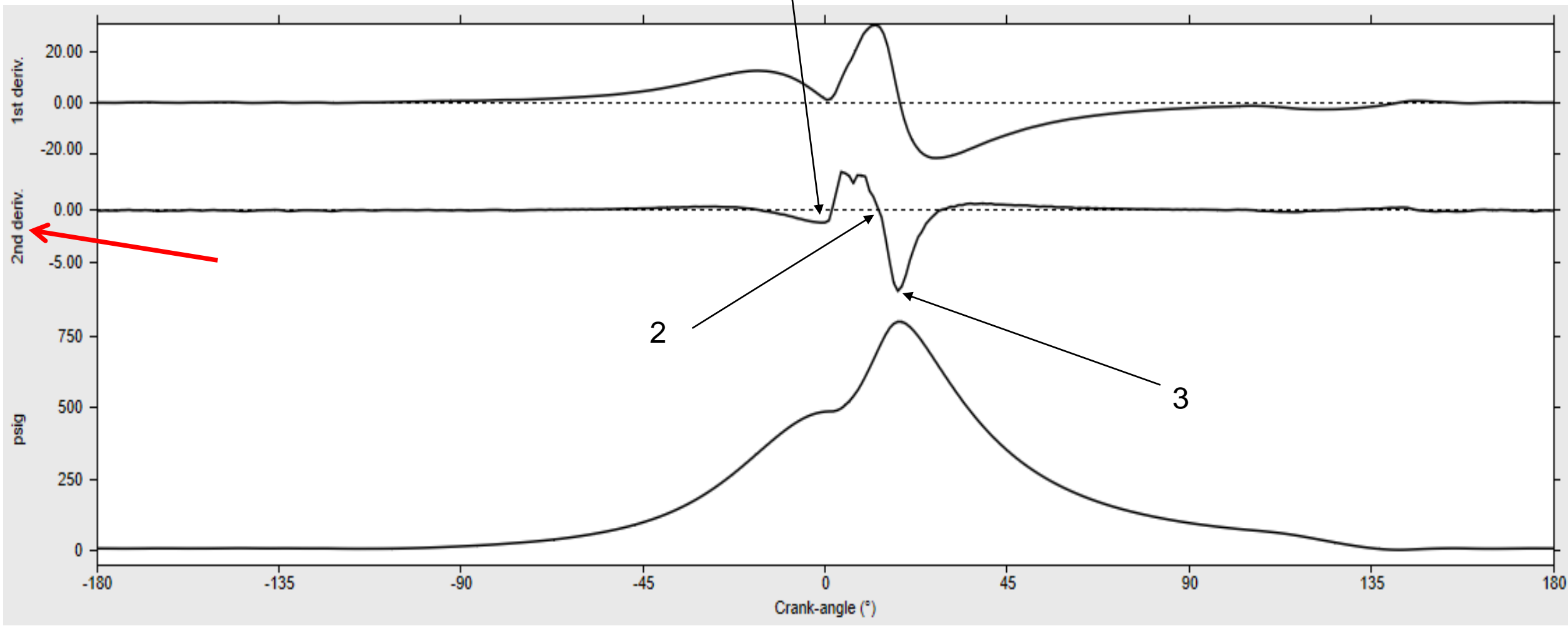
MPRR from 1st Derivative

Diesel	Natural Gas
Max Rise Rate (psi/deg)	Max Rise Rate (psi/deg)
50	11
51	18
45	14
47	17
47	14
45	20
44	26
43	11
47	16
17%	93%

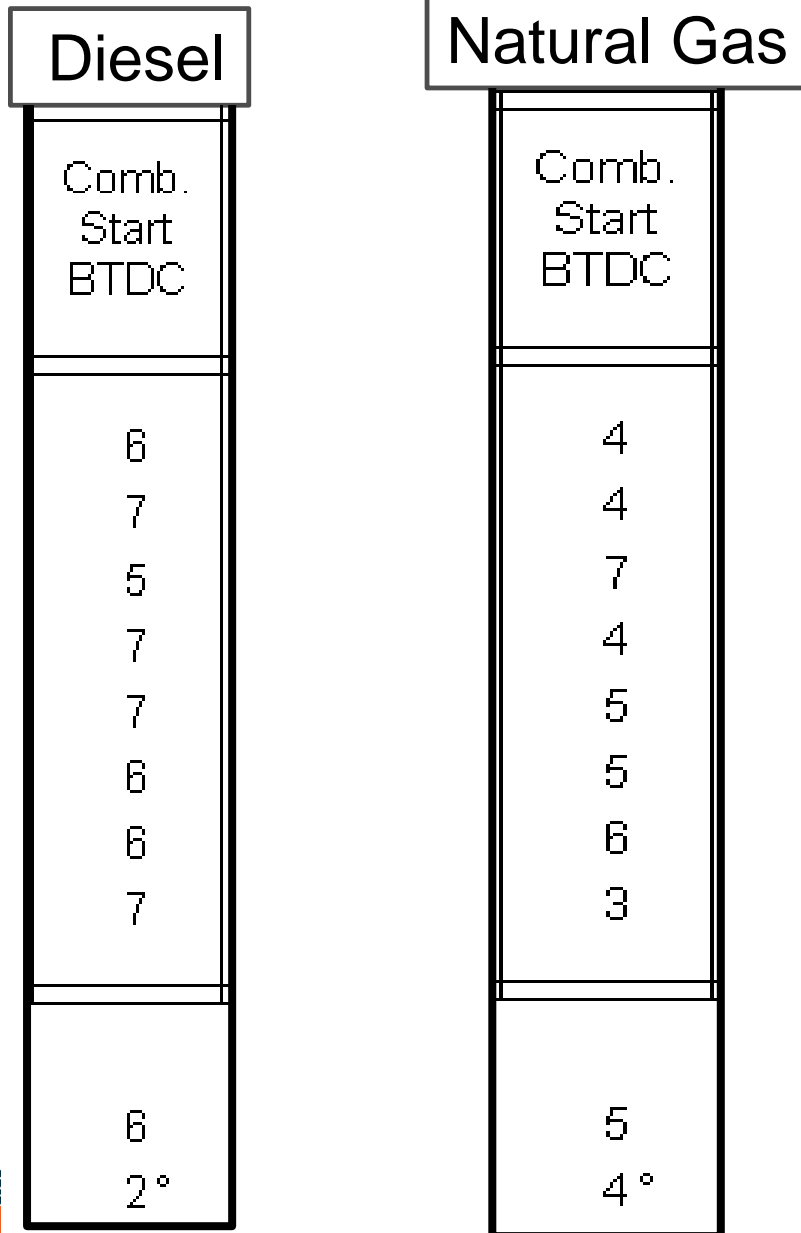
Main Factors That Affect MPRR-

1. Combustion Start
2. Air/Fuel Ratio

Normal PT 2nd Derivative



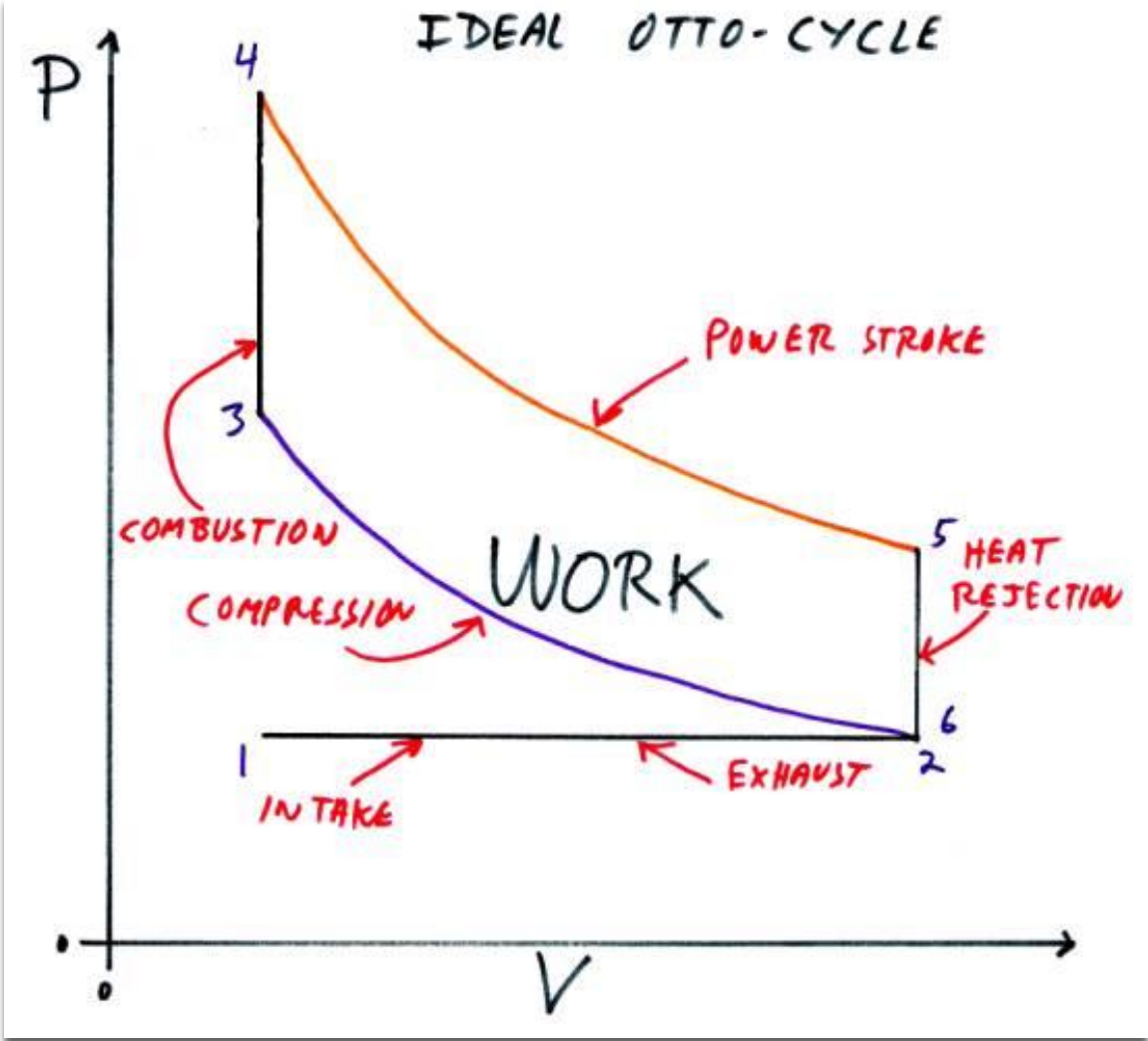
SOC from 2nd Derivative



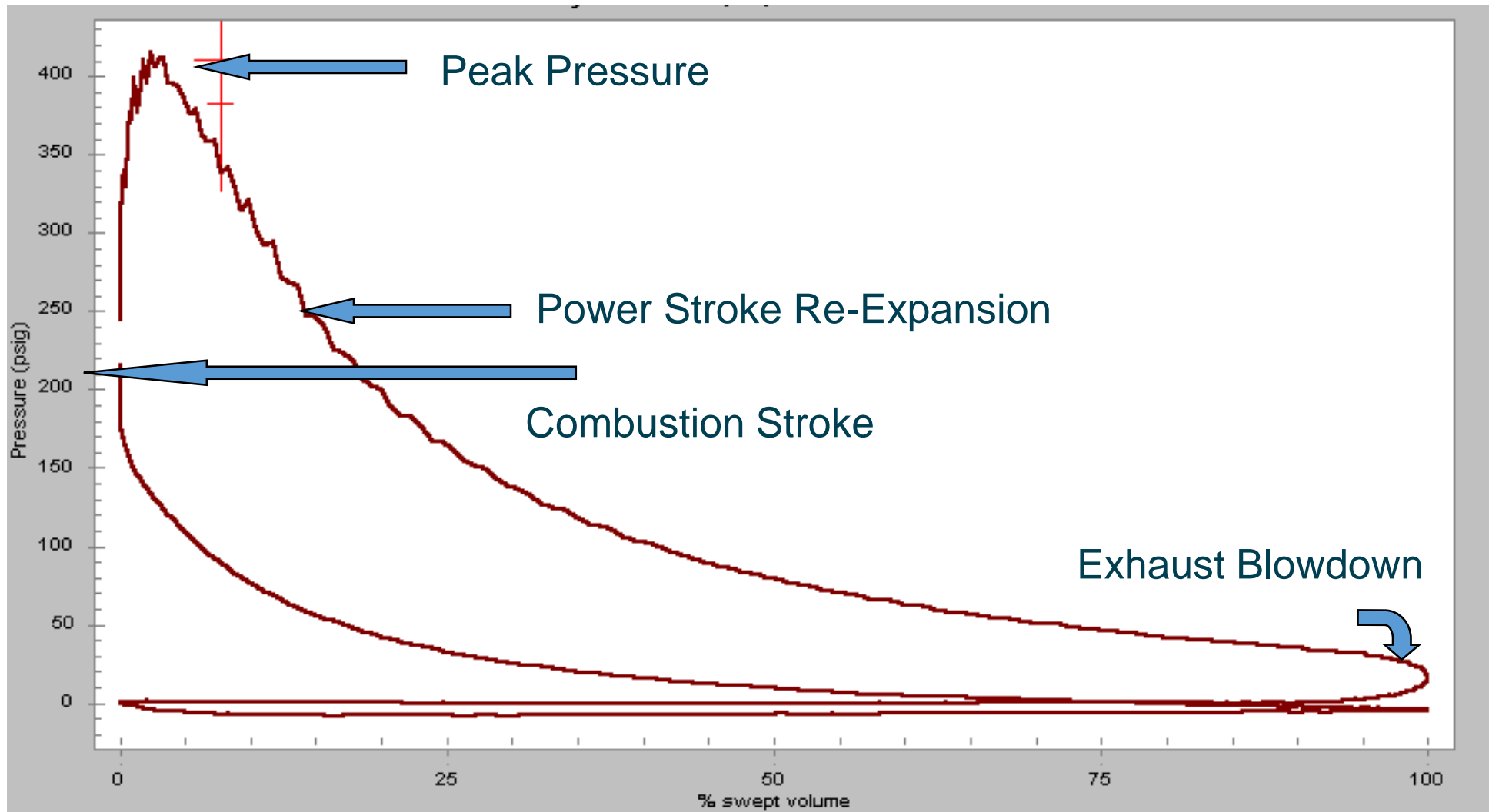
Main Factors That Affect SOC-

1. Timing
2. Fuel Atomization

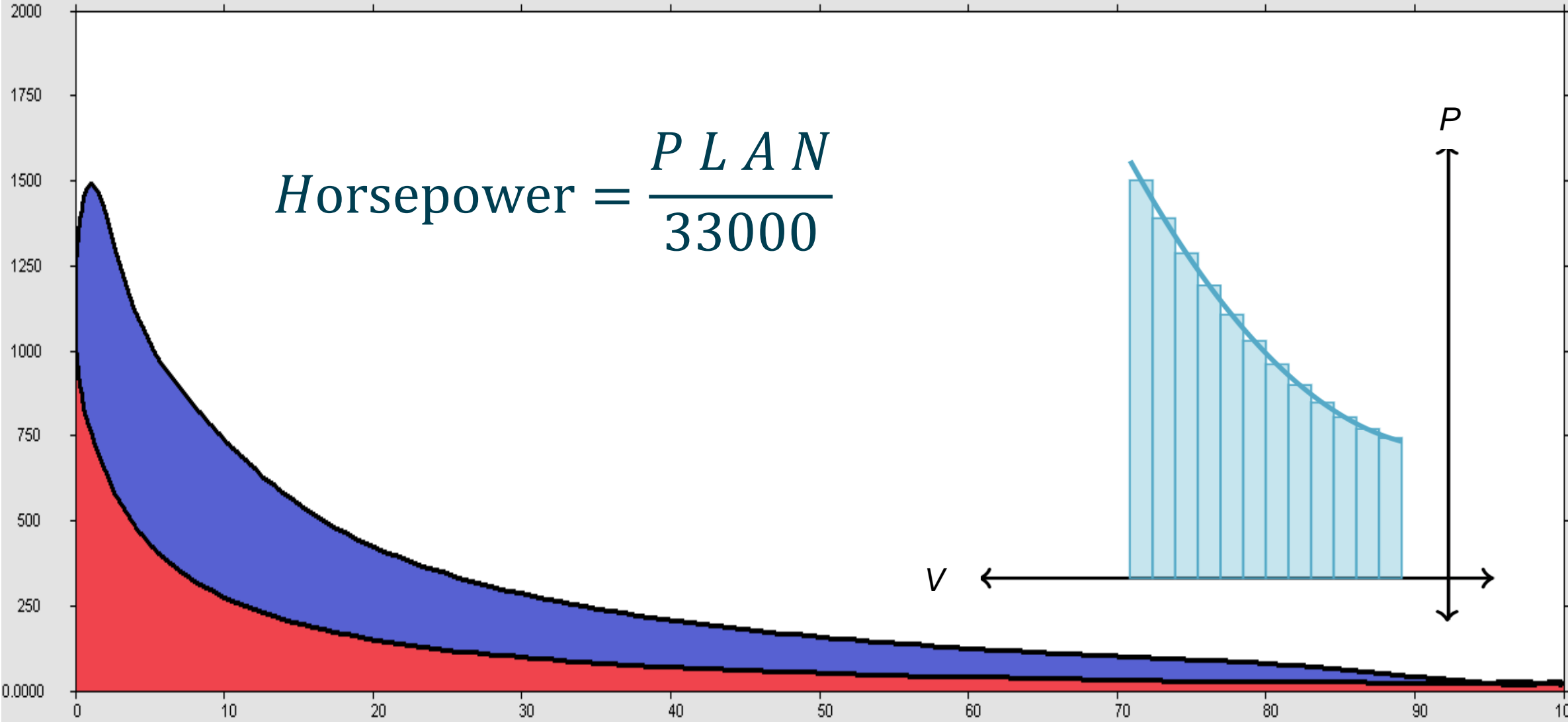
Engine Pressure vs. Volume



4-Stroke – Pressure – Volume Card



2-Stroke - Positive HP vs. Negative HP



Horsepower = Work/Time

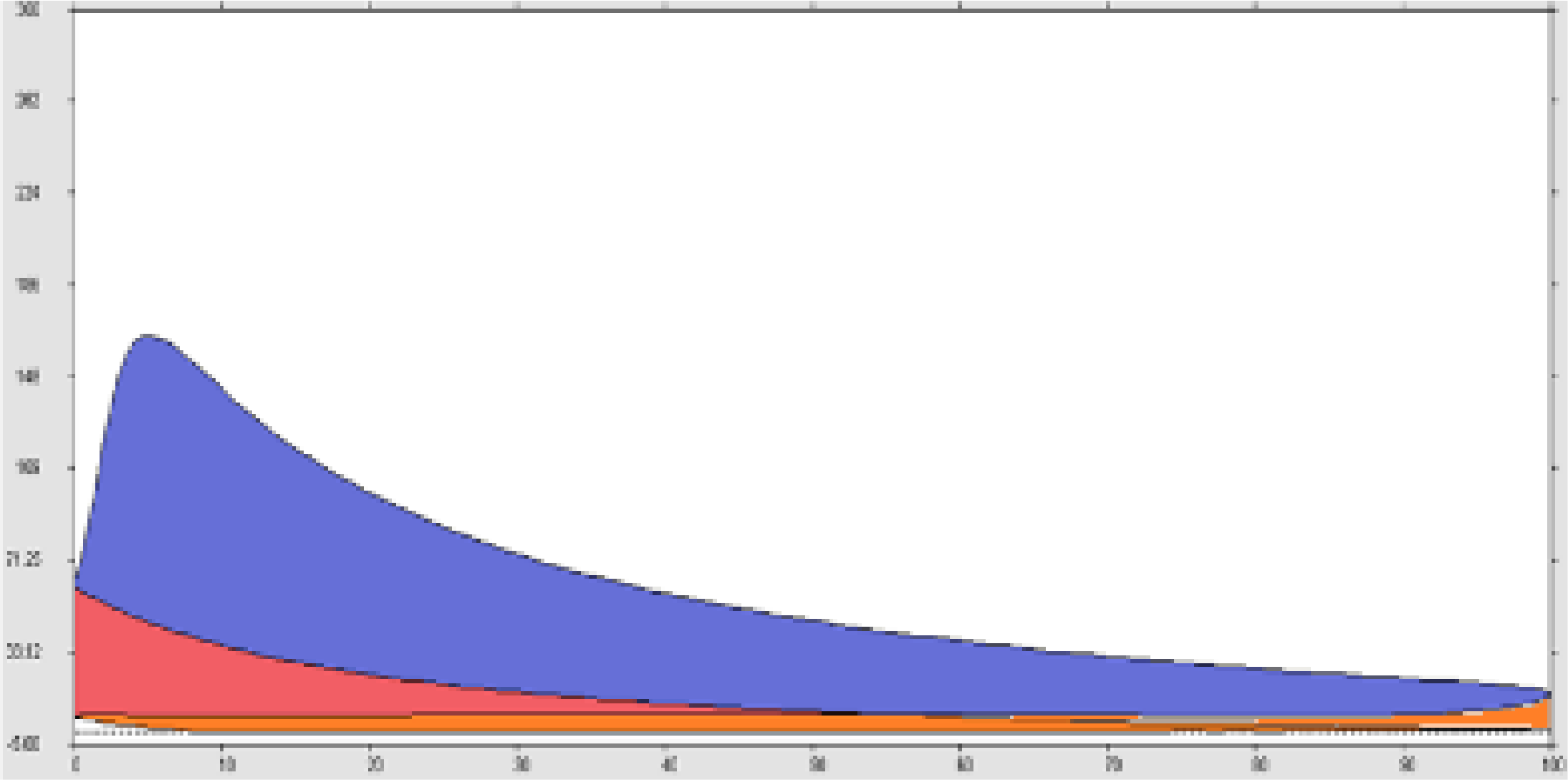
$$Power = \frac{Positive\ Work - Negative\ Work}{Time\ (RPM)}$$

Work = Force x Distance (Stroke) from one degree to the next degree

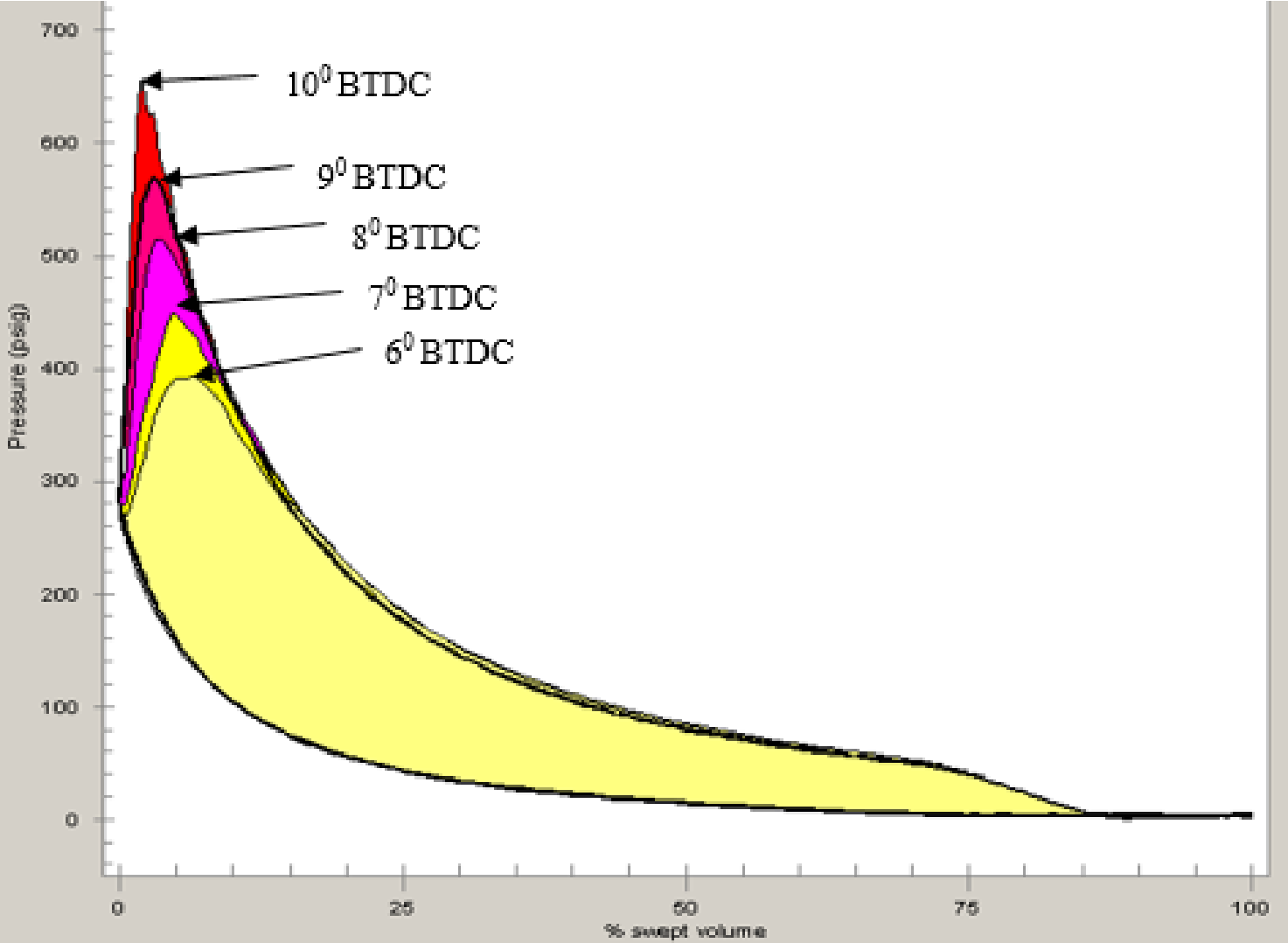
$$HP = Power/33000$$

Pressure = Sampled at every Crankangle

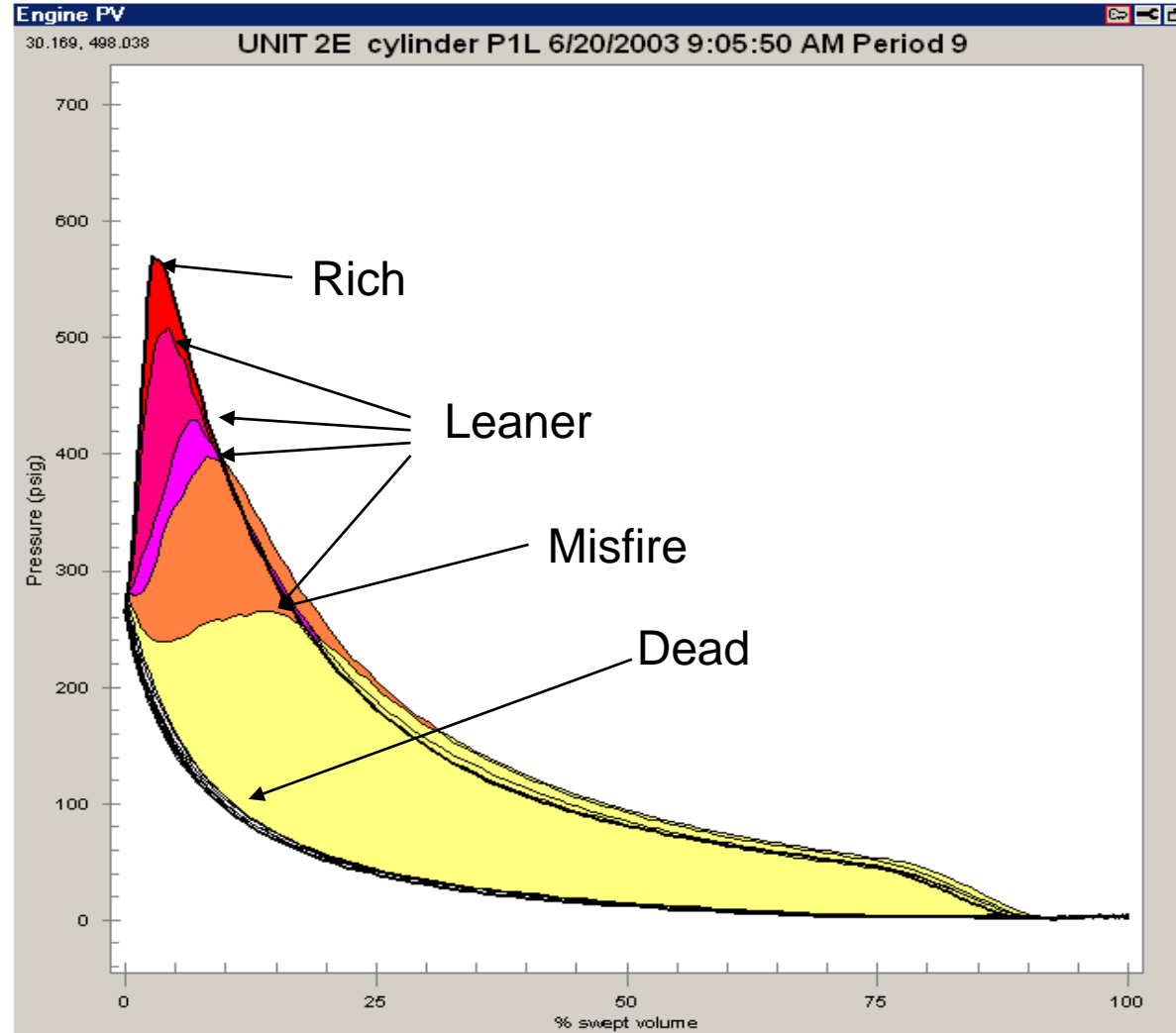
4-Stroke - Positive HP vs. Negative HP



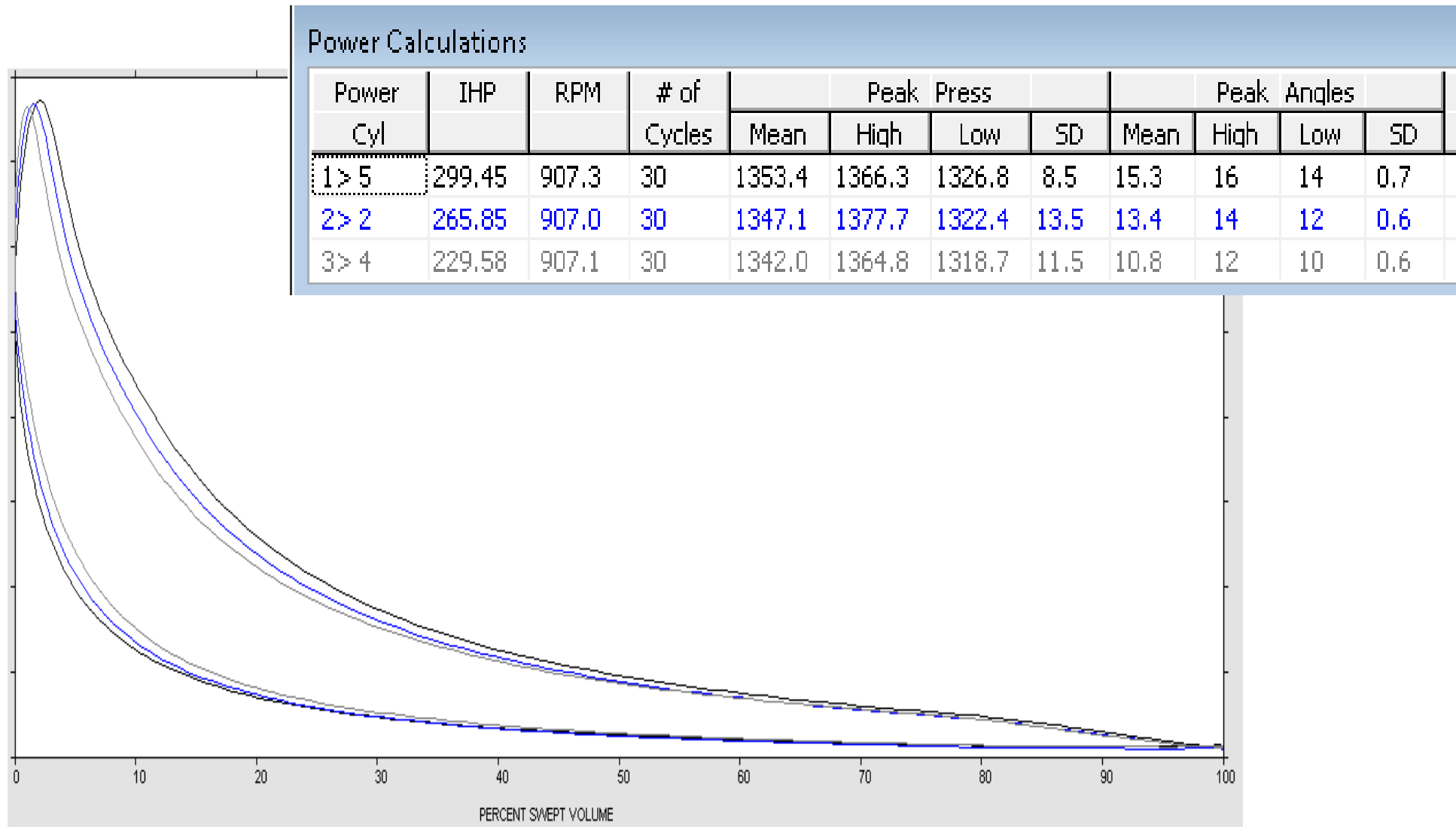
Ignition Timing Affects on PV



Air/Fuel Ratio Affects on PV



TDC Affects on PV



Compare HP to Load

Compressor HP

Total Indicated Power, (IHP)	3171.9 @ 330.3 average RPM
Total BHP, (ghp)	3338.8 @ 330.3 average RPM
Auxiliary Power, (bhp)	100.0 @ 330.3 average RPM
Compressor Total Power, (BHP)	3438.8 @ 330.3 average RPM

Engine HP

Total IHP = 4129.6 @ 329.5 average RPM
Total BHP = 3510.18 @ 85.0 efficiency



Thanks For Listening

