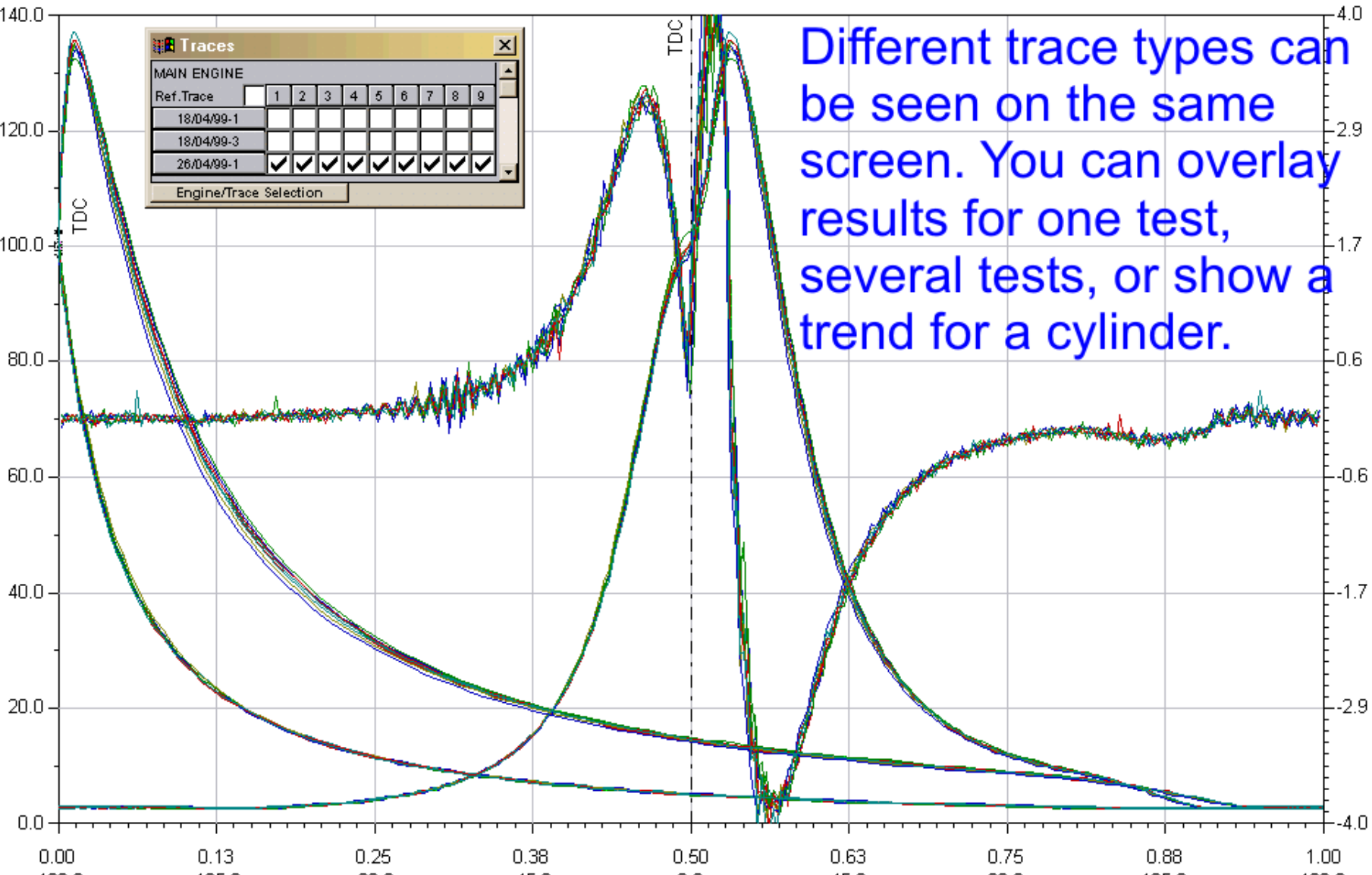


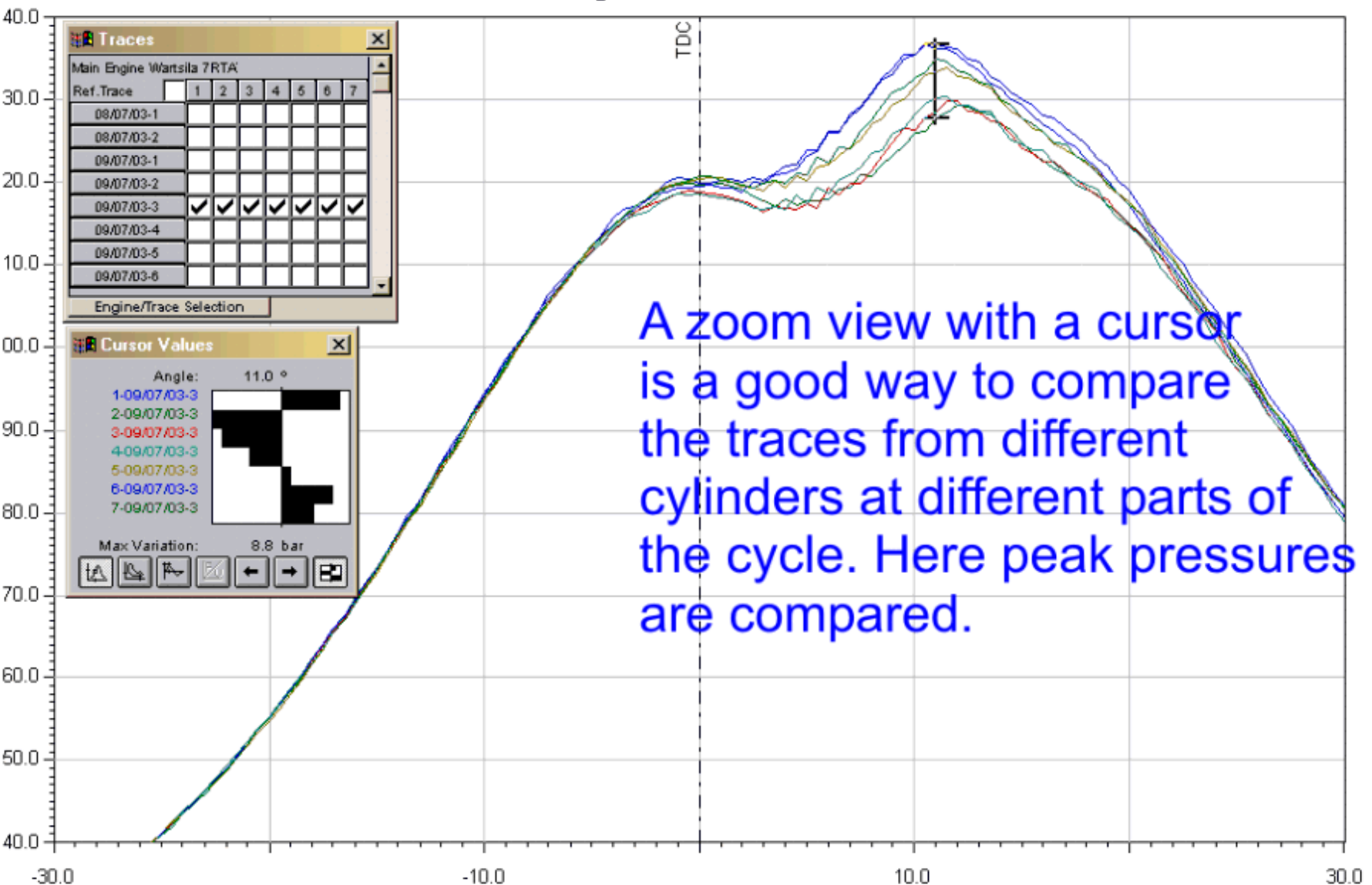
Basic Analysis Tools

MAIN ENGINE 9RTA84



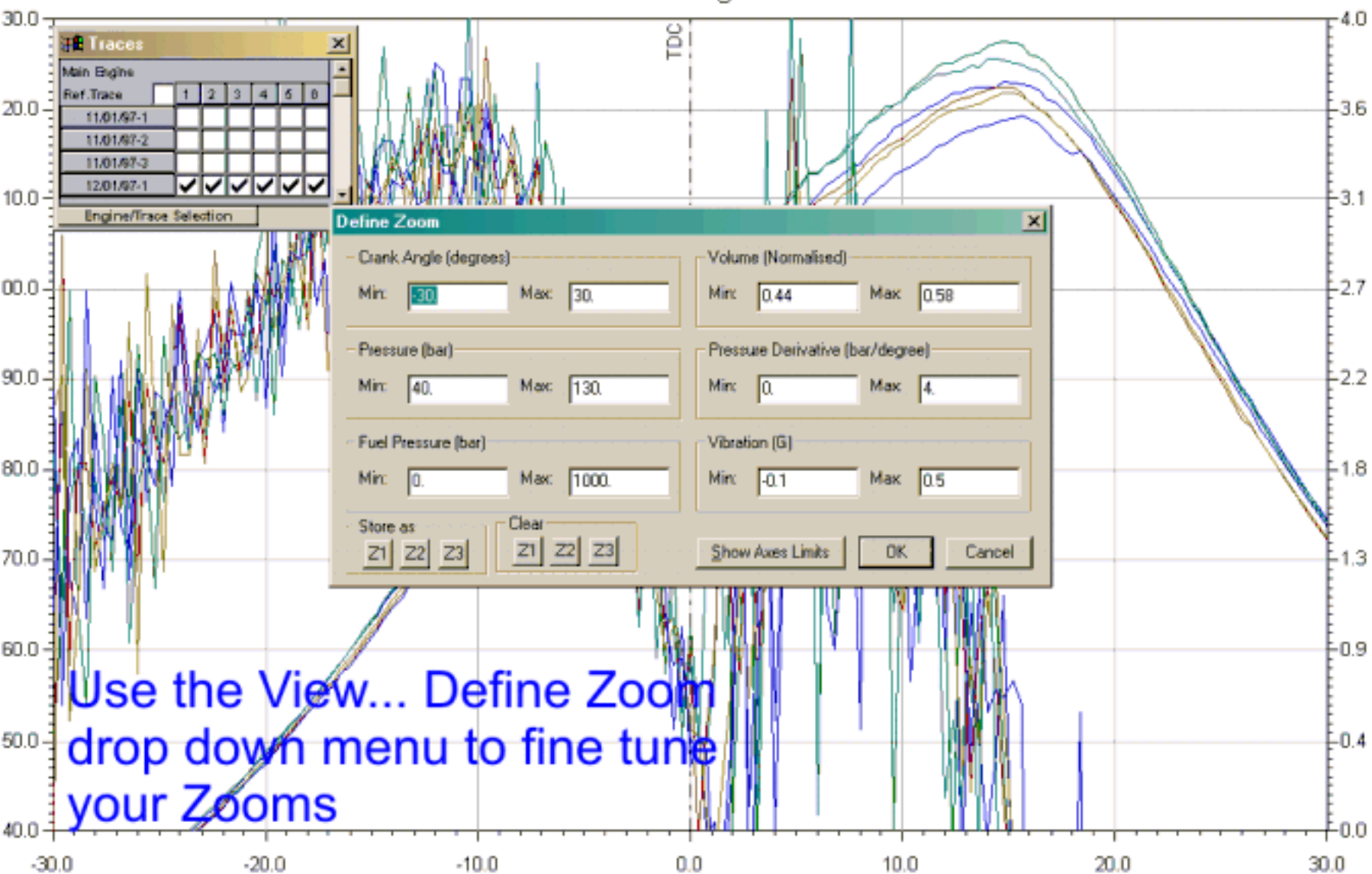
Basic Analysis Tools

Main Engine Wartsila 7RTA72U-B



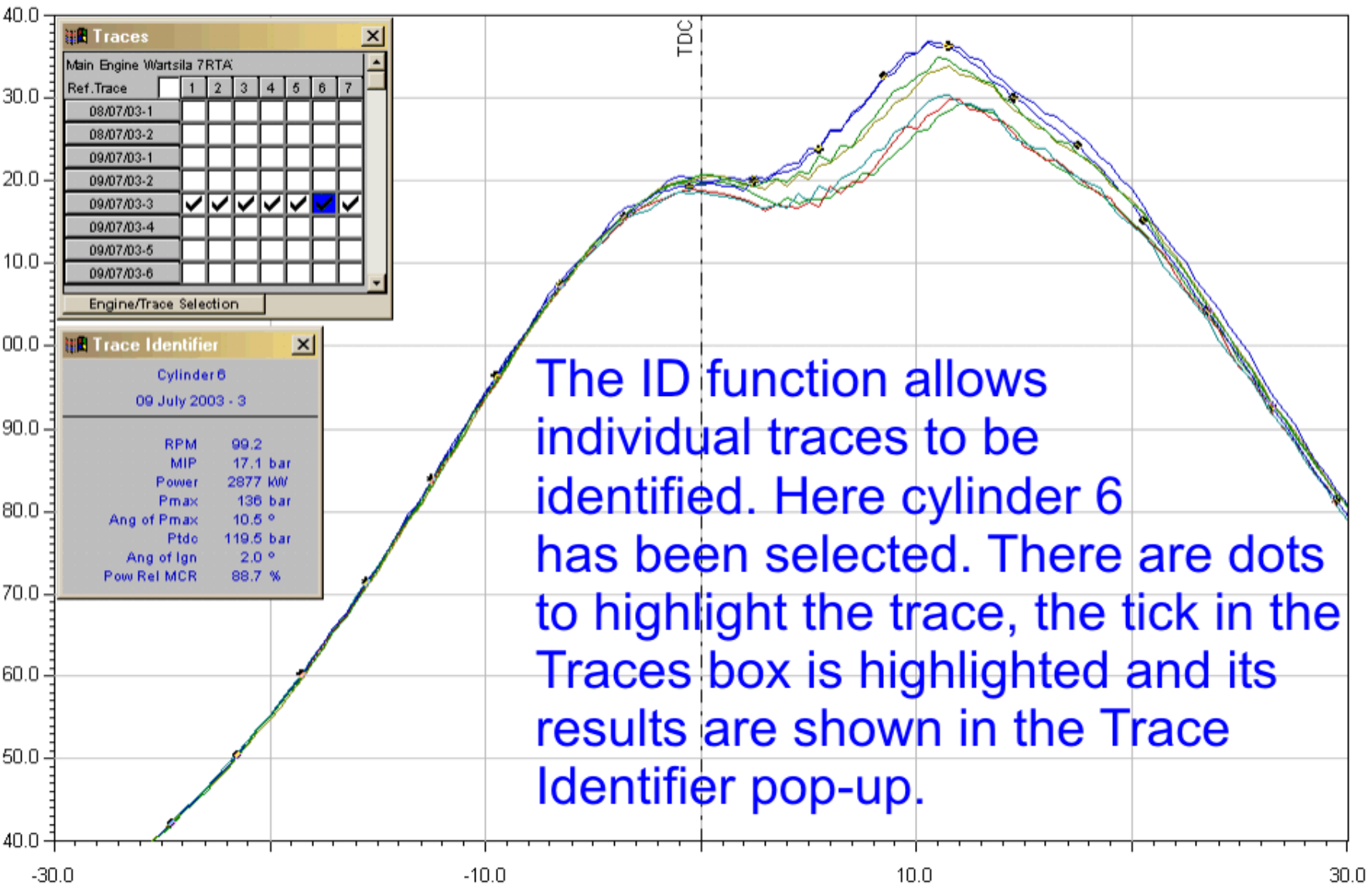
Basic Analysis Tools

Container Ship Company - M.S. Carrier
Main Engine



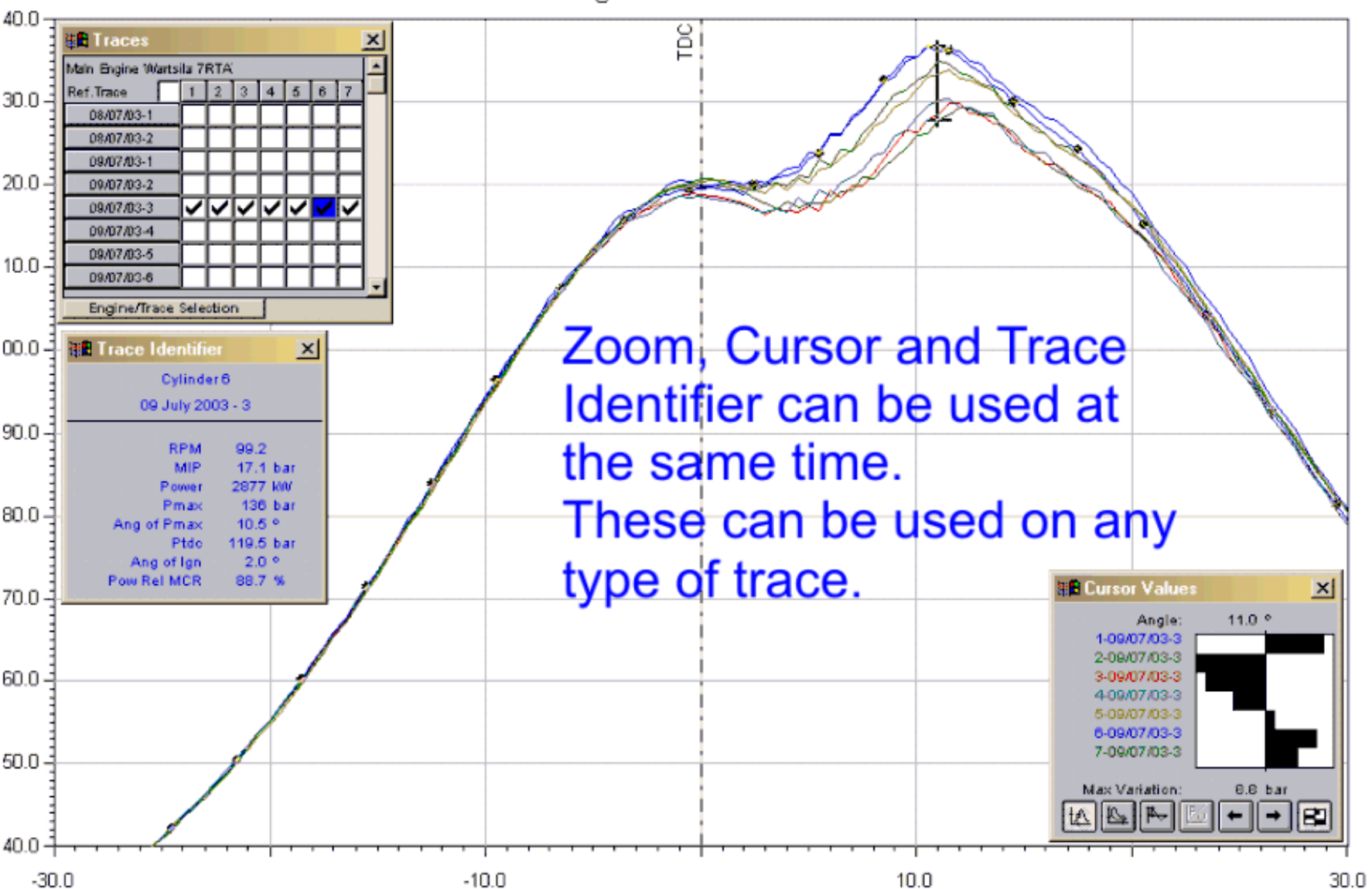
Basic Analysis Tools

Main Engine Wartsila 7RTA72U-B



Basic Analysis Tools

Main Engine Wartsila 7RTA72U-B



Basic Analysis Tools

Traces

Man Engine Wartsila 7RTA

Ref Trace

	1	2	3	4	5	6	7
08/07/03-1							
08/07/03-2							
09/07/03-1							
09/07/03-2							
09/07/03-3							
09/07/03-4							
09/07/03-5	✓	✓	✓	✓	✓	✓	✓
09/07/03-6							

Engine/Trace Selection

Sea Trial Results 7RTA72U-B

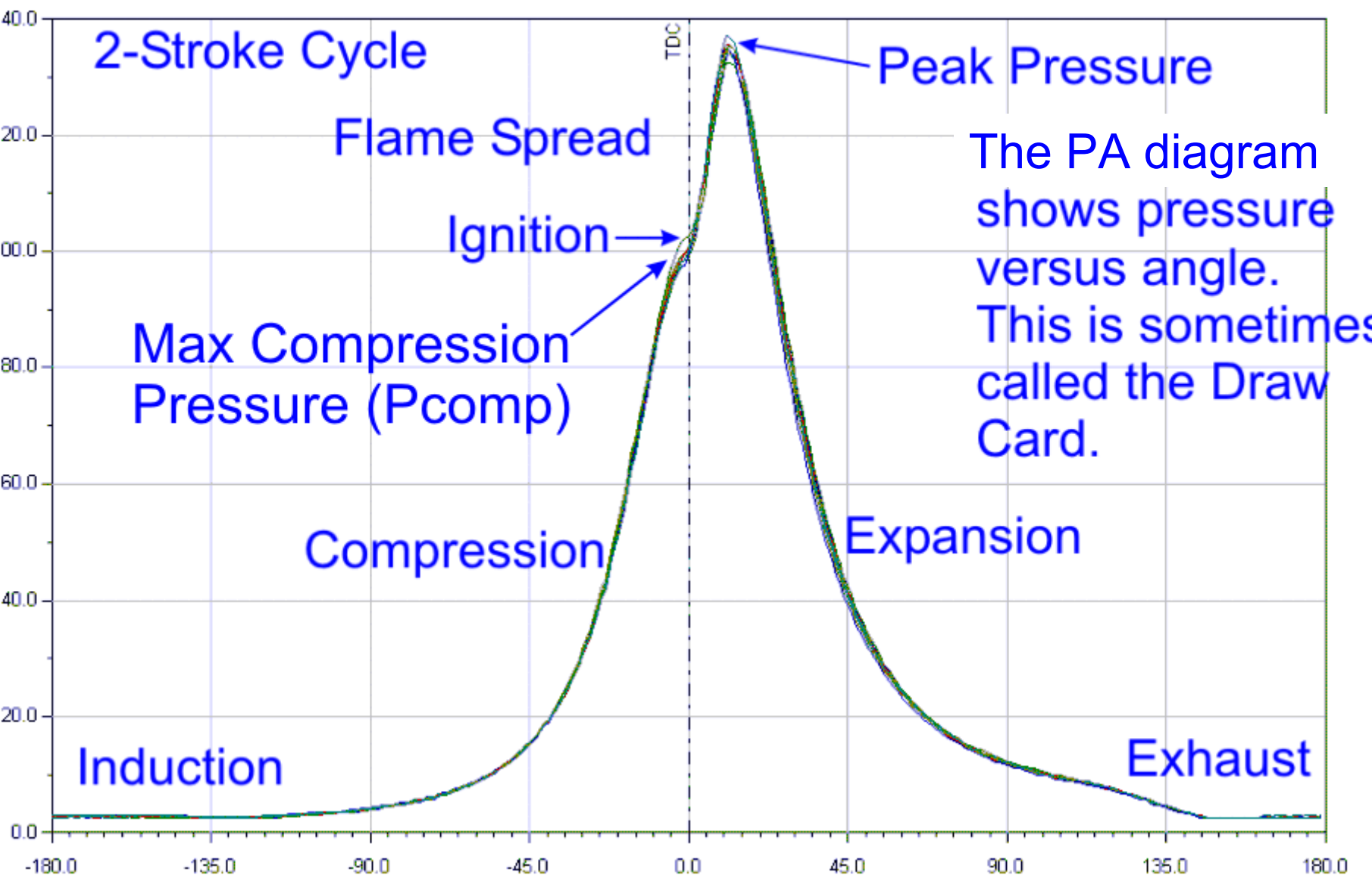
Total Power

	Cylinder 1 09/07/03-5	Cylinder 2 09/07/03-5	Cylinder 3 09/07/03-5	Cylinder 4 09/07/03-5	Cylinder 5 09/07/03-5	Cylinder 6 09/07/03-5	Cylinder 7 09/07/03-5	Mean	Variation (per cent)	Total
RPM ()	102.4	102.0	102.0	102.0	102.2	102.0	101.9	102.1	0.5	
Pscav (bar)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0	
MIP (bar)	17.9	17.6	17.3	17.3	17.8	17.7	17.9	17.7	3.8	
Power (kW)	3117	3055	2995	2967	3090	3060	3092	3056	4.3	21394.7
Pmax (bar)	140	131	131	133	137	139	136	135	7.0	
Ang of Pmax (°)	11.5	13.0	12.5	12.0	12.5	11.5	12.0	12.1	12.4	
Ptdc (bar)	128.8	127.5	127.2	127.8	129.9	128.0	129.3	128.3	2.0	
Ang of Ign (°)	1.5	4.0	5.0	4.5	3.5	5.0	4.5	4.0	87.5	
Pow Rel MCR (%)	96.1	94.2	92.4	92.1	95.3	94.4	95.4	94.3	4.3	

Power Variation

2-Stroke Analysis

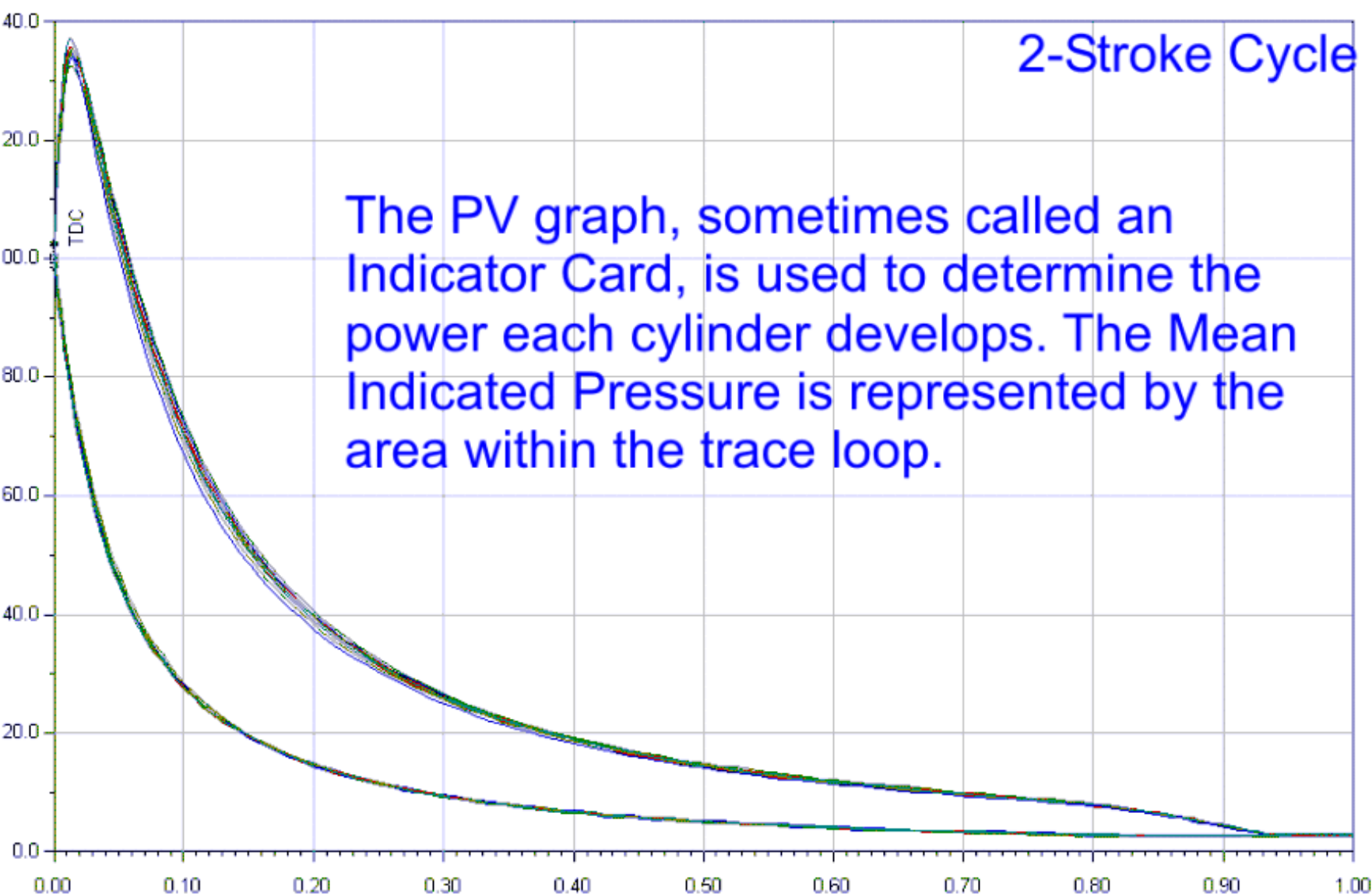
MAIN ENGINE 9RTA84



2-Stroke Analysis

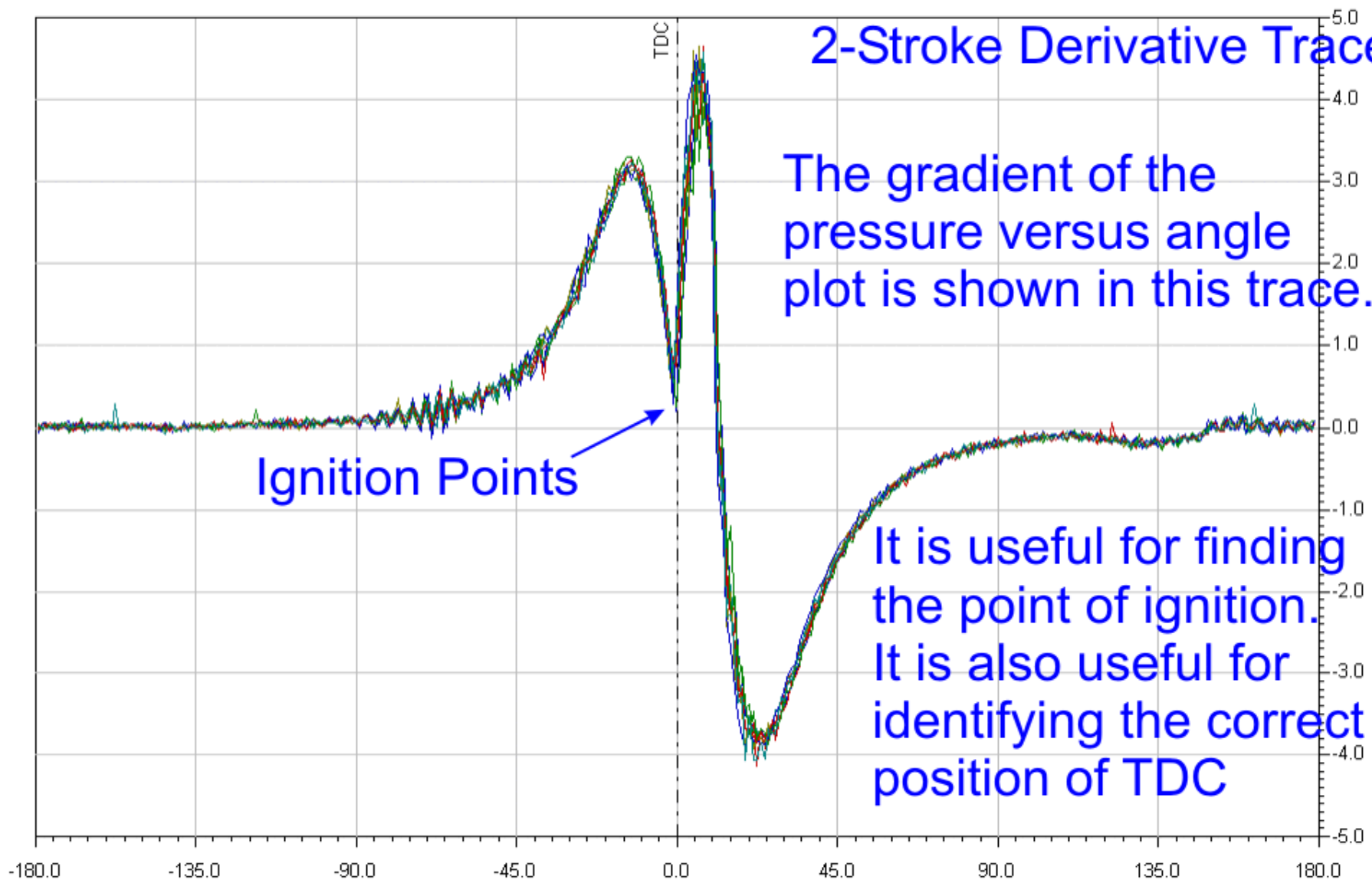
MAIN ENGINE 9RTA84

2-Stroke Cycle

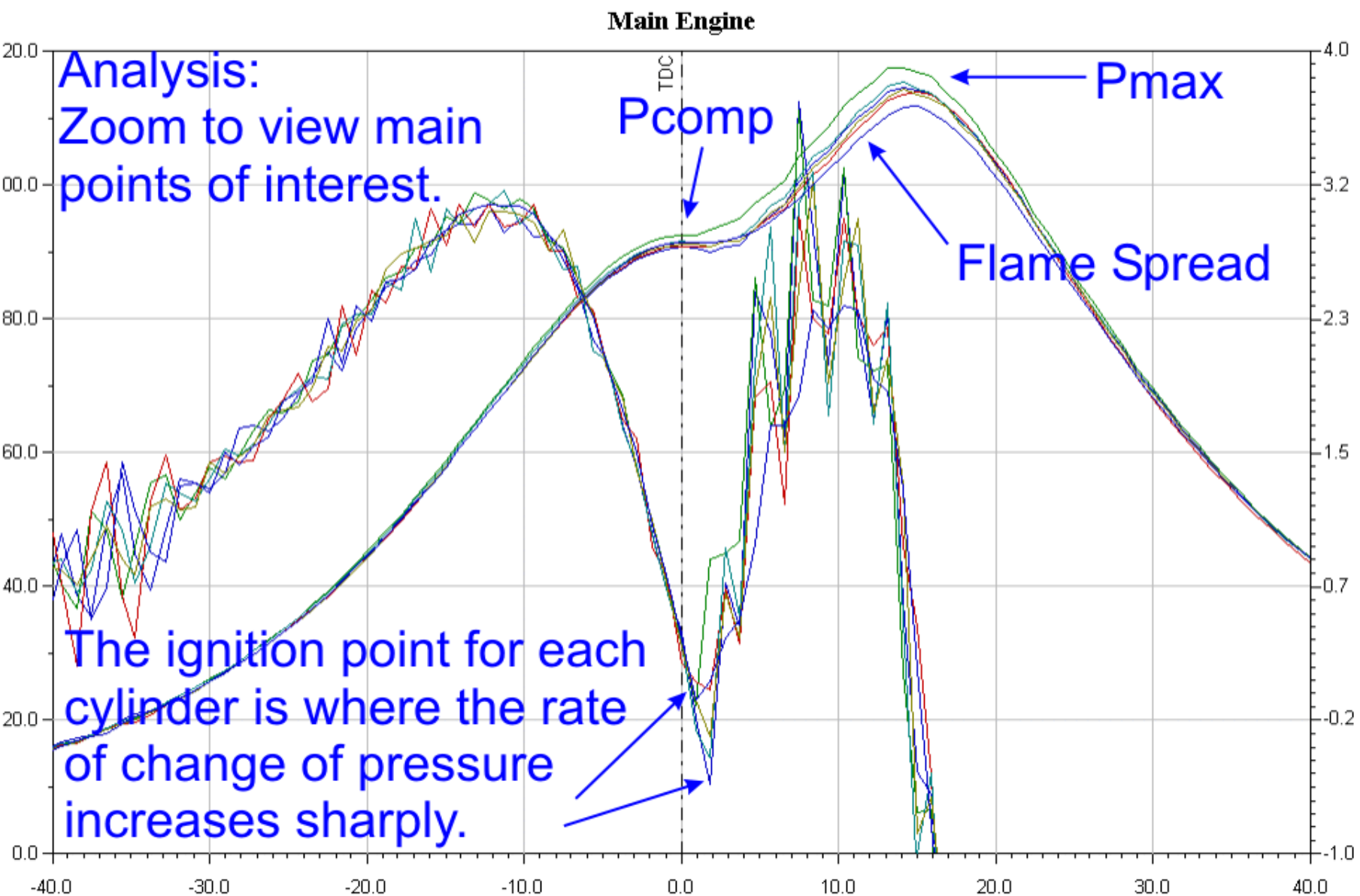


2-Stroke Analysis

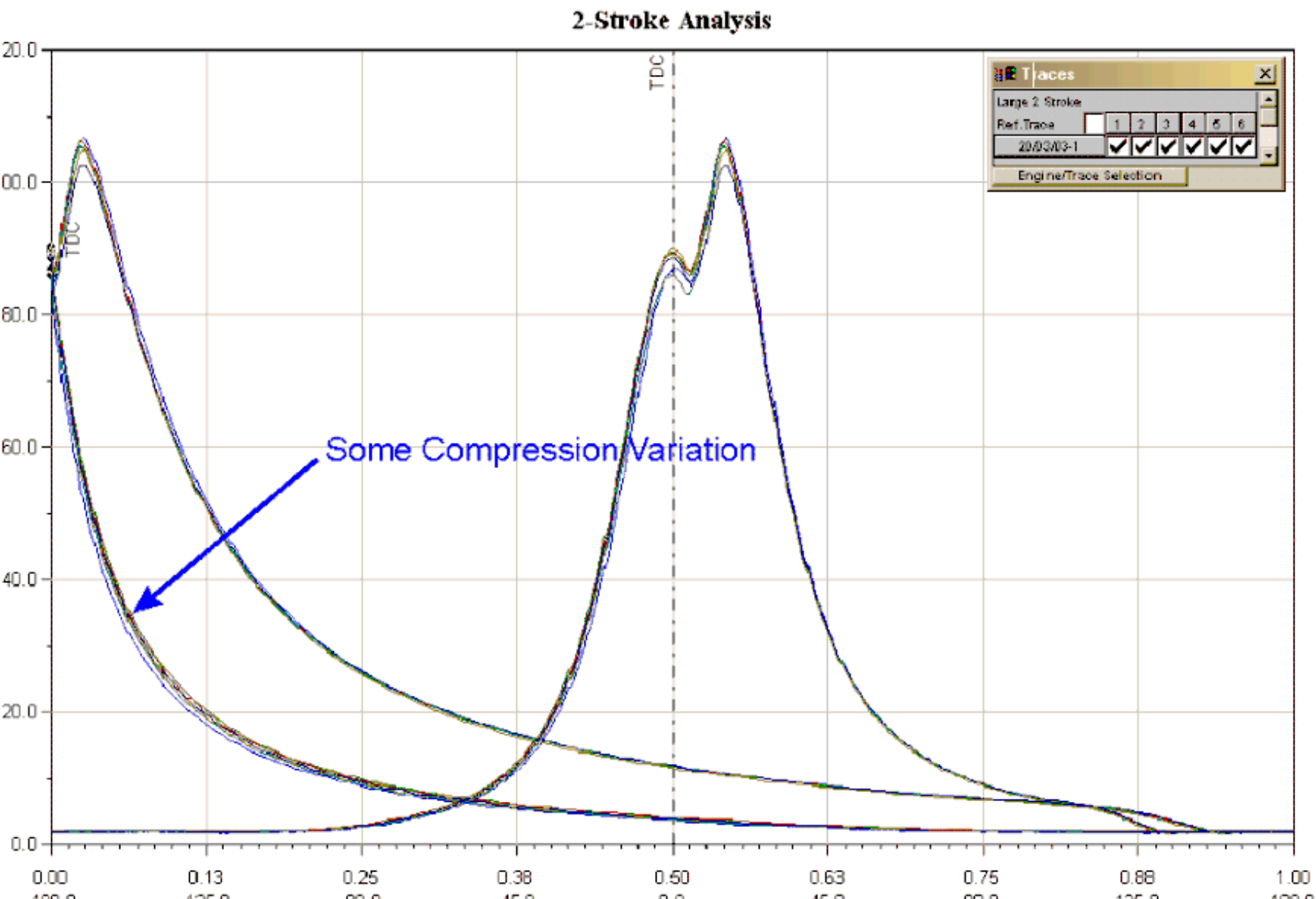
MAIN ENGINE 9RTA84



2-Stroke Analysis

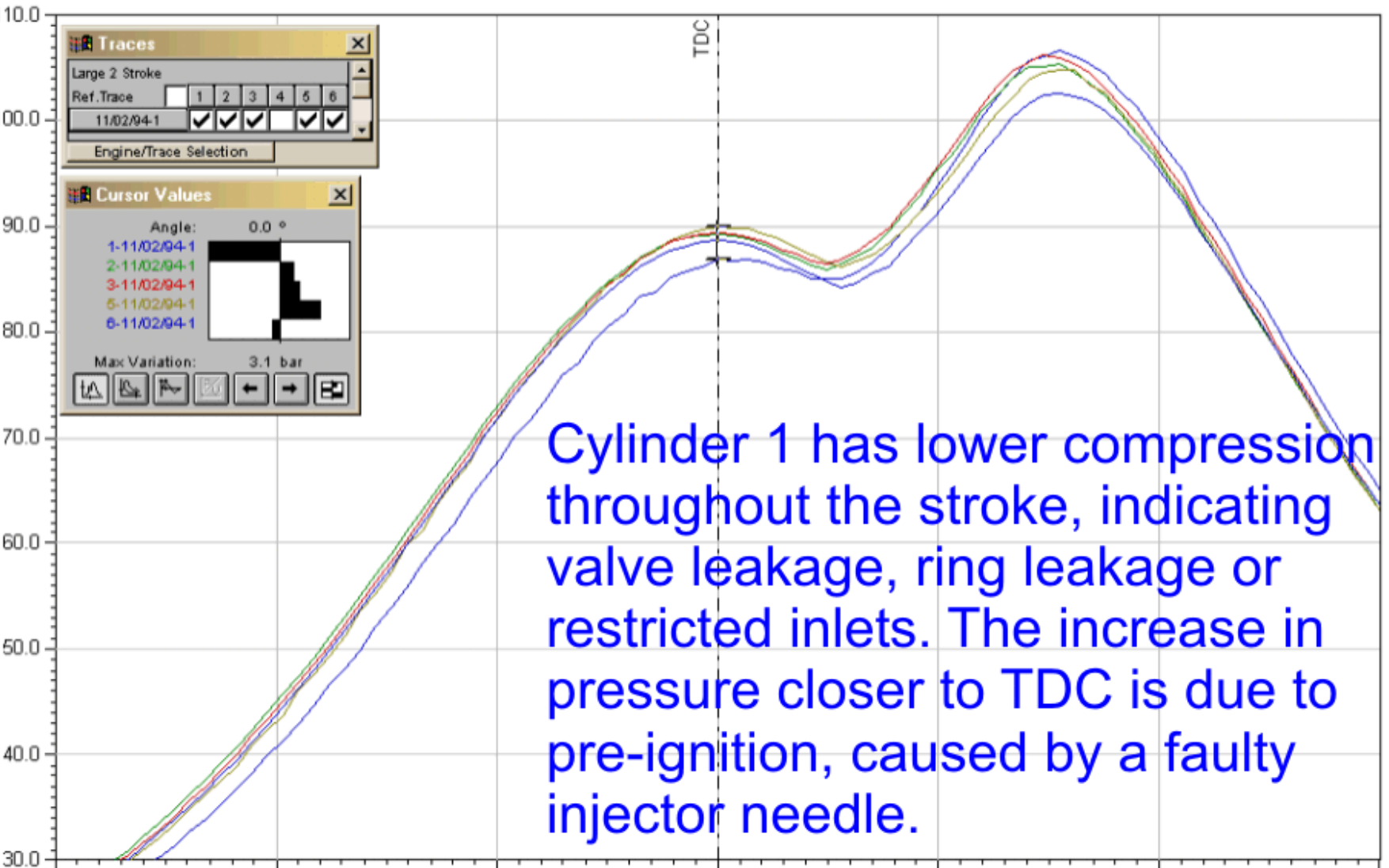


2-Stroke Analysis



2-Stroke Analysis

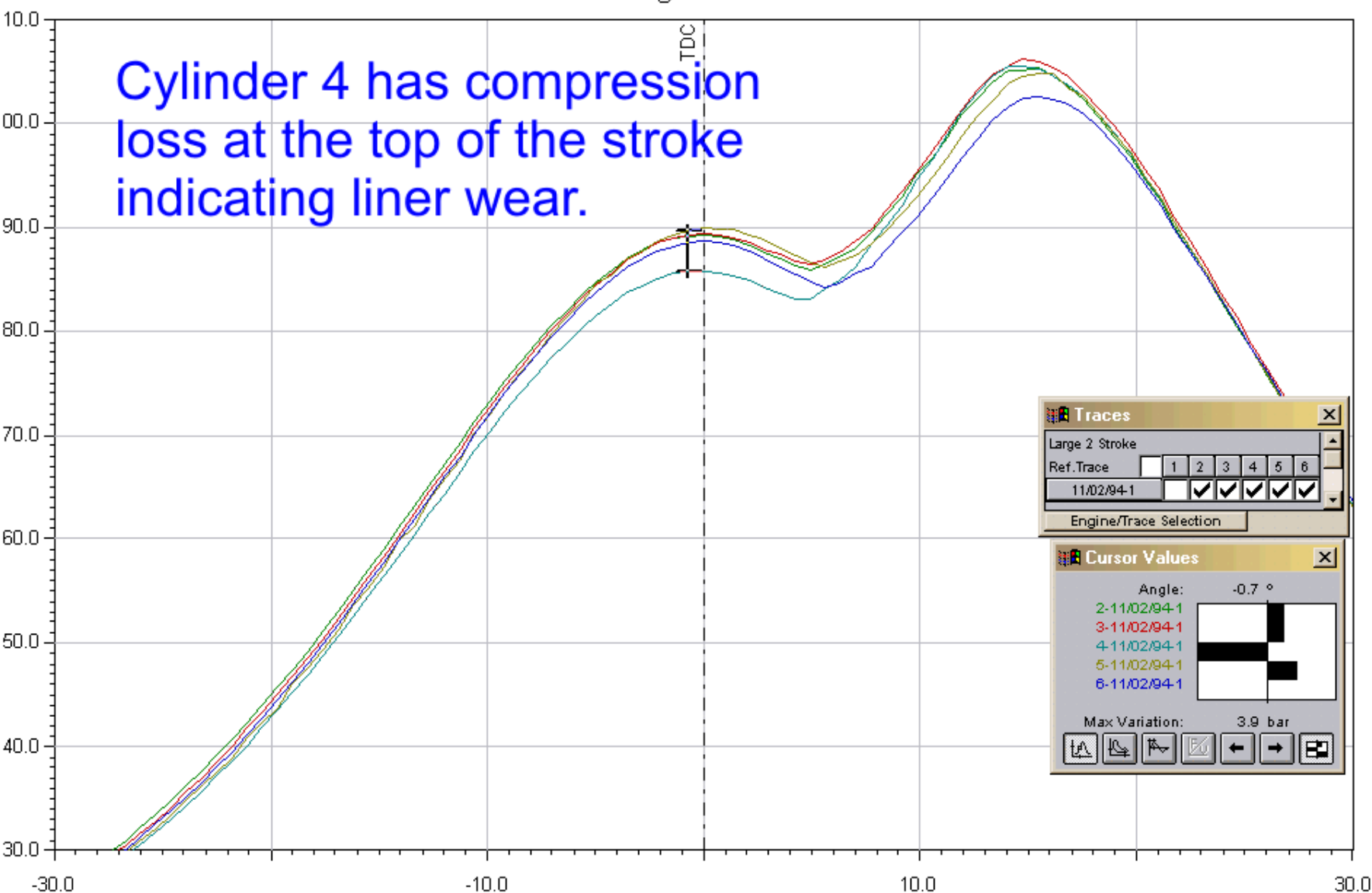
Trading Company - Cargo Ship
Large 2 Stroke



2-Stroke Analysis

Trading Company - Cargo Ship
Large 2 Stroke

Cylinder 4 has compression loss at the top of the stroke indicating liner wear.



Traces

Large 2 Stroke

Ref. Trace ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

11/02/94-1 ☐ ☒ ☒ ☒ ☒ ☒

Engine/Trace Selection

Cursor Values

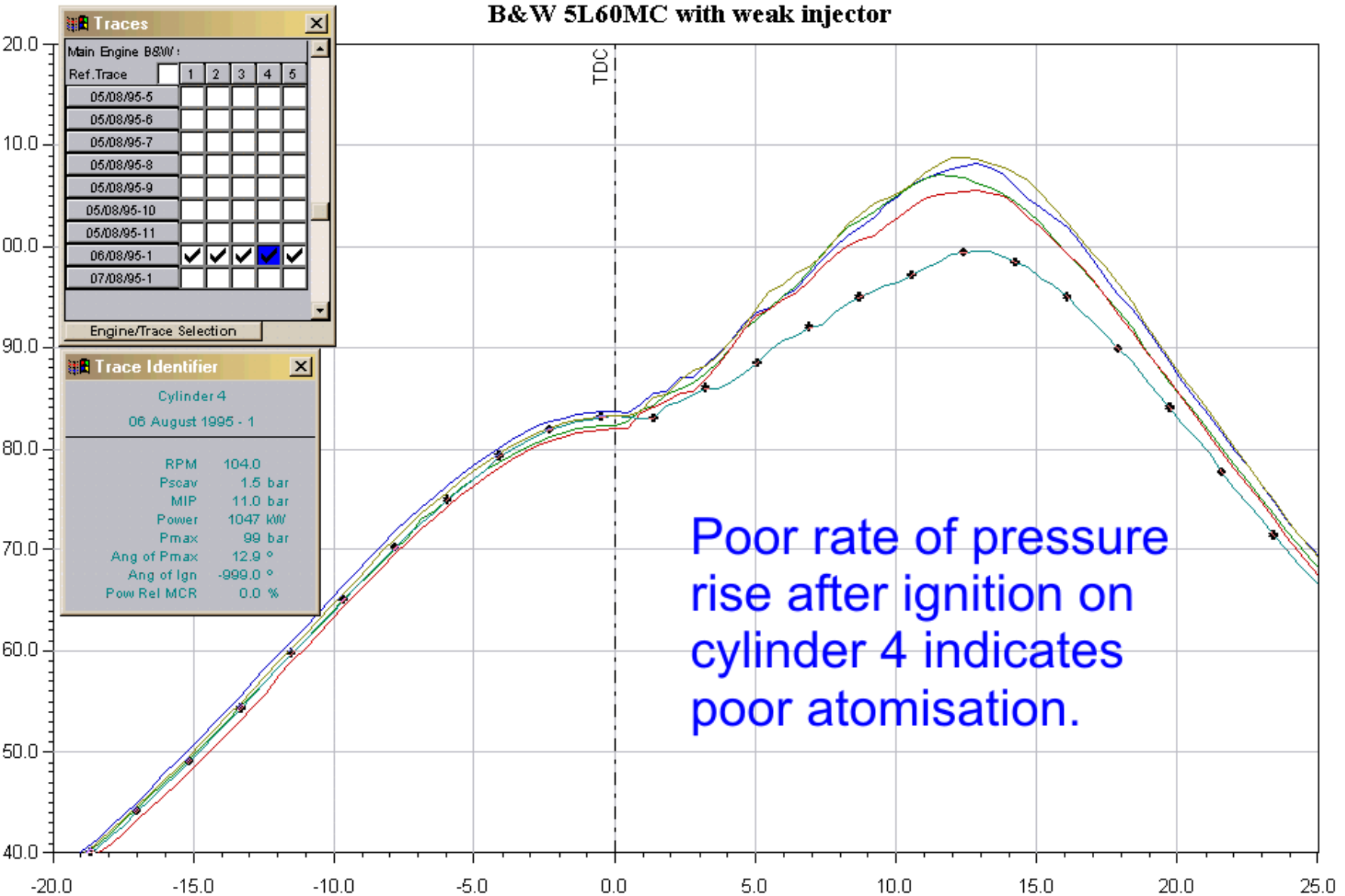
Angle: -0.7 °

2-11/02/94-1
3-11/02/94-1
4-11/02/94-1
5-11/02/94-1
6-11/02/94-1

Max Variation: 3.9 bar

2-Stroke Analysis

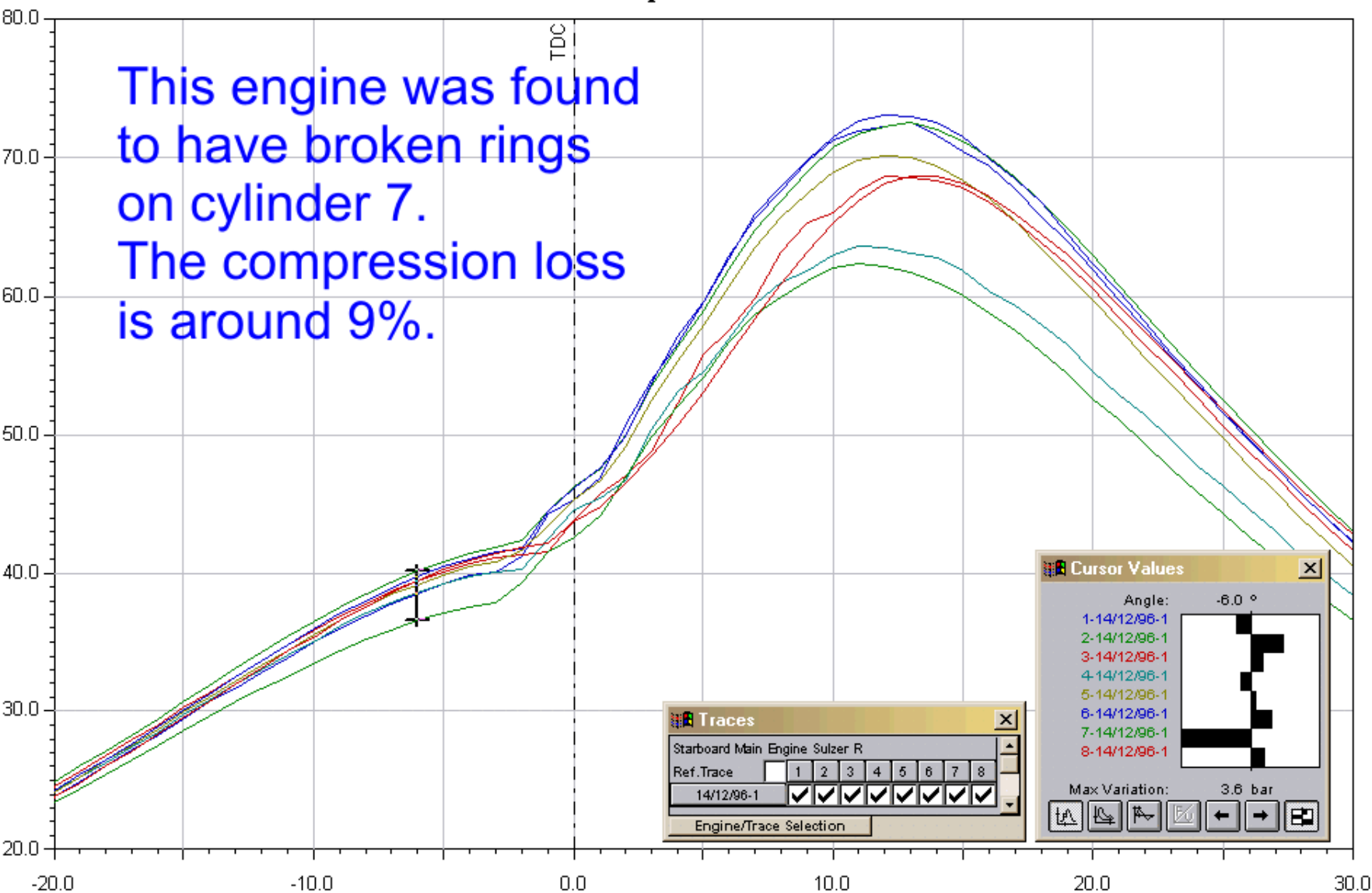
B&W 5L60MC with weak injector



2-Stroke Analysis

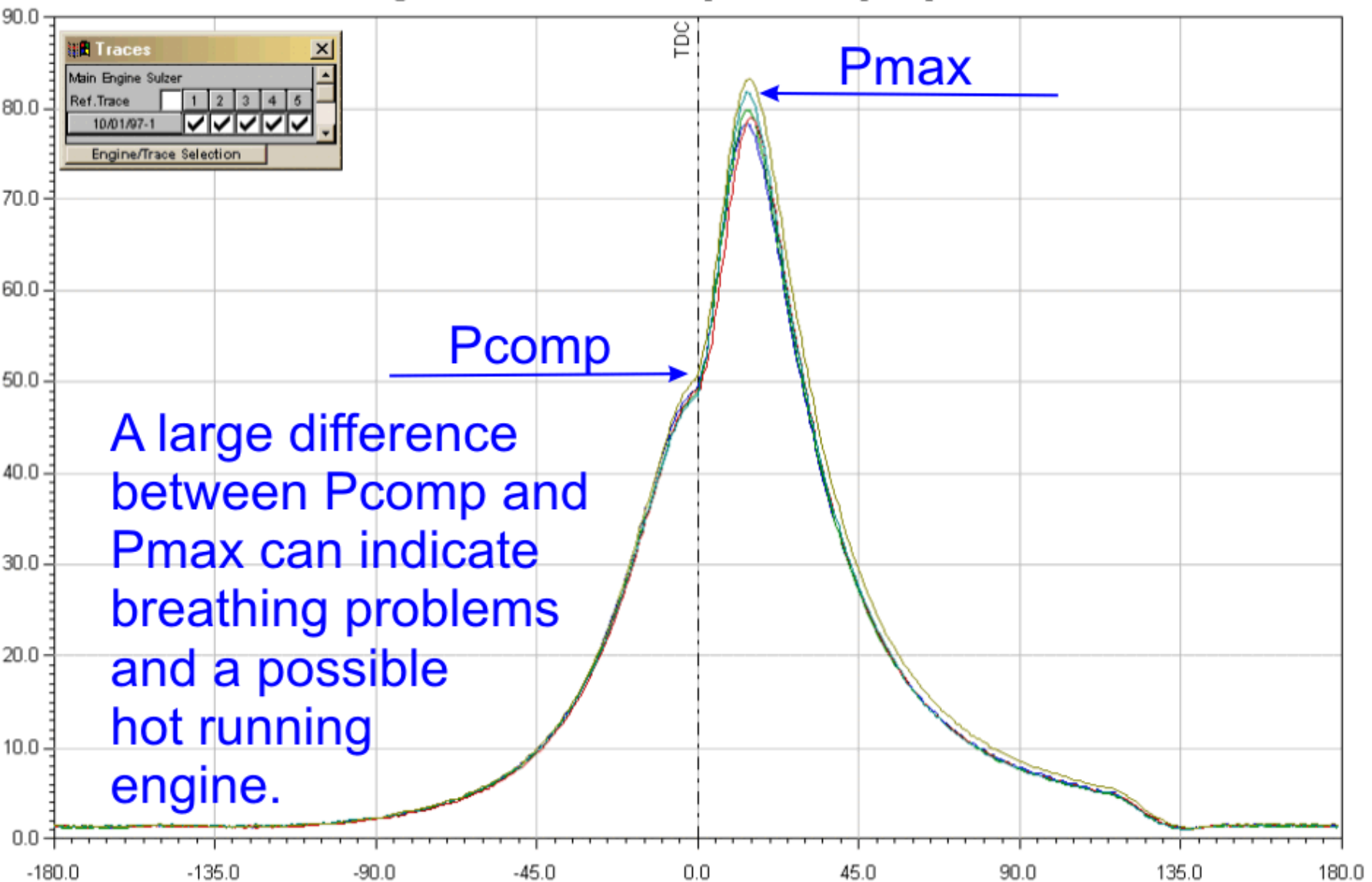
Compression Fault

This engine was found to have broken rings on cylinder 7. The compression loss is around 9%.



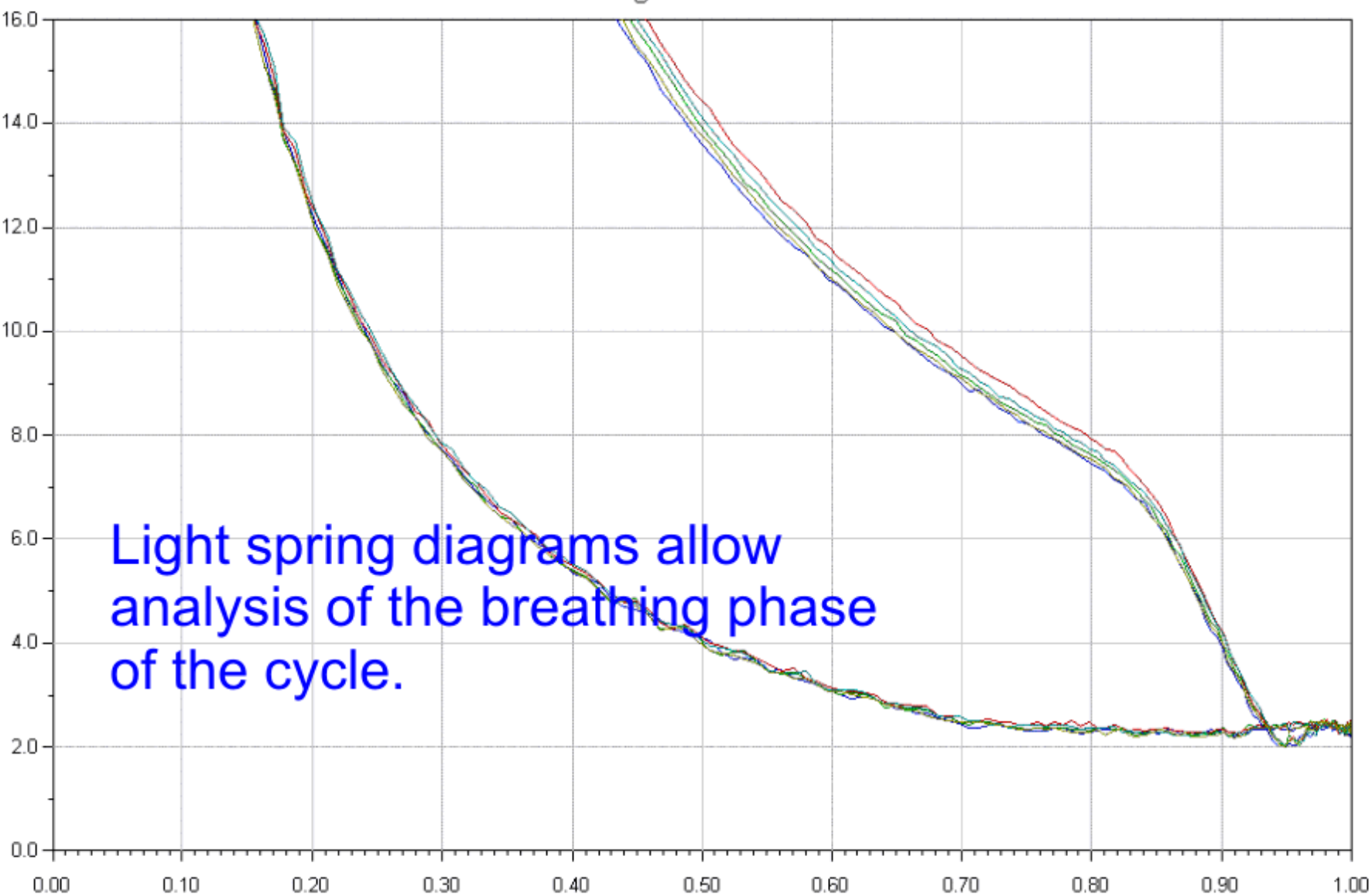
2-Stroke Analysis

Large difference between compression and peak pressures.



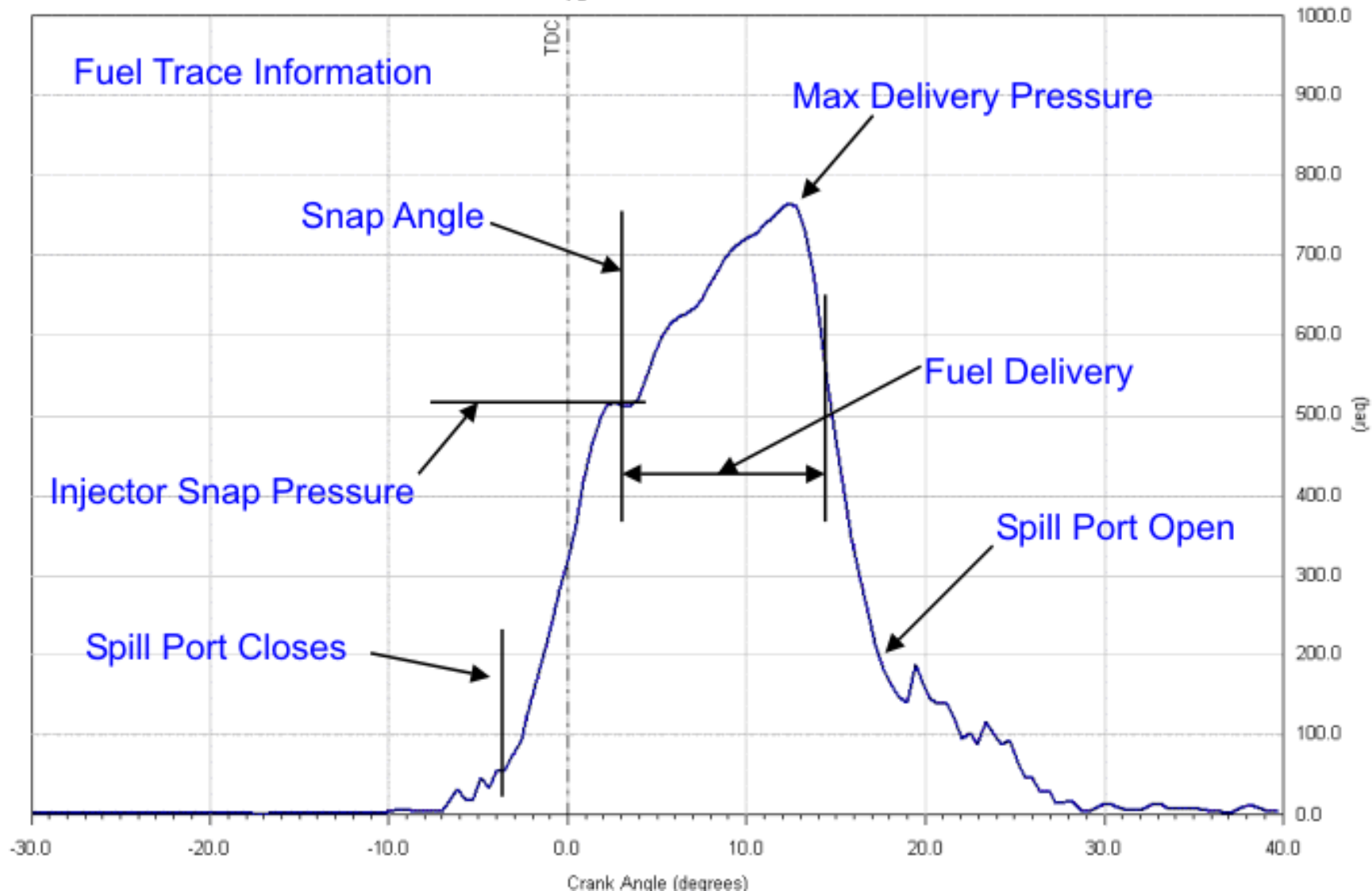
2-Stroke Analysis

Main Engine B&W 5S60MC



2-Stroke Analysis - Fuel Pressure

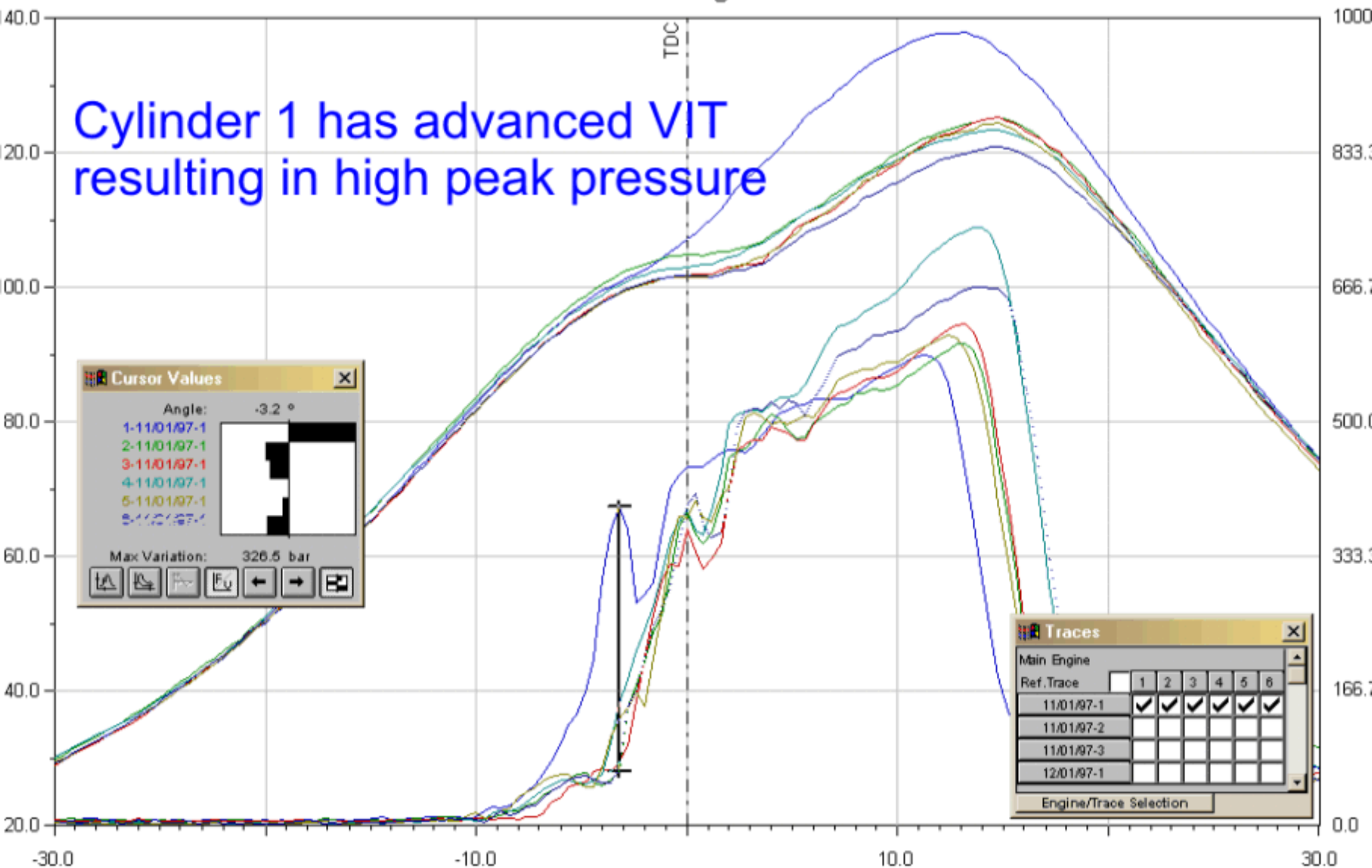
Typical Fuel Trace



2-Stroke Analysis - Fuel Pressure

Container Ship Company - M.S. Carrier
Main Engine

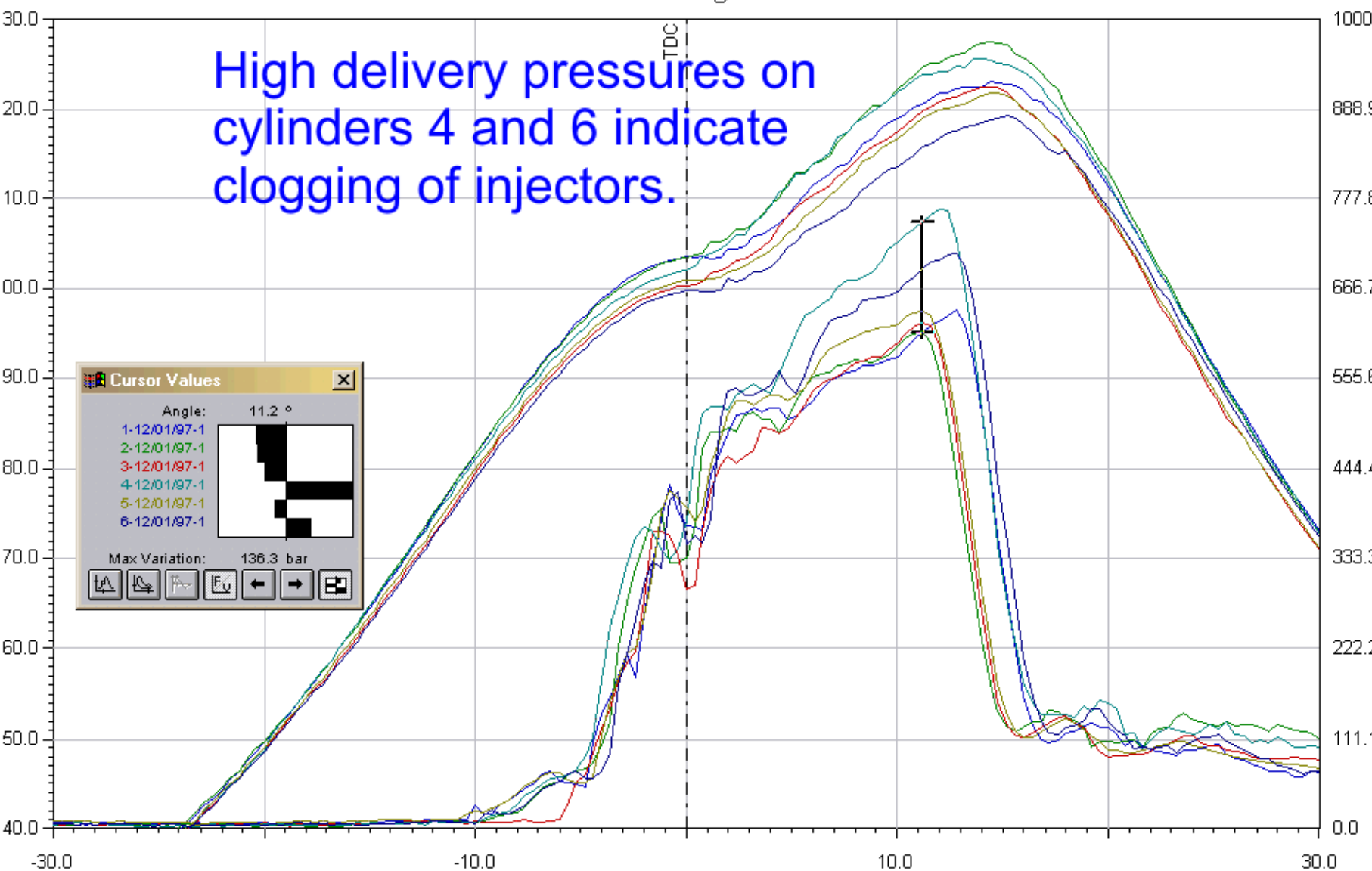
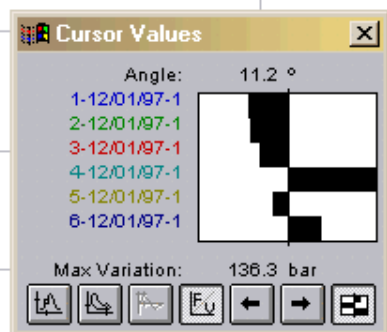
Cylinder 1 has advanced VIT
resulting in high peak pressure



2-Stroke Analysis - Fuel Pressure

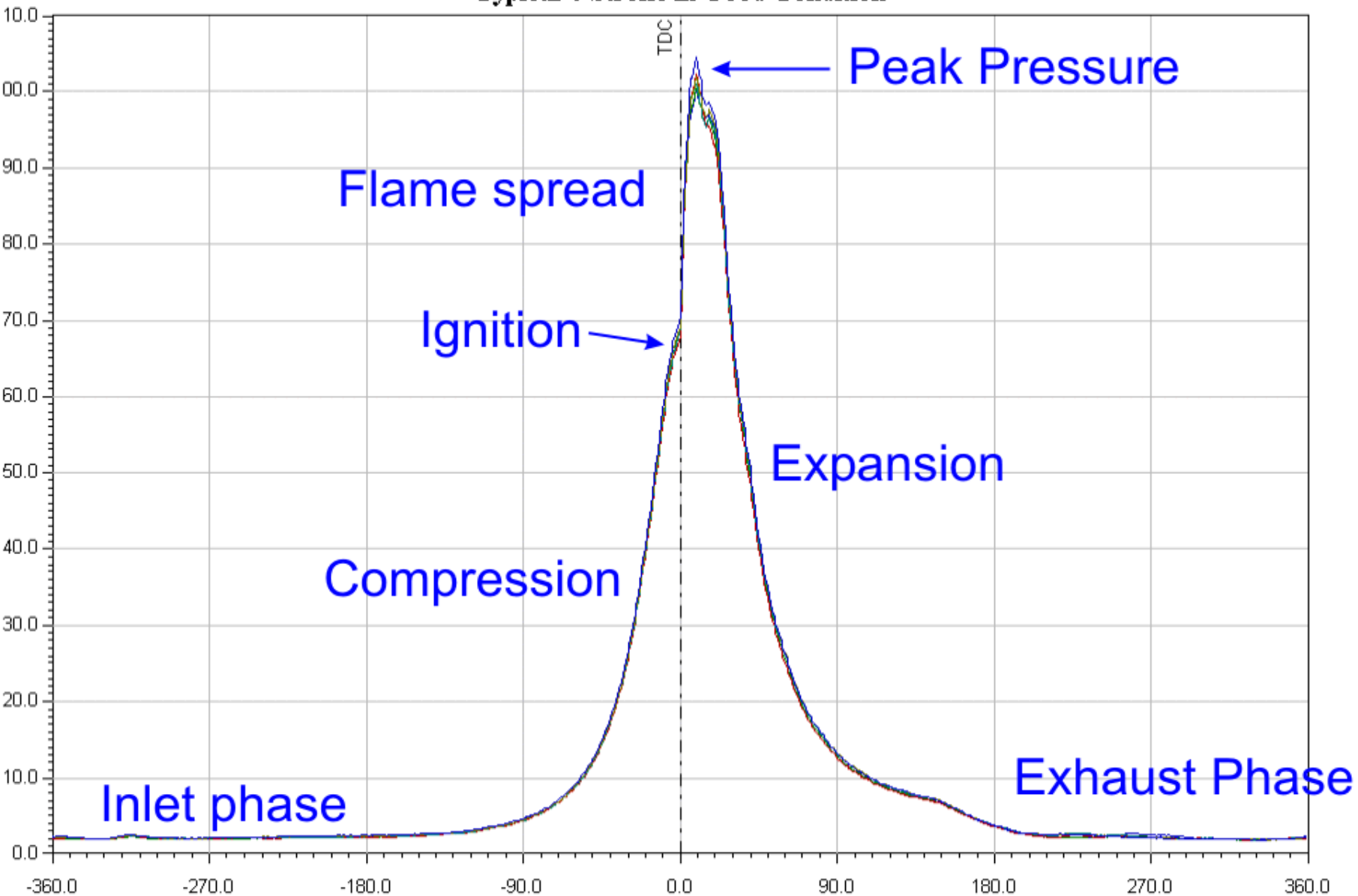
Container Ship Company - M.S. Carrier
Main Engine

High delivery pressures on cylinders 4 and 6 indicate clogging of injectors.



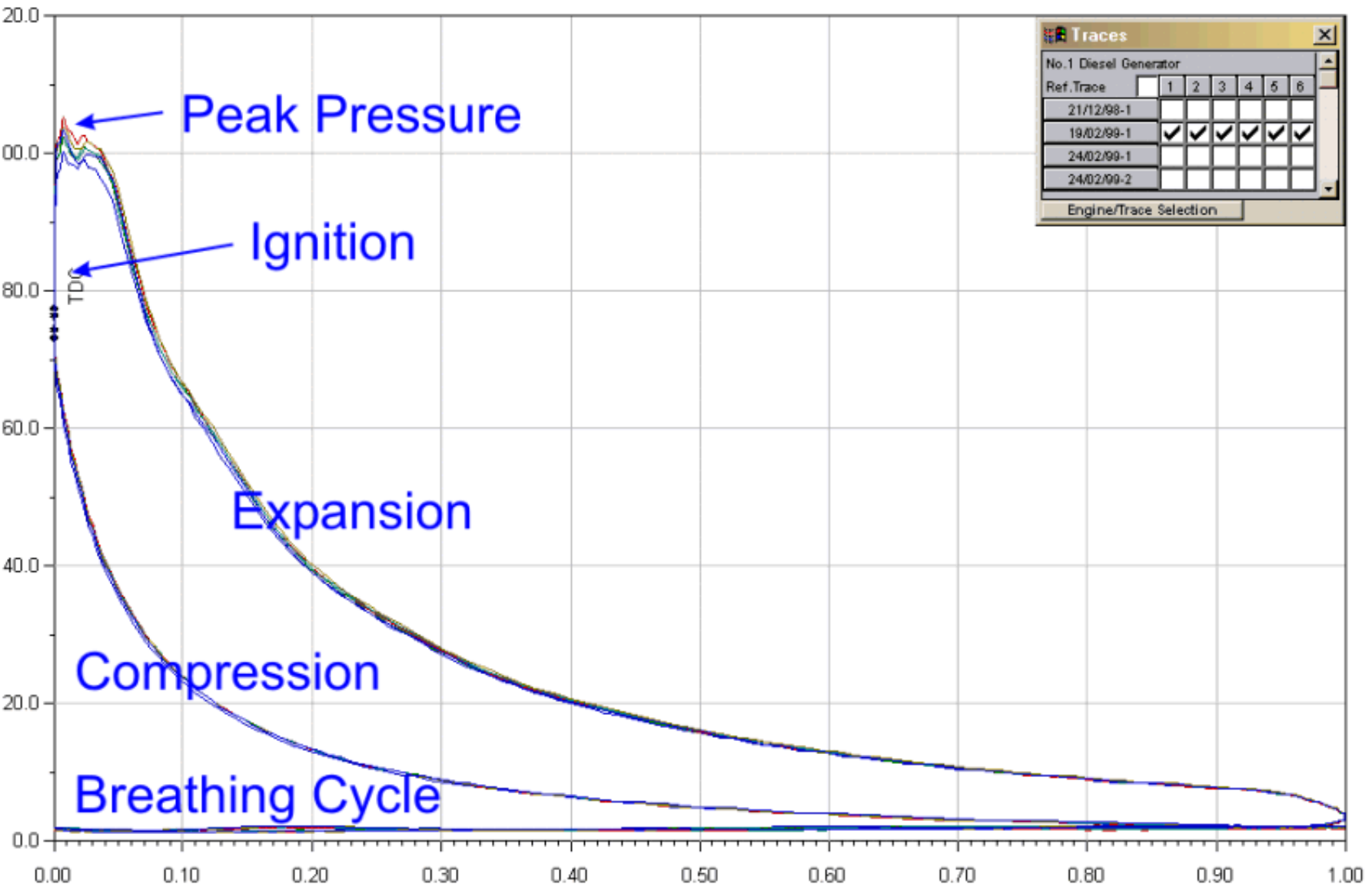
4-Stroke Analysis

Typical 4-Stroke in Good Condition



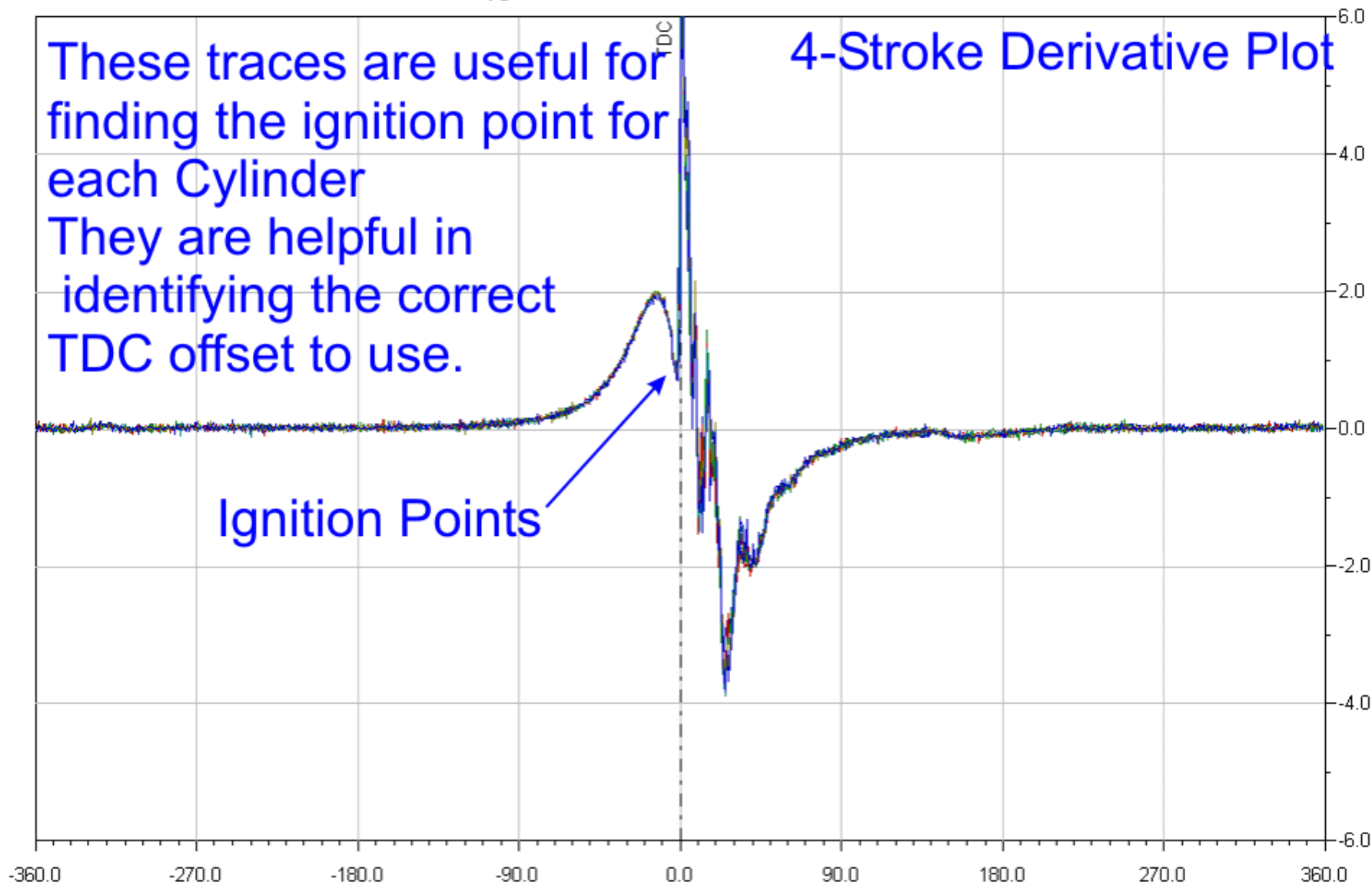
4-Stroke Analysis

Typical 4 Stroke in Good Condition



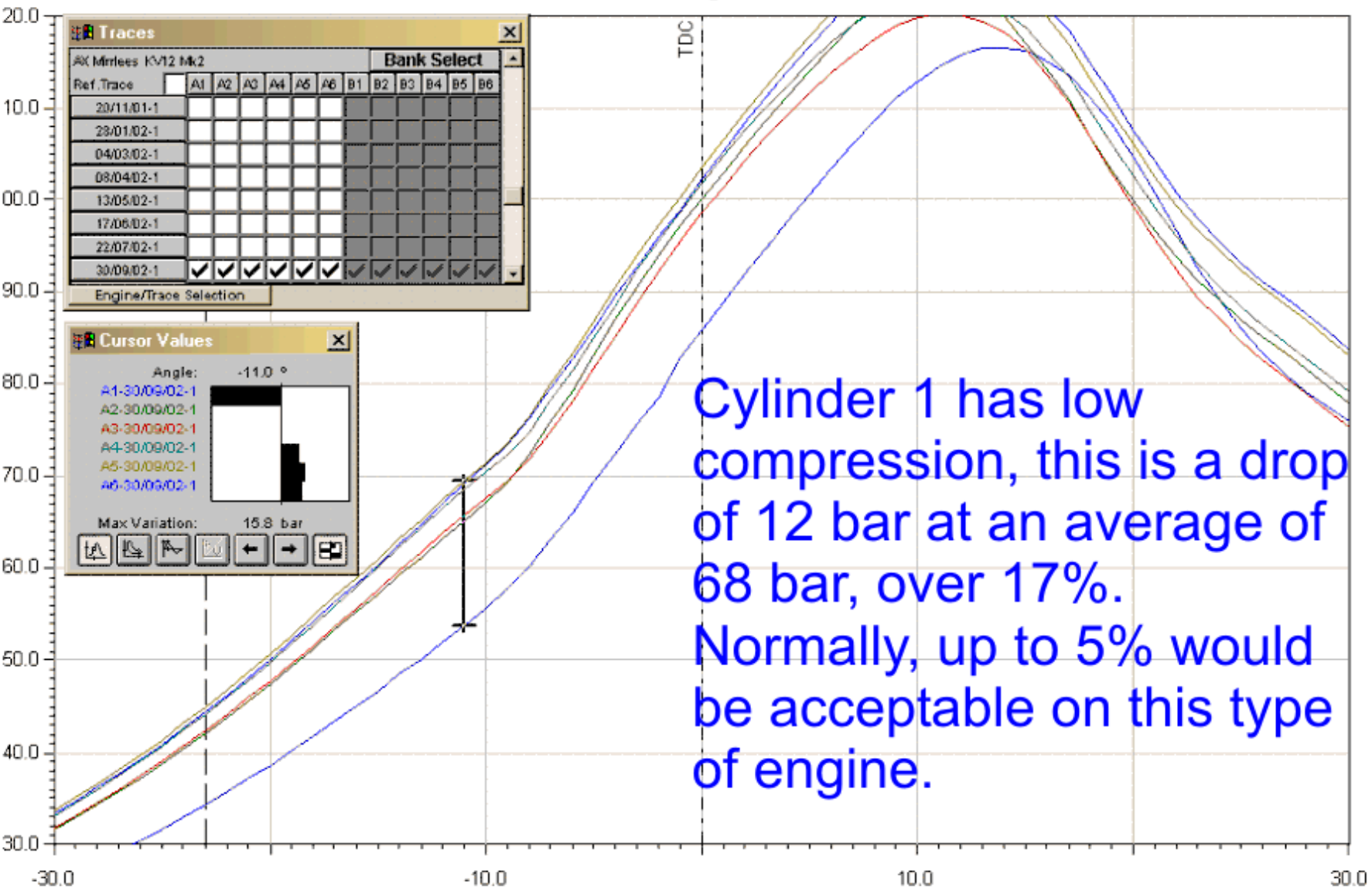
4-Stroke Analysis

Typical 4-Stroke in Good Condition



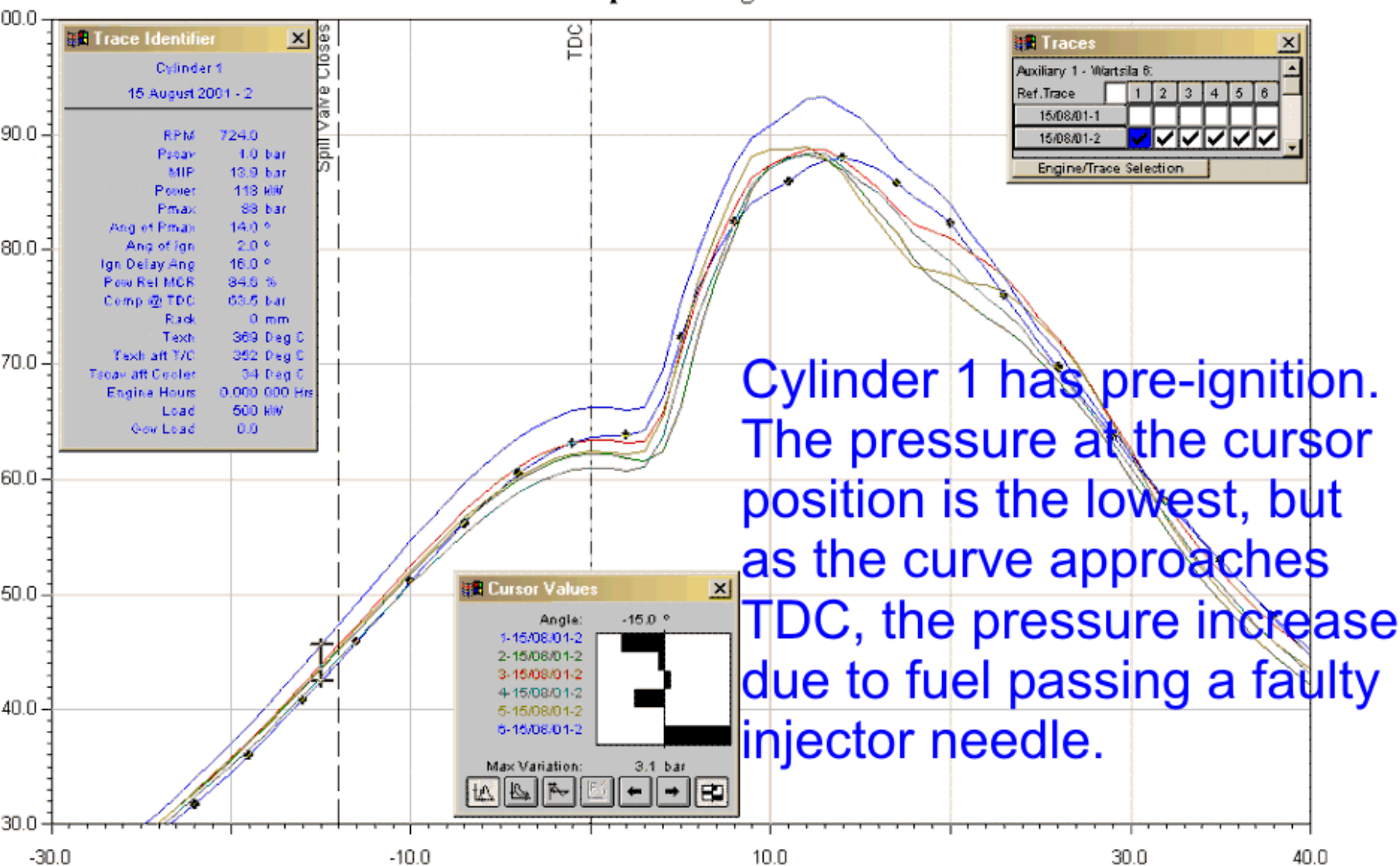
4-Stroke Analysis

Low Compression



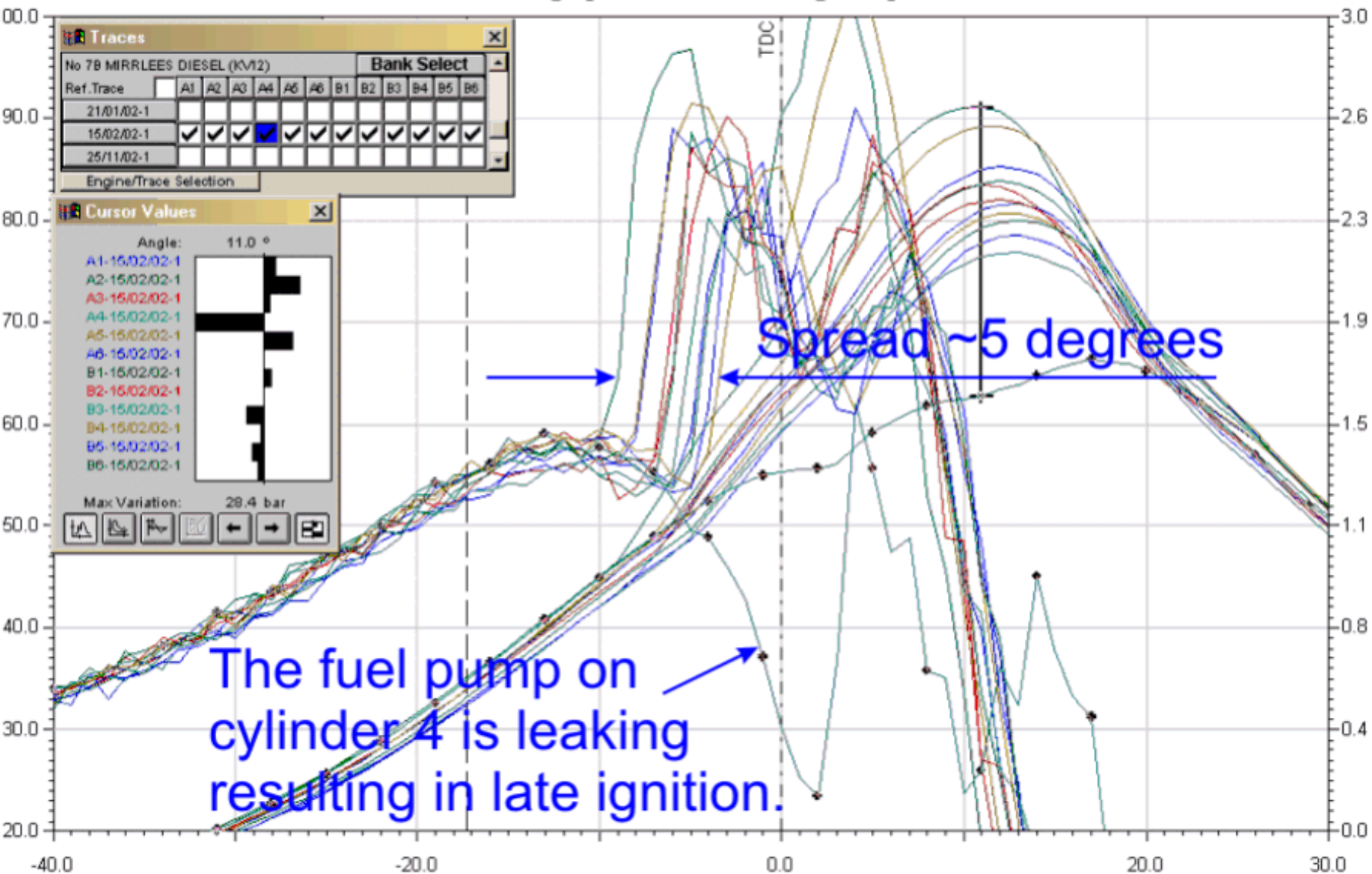
4-Stroke Analysis

Example of Pre-Ignition



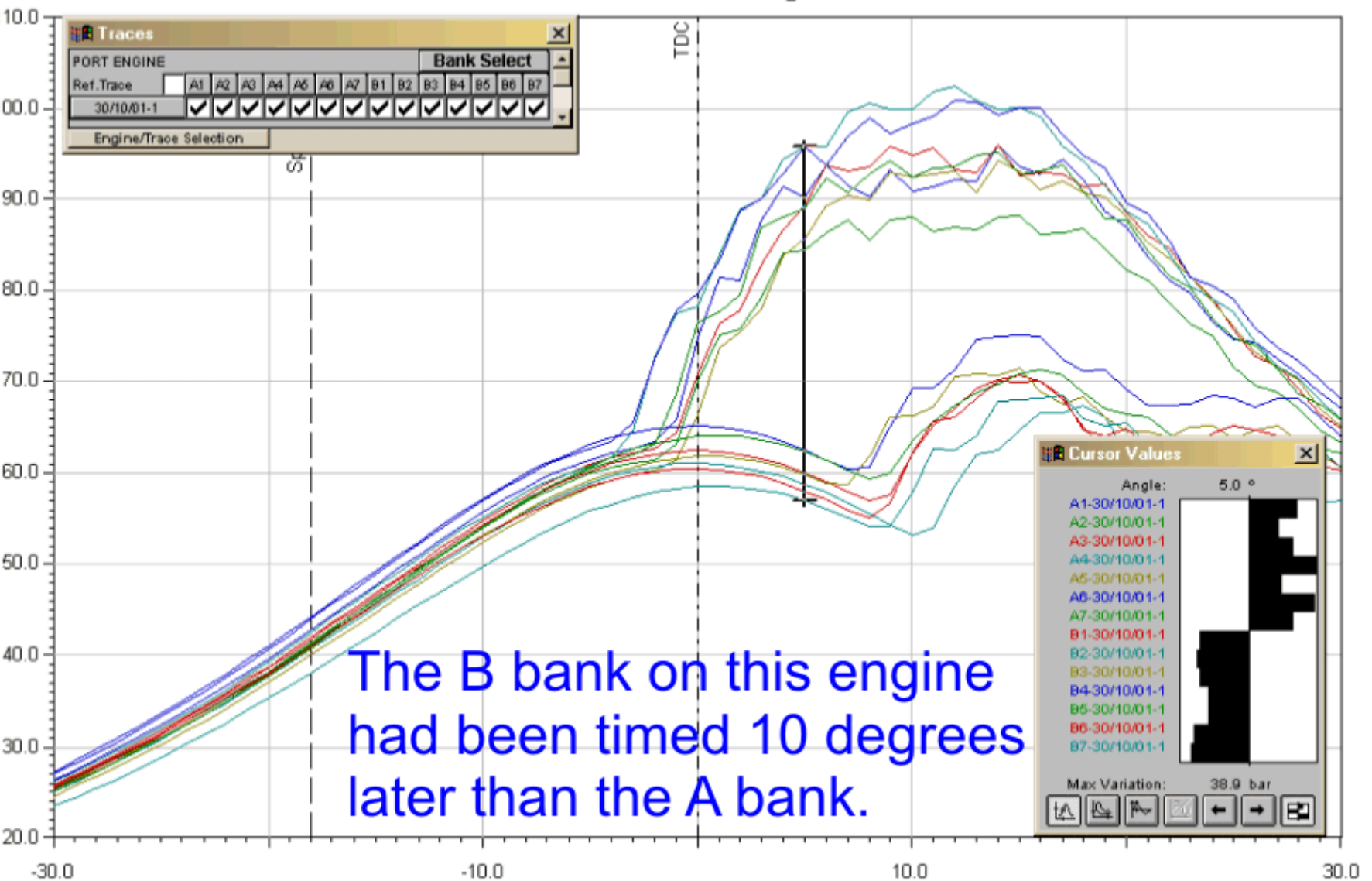
4-Stroke Analysis

Timing Spread and a Leaking Pump



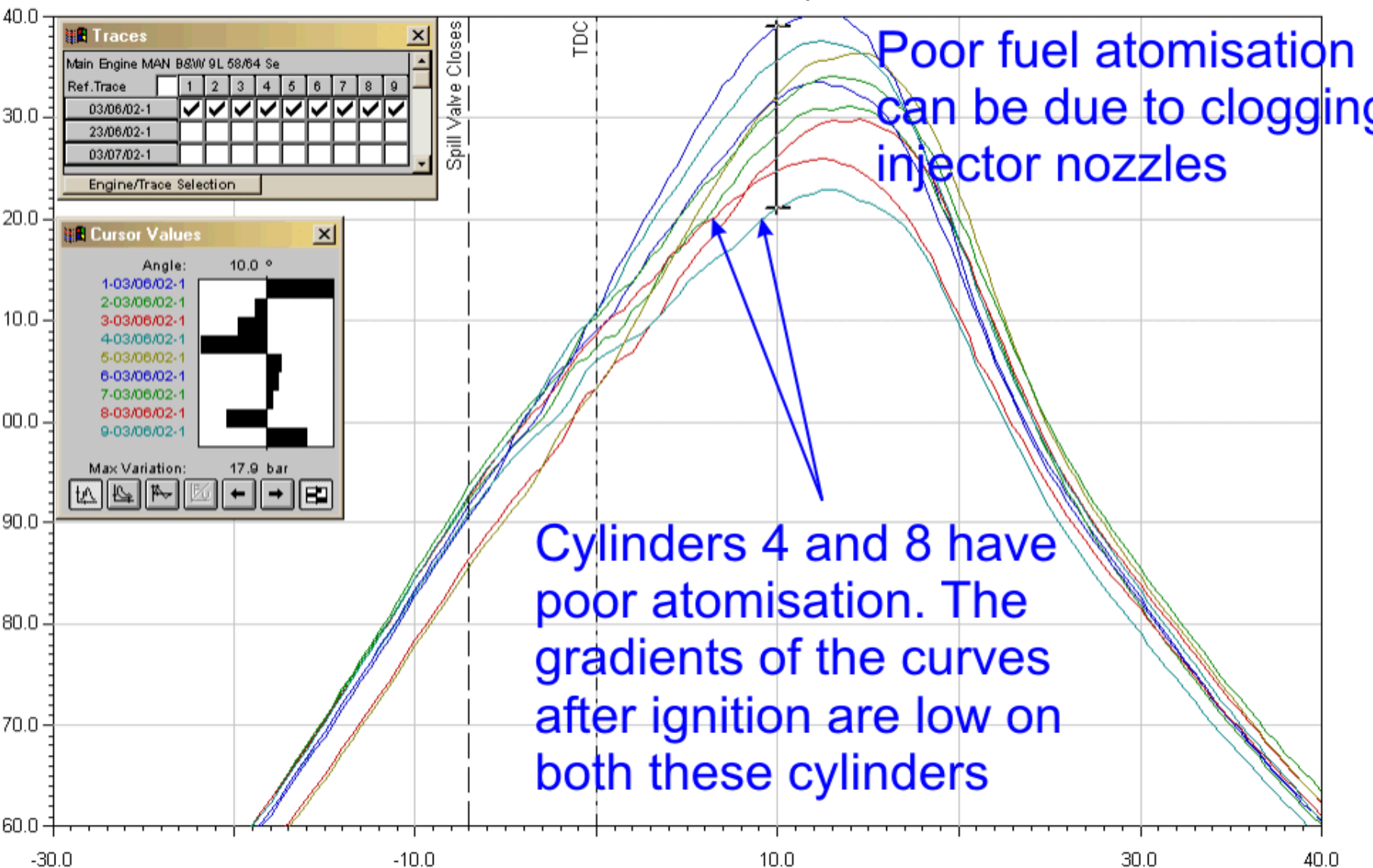
4-Stroke Analysis

Incorrect Timing



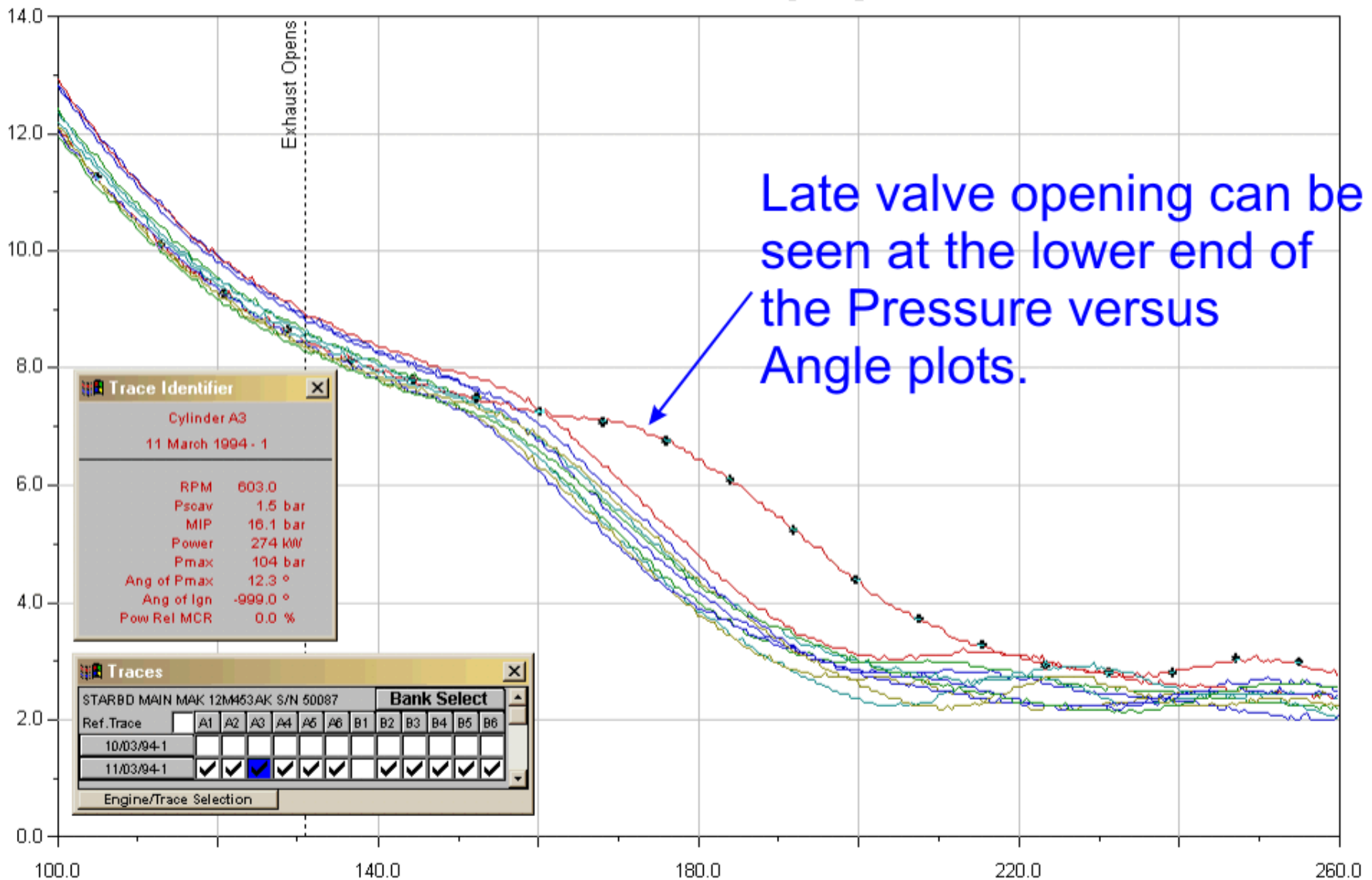
4-Stroke Analysis

Poor Atomisation on Two Cylinders



4-Stroke Analysis

Late Exhaust Valve Opening



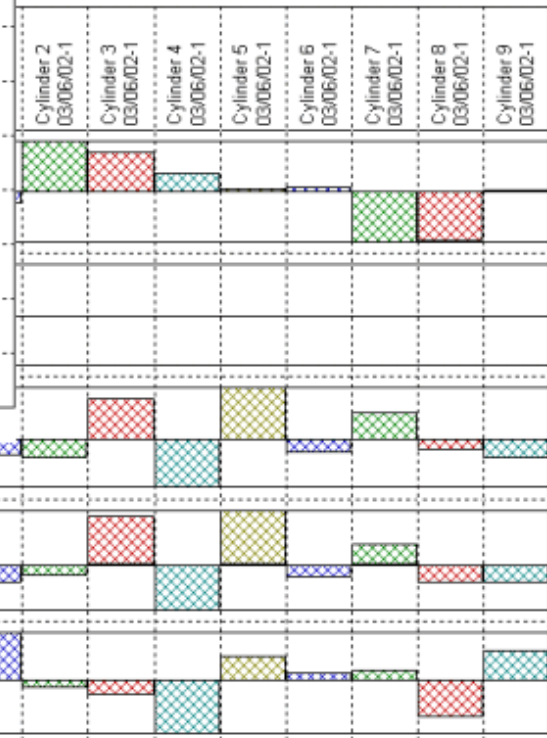
4-Stroke Analysis

Power Results

	Cylinder 1 03/06/02-1	Cylinder 2 03/06/02-1	Cylinder 3 03/06/02-1	Cylinder 4 03/06/02-1	Cylinder 5 03/06/02-1	Cylinder 6 03/06/02-1	Cylinder 7 03/06/02-1	Cylinder 8 03/06/02-1	Cylinder 9 03/06/02-1	Mean	Variation (per cent)	Total
RPM ()	428.9	434.4	433.5	431.6	430.2	430.4	425.4	425.5	430.0	430.0	2.1	
Pscav (bar)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	
MIP (bar)	18.2	18.1	19.6	17.3	19.9	18.2	19.3	18.3	18.1	18.6	13.8	
Power (kW)	1098	1108	1198	1053	1205	1106	1155	1097	1097	1124	13.5	10116.1
Pmax (bar)	140	131	130	123	136	133	134	126	138	132	13.2	
Ang of Pmax (°)	13.0	14.0	14.5	12.5	14.5	12.0	13.0	12.5	12.5	13.2	19.0	
Ang of Ign (°)	-1.5	-4.0	2.0	-3.0	-4.0	-4.0	2.0	1.5	-0.5	-1.3	-469.6	
Pow Rel MCR (%)	79.0	79.7	86.2	75.9	86.8	79.6	83.2	79.0	79.0	80.9	13.5	
Fuel Rack (mm)	73	74	71	74	74	73	71	73	71	73	4.1	
Exh Temp Local (Deg.C)	470	500	500	490	510	465	480	510	485	490	9.2	
T/B rpm (RPM)	13000	13000	13000	13000	13000	13000	13000	13000	13000	13000	0.0	
Scav Air Temp (Deg.C)	61	61	61	61	61	61	61	61	61	61	0.0	

13.5 % variation is more than desirable. Under 10% would be OK

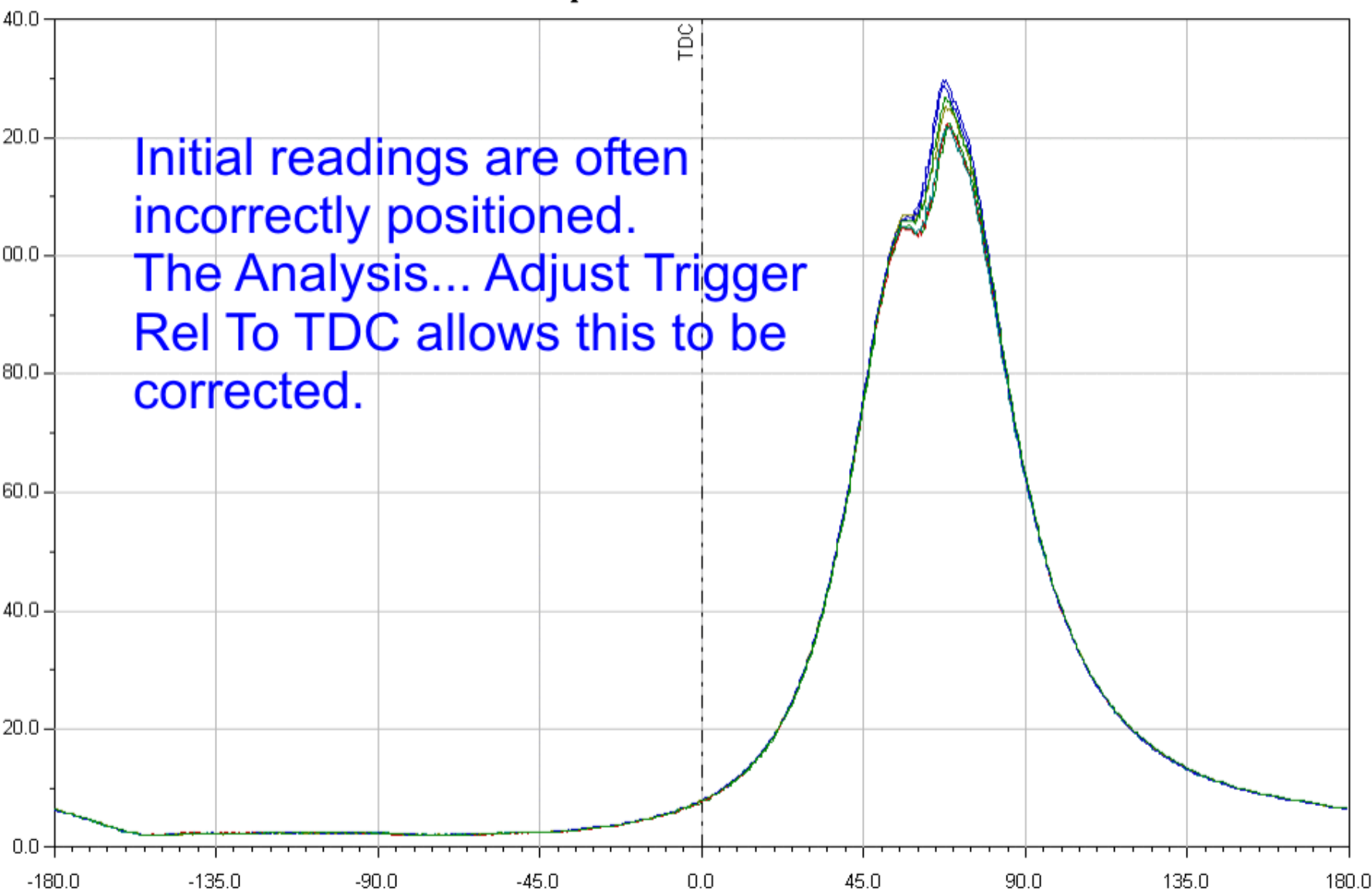
Power Results



Tables show totals and variations, bar graphs give instant visual comparison

TDC Adjustment

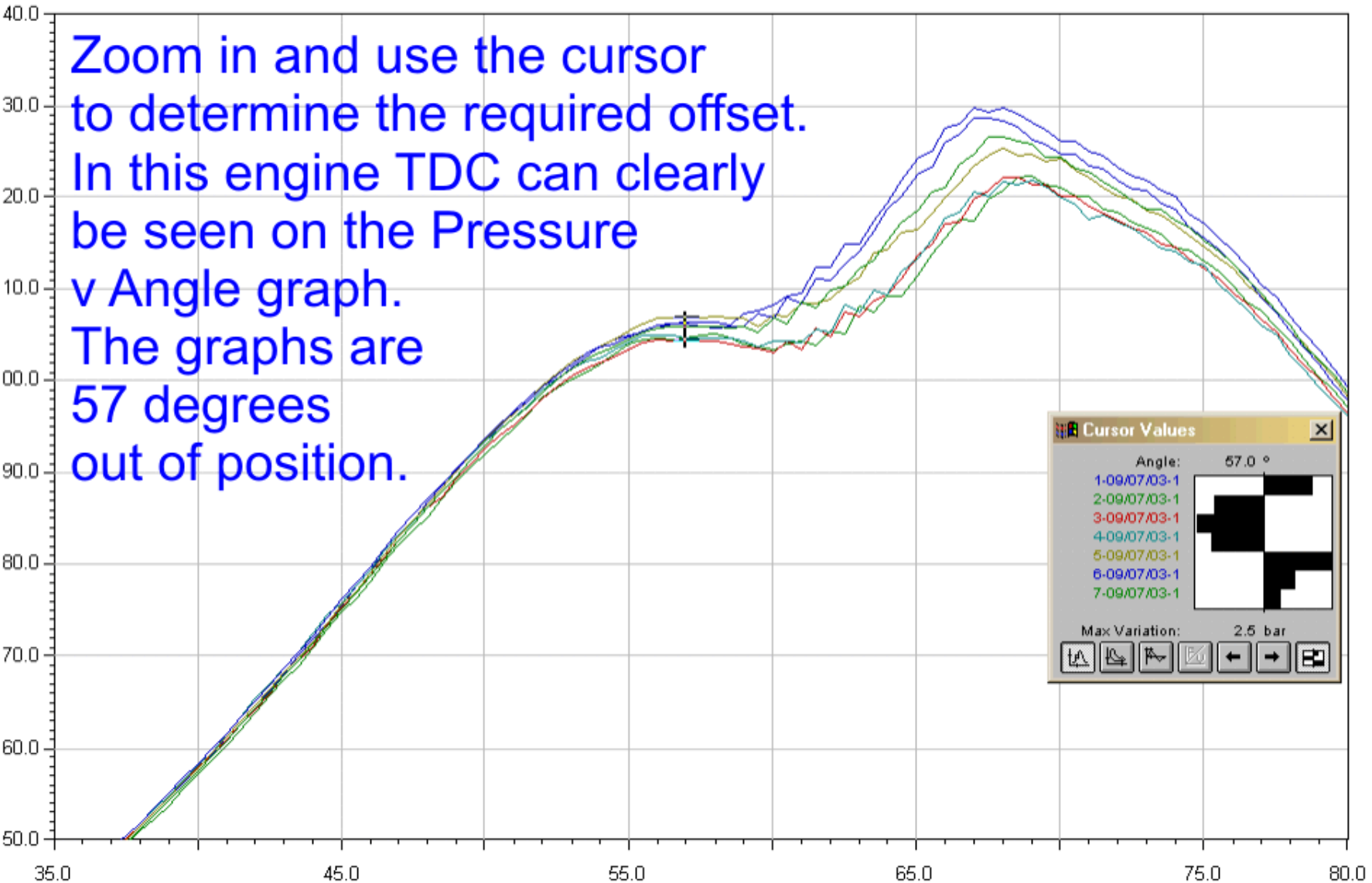
Offset Graphs Due to Incorrect TDC Offset



TDC Adjustment

Offset Graphs Due to Incorrect TDC Offset

Zoom in and use the cursor
to determine the required offset.
In this engine TDC can clearly
be seen on the Pressure
v Angle graph.
The graphs are
57 degrees
out of position.



TDC Adjustment

Offset Graphs Due to Incorrect TDC Offset

The offset to enter is -57 degrees for all cylinders to correct the 57 degree error. All cylinders normally have the same offset applied.

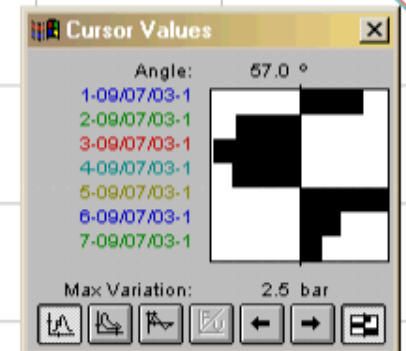
Adjust Trigger Relative To TDC

Trace	Trigger Rel. To TDC (degrees)	Trigger Angle Change (degrees)
Cylinder 1 - Test 1	0.0	-57.0
Cylinder 2 - Test 1	0.0	-57.0
Cylinder 3 - Test 1	0.0	-57.0
Cylinder 4 - Test 1	0.0	-57.0
Cylinder 5 - Test 1	0.0	-57.0
Cylinder 6 - Test 1	0.0	-57.0
Cylinder 7 - Test 1	0.0	-57.0

Apply To:
☒ Traces And New Data
☐ Traces Only

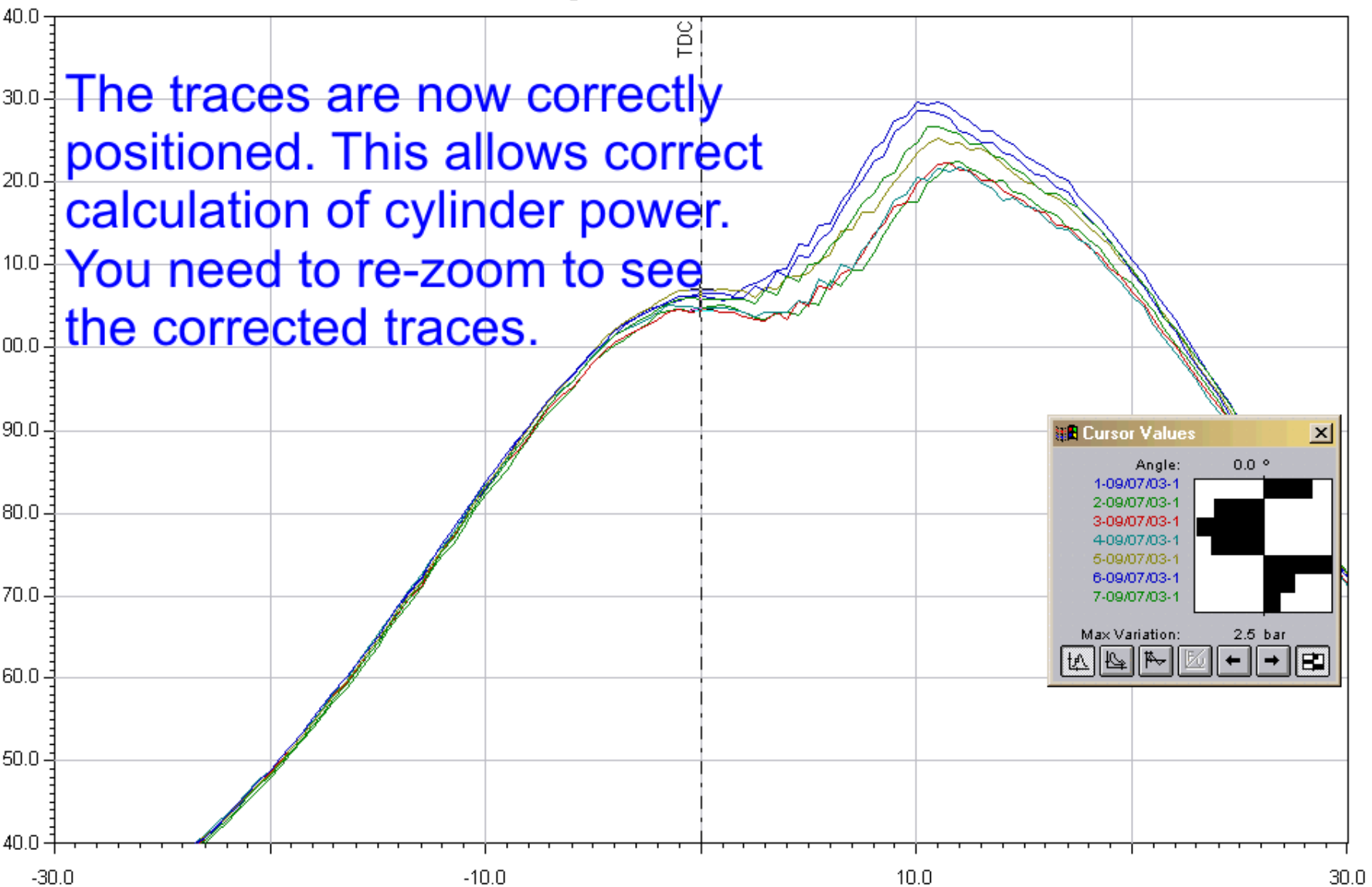
Set All To: -57

OK
Cancel



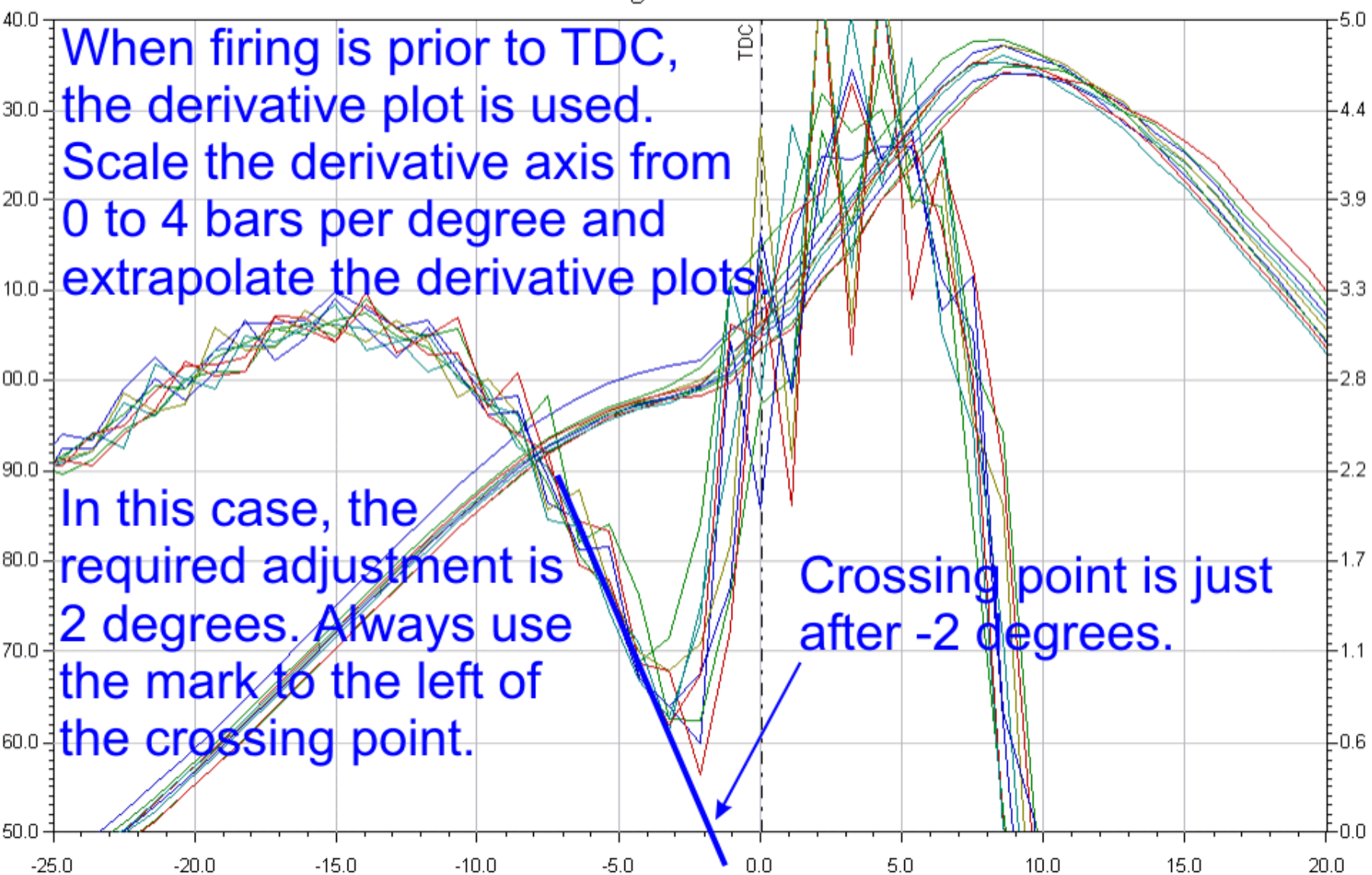
TDC Adjustment

Offset Graphs Due to Incorrect TDC Offset



TDC Adjustment

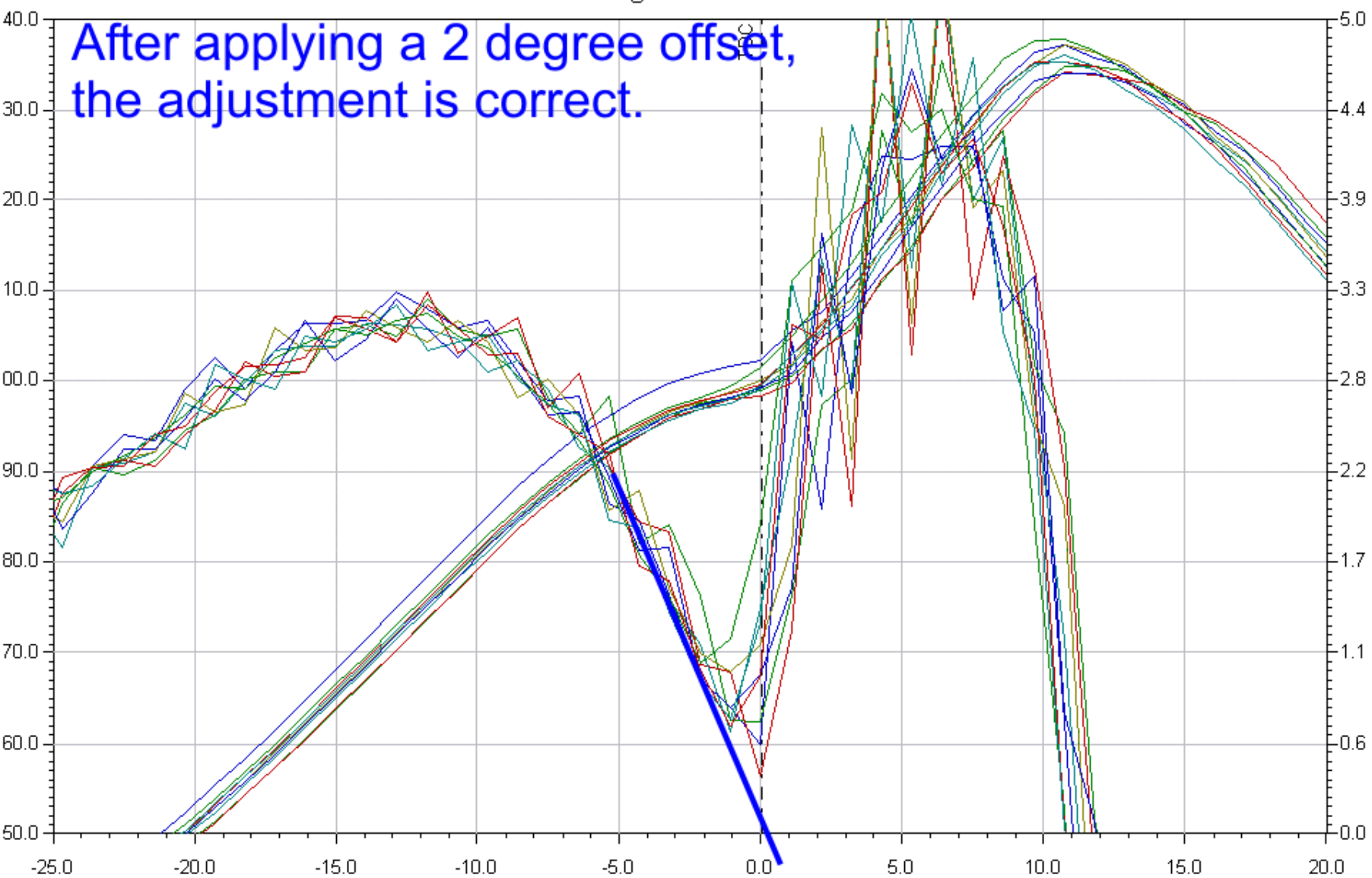
Firing Prior to TDC



TDC Adjustment

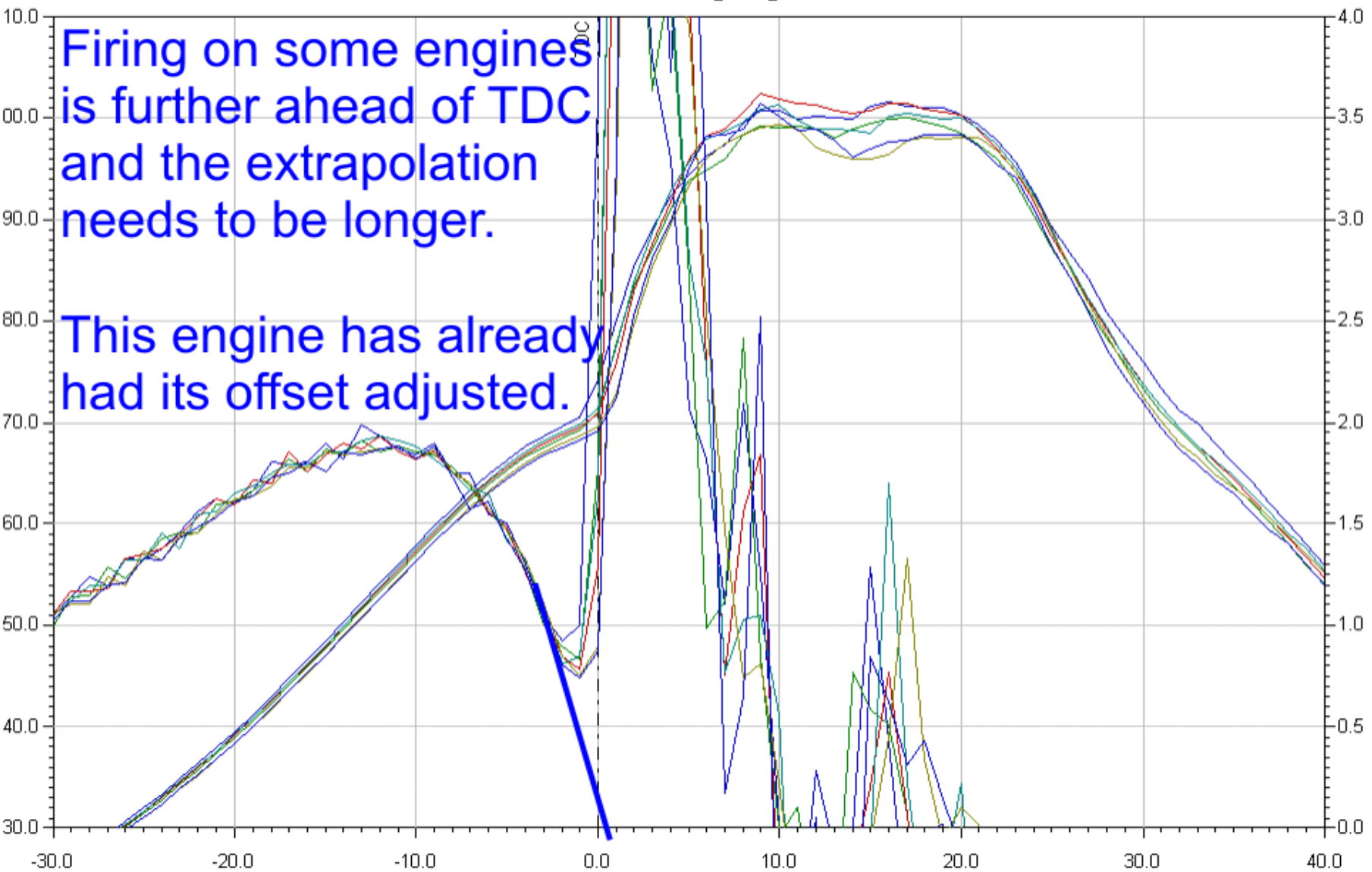
Firing Prior to TDC

After applying a 2 degree offset,
the adjustment is correct.



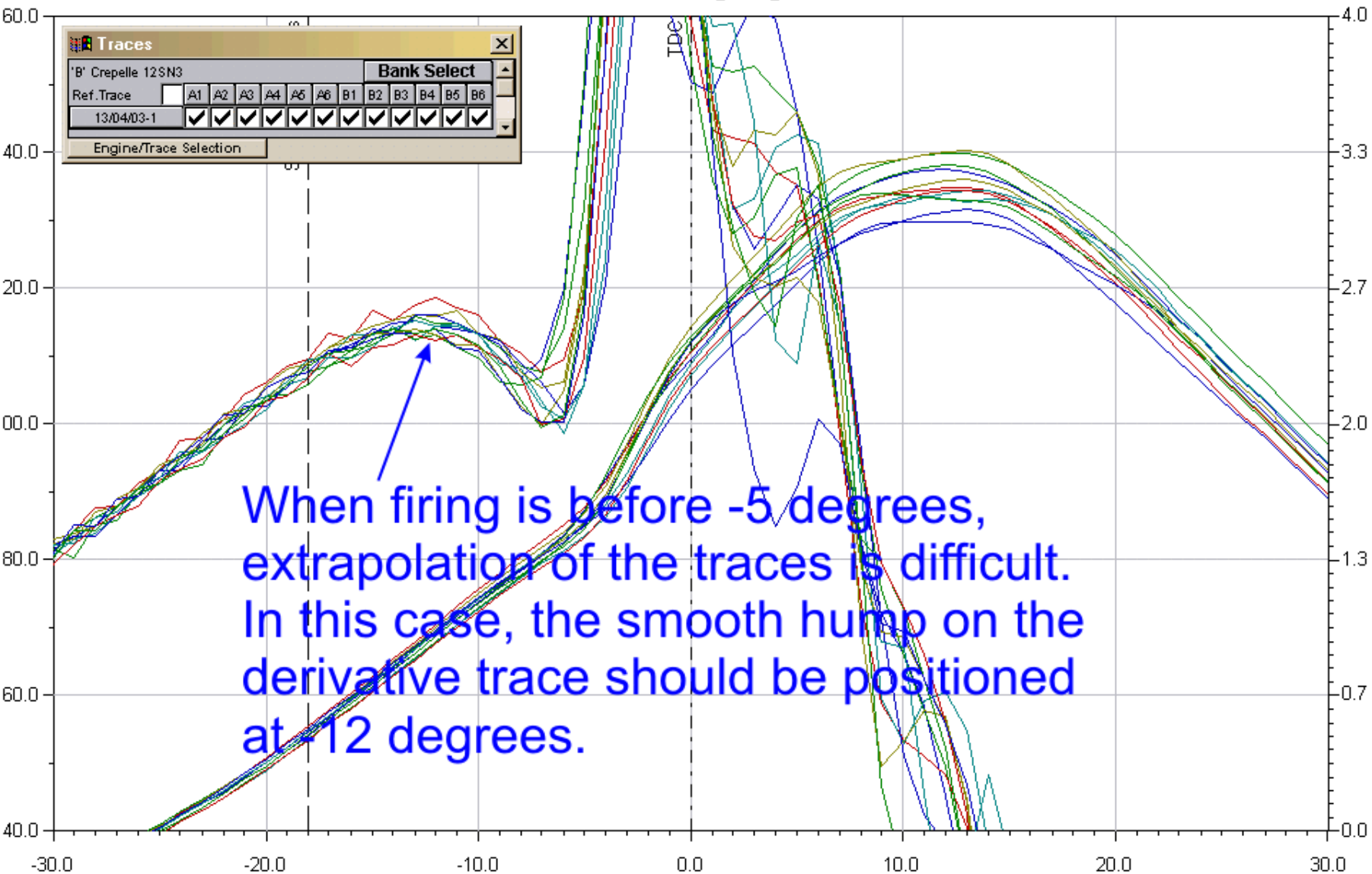
TDC Adjustment

Earlier Firing Engine



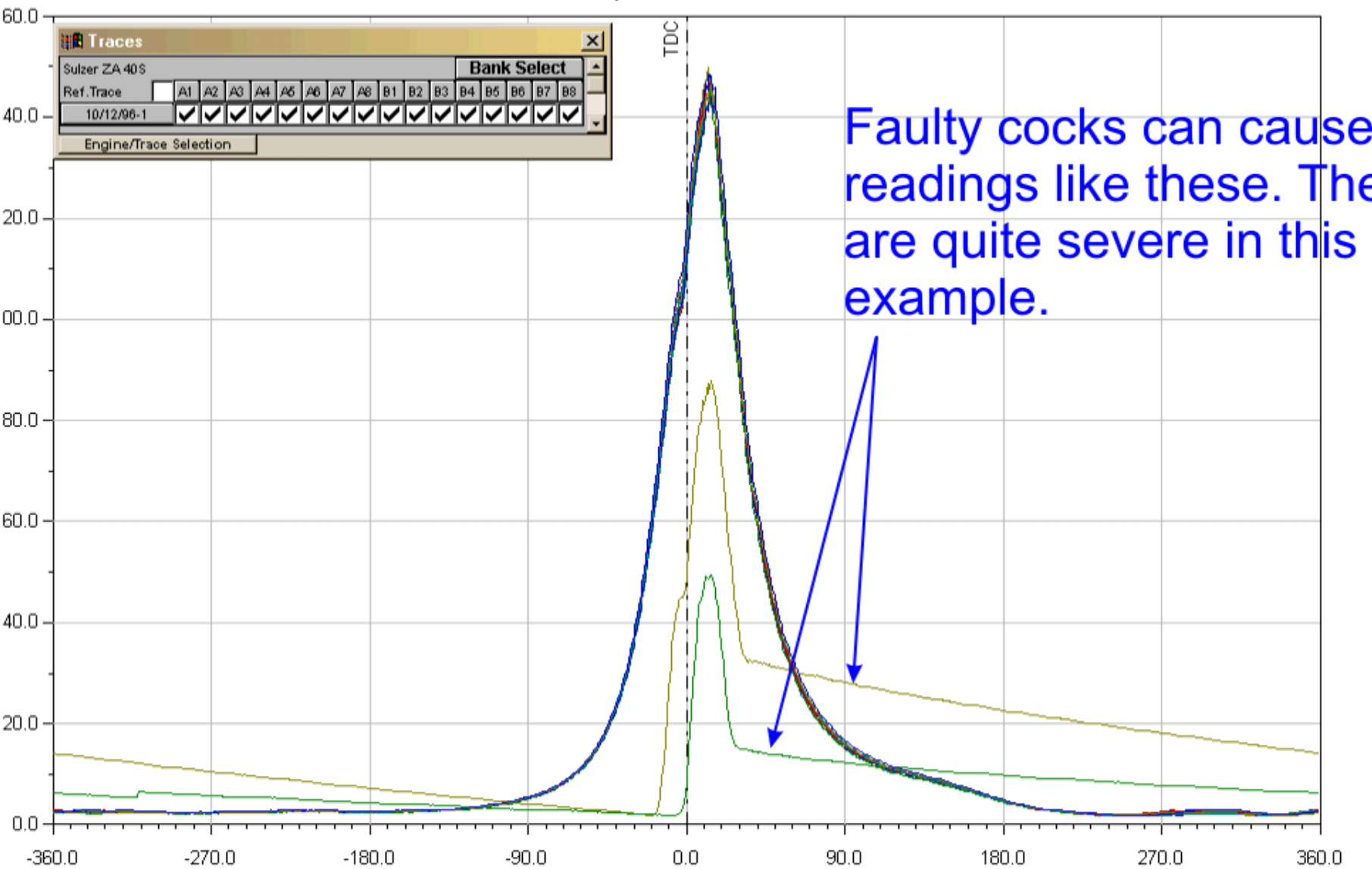
TDC Adjustment

Earlier Firing Engine



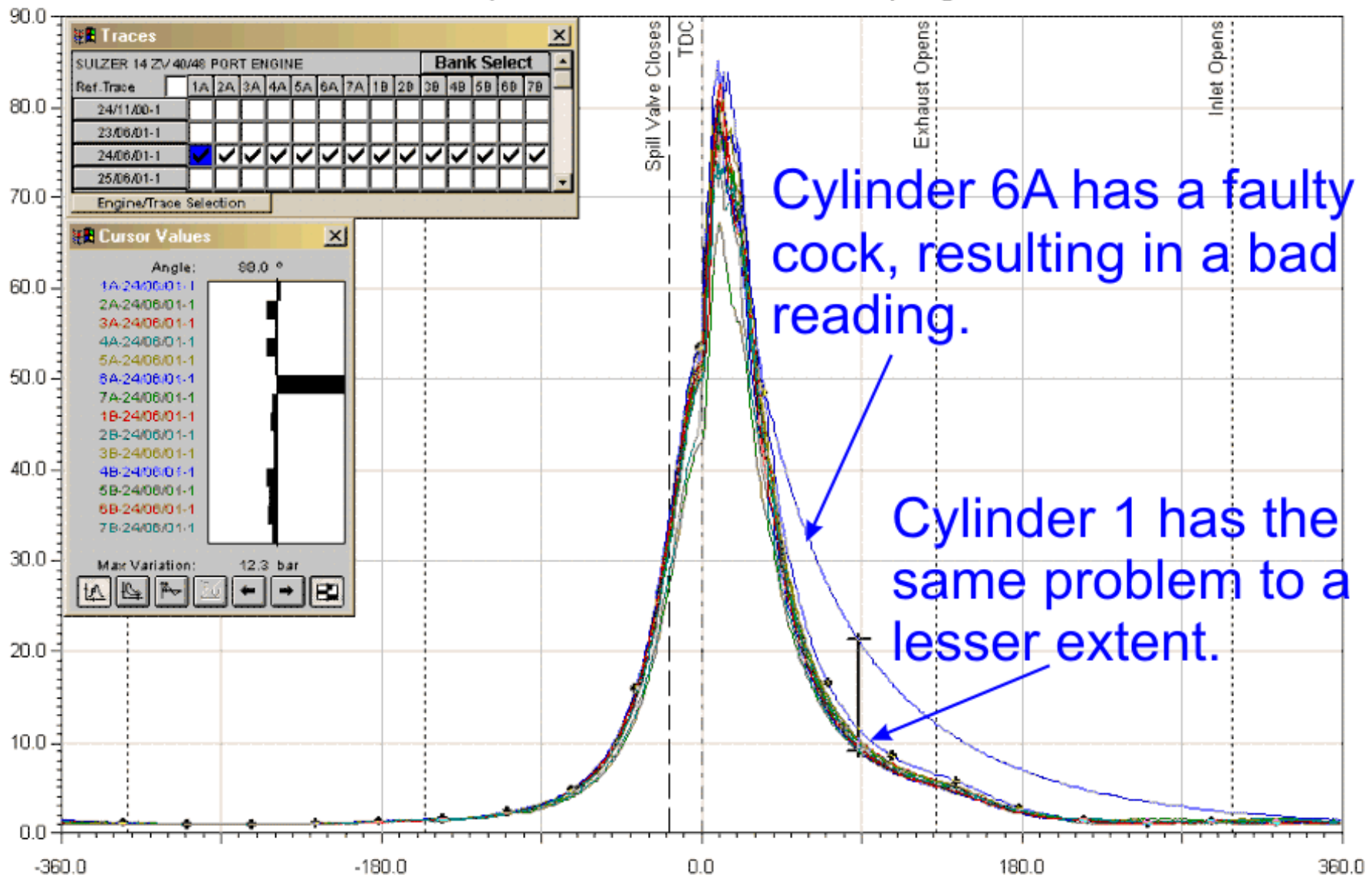
Troubleshooting

Faulty Indicator Cocks



Troubleshooting

Faulty Cocks, One Severe and One Only Slight



Troubleshooting

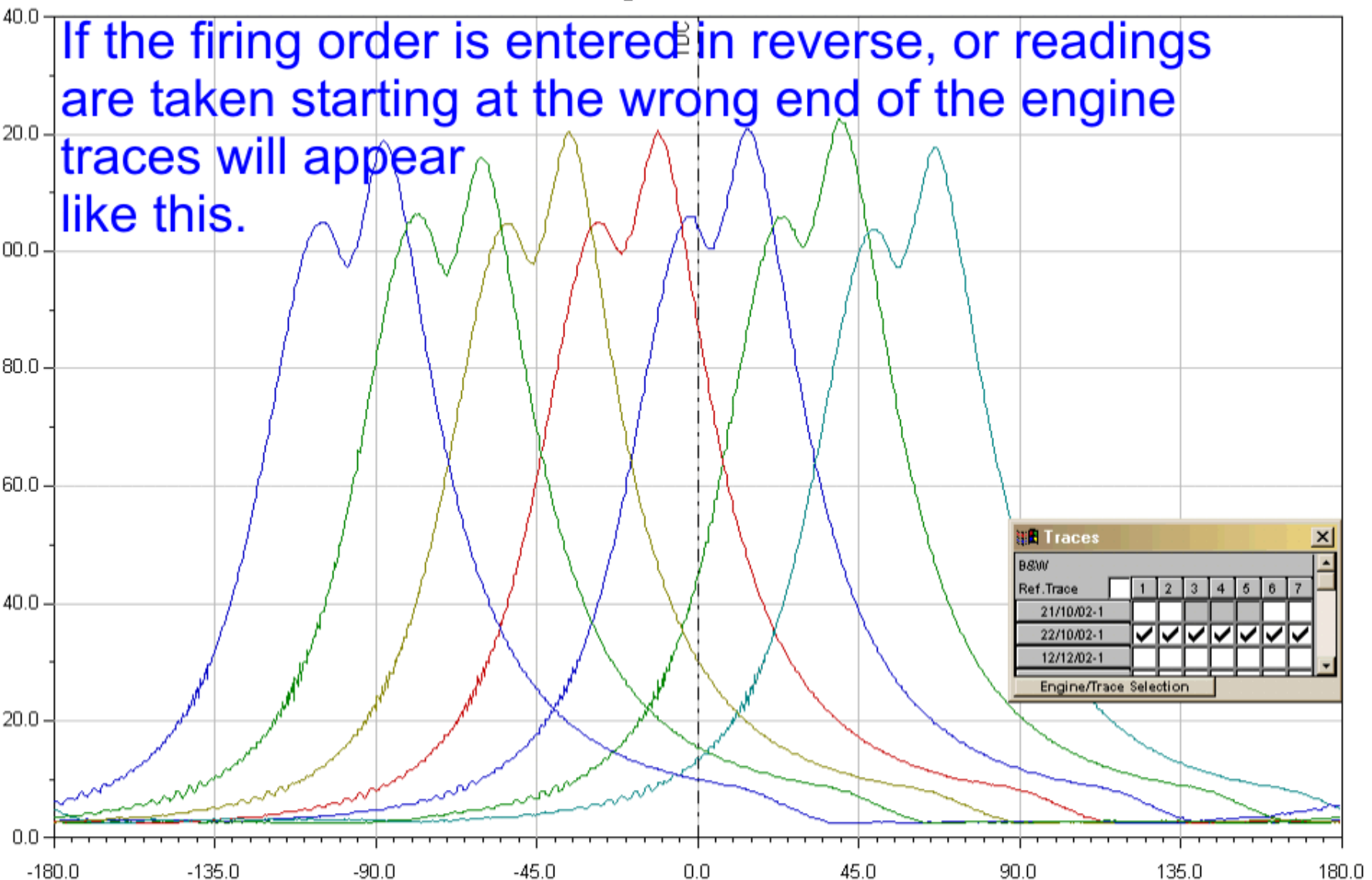
Restricted Indicator Cock or Passageway



Troubleshooting

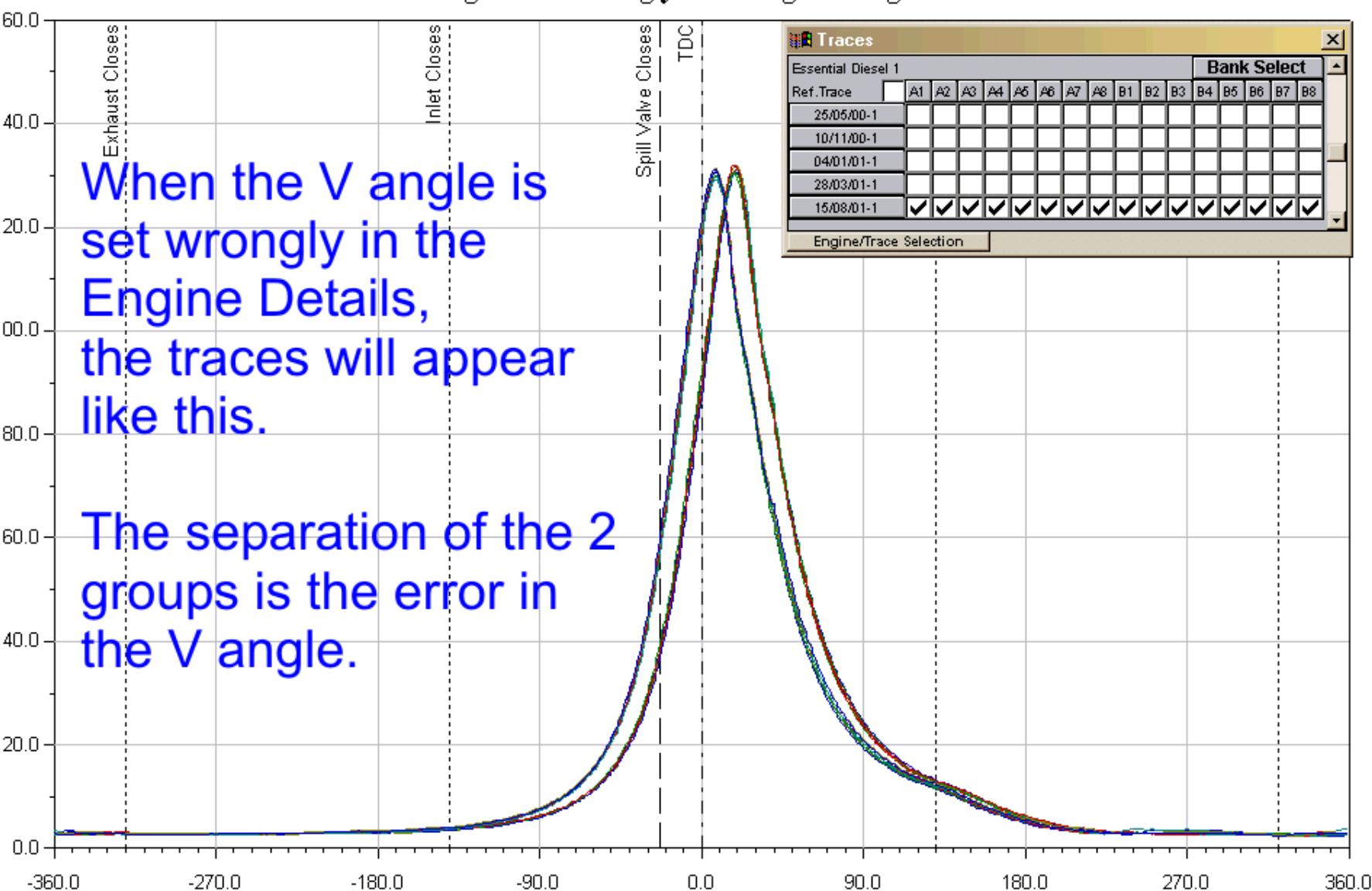
Firing Order Reversed

If the firing order is entered in reverse, or readings are taken starting at the wrong end of the engine traces will appear like this.



Troubleshooting

V Engine with wrongly set V Angle in Engine Data

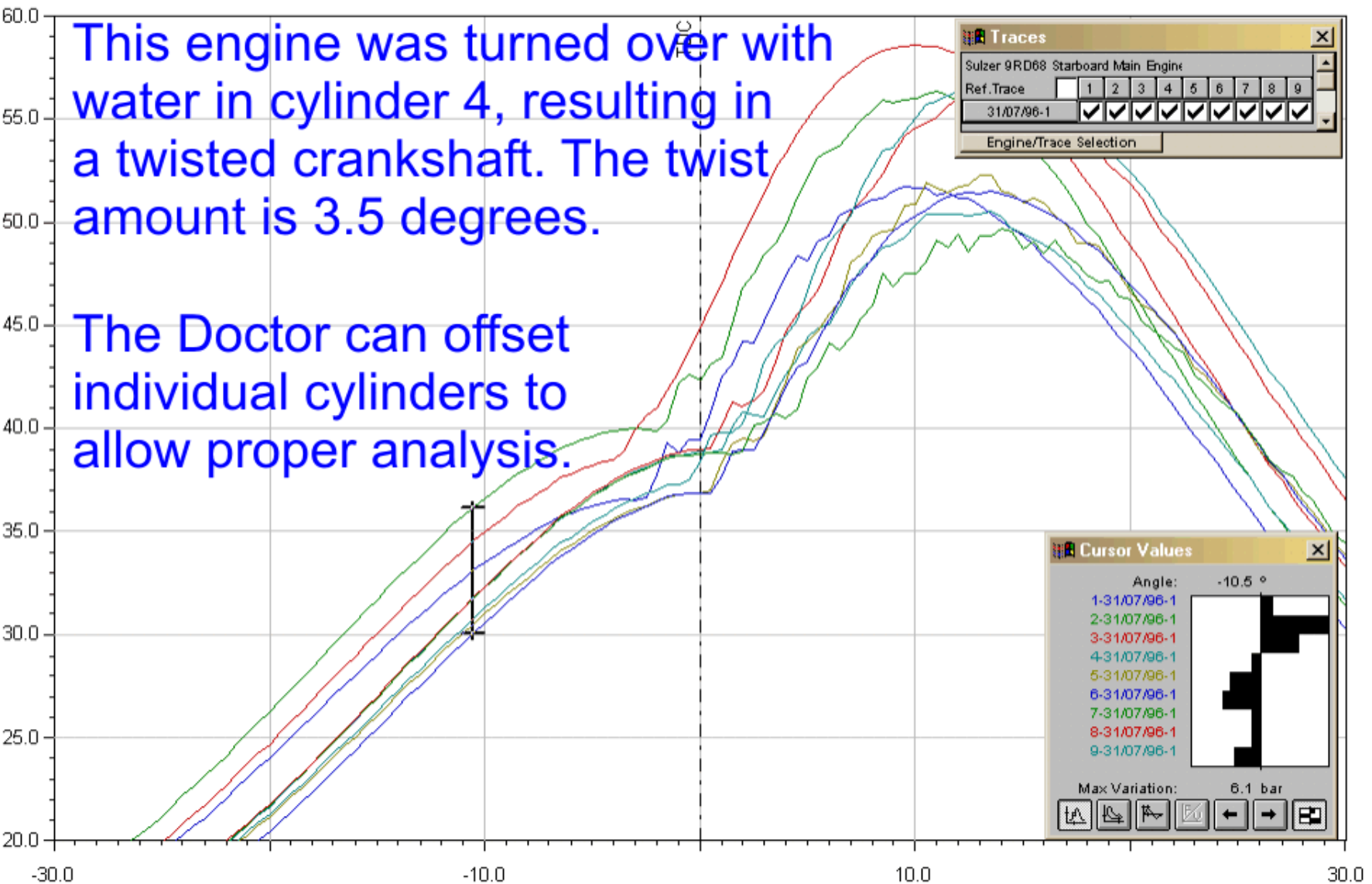


Troubleshooting

Twisted Crankshaft

This engine was turned over with water in cylinder 4, resulting in a twisted crankshaft. The twist amount is 3.5 degrees.

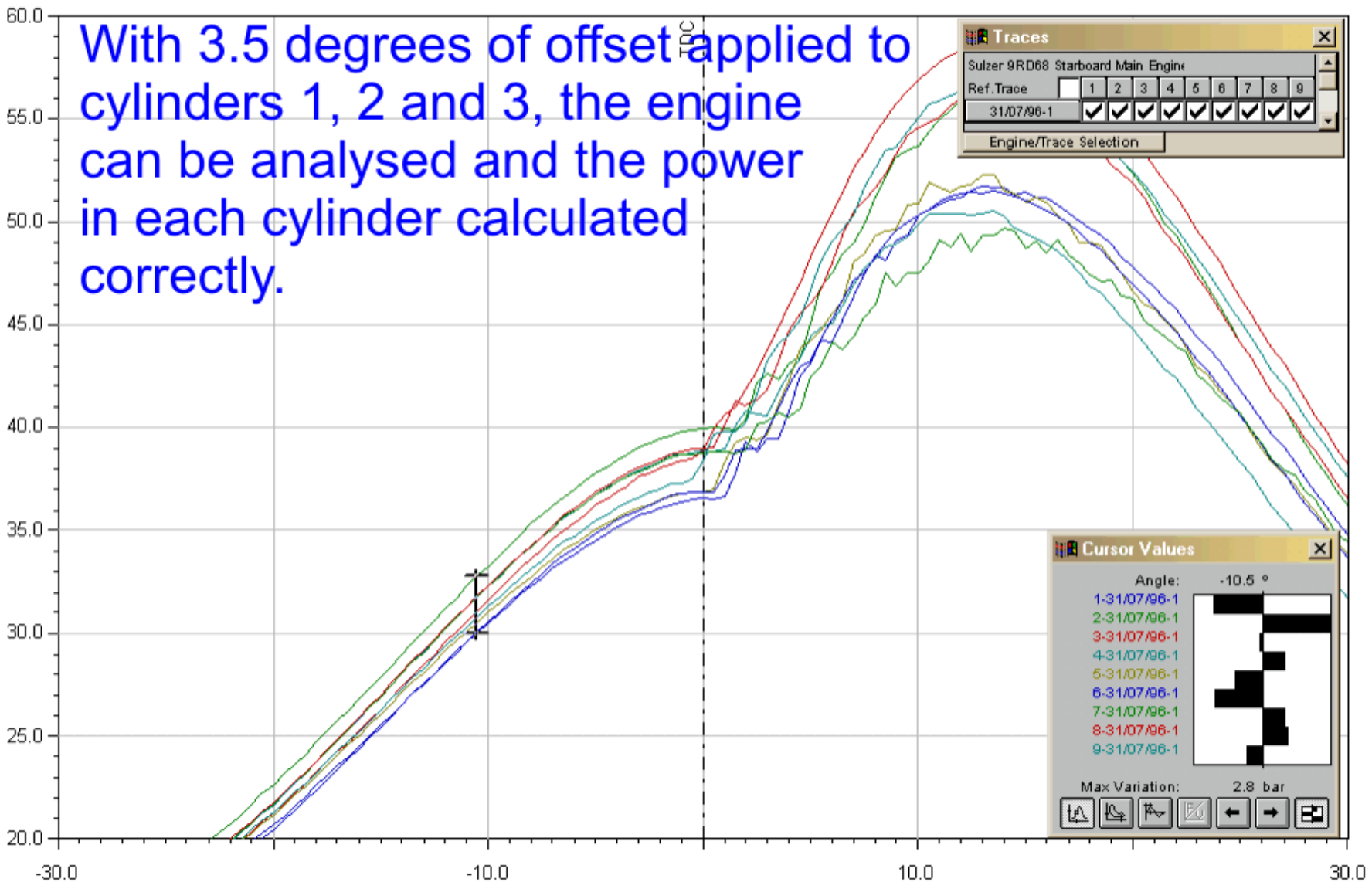
The Doctor can offset individual cylinders to allow proper analysis.



Troubleshooting

Twisted Crankshaft

With 3.5 degrees of offset applied to cylinders 1, 2 and 3, the engine can be analysed and the power in each cylinder calculated correctly.

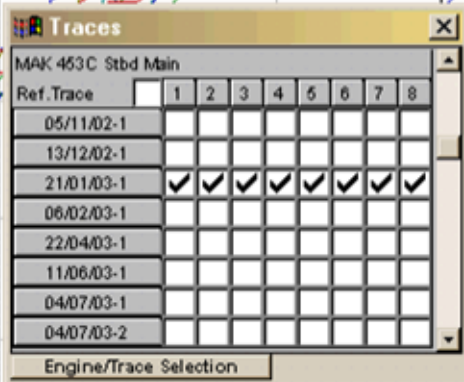


Troubleshooting

4-Stroke With Uneven Firing

An spread of the traces at TDC can indicate uneven revs on a 4-stroke engine. The solution is to fit dual crank pickups to track speed changes

Spread ~ 5 degrees



Troubleshooting

4-Stroke With Uneven Firing - Dual Pickups Fitted

Dual pickups track the speed changes and the spread is now minimal.

