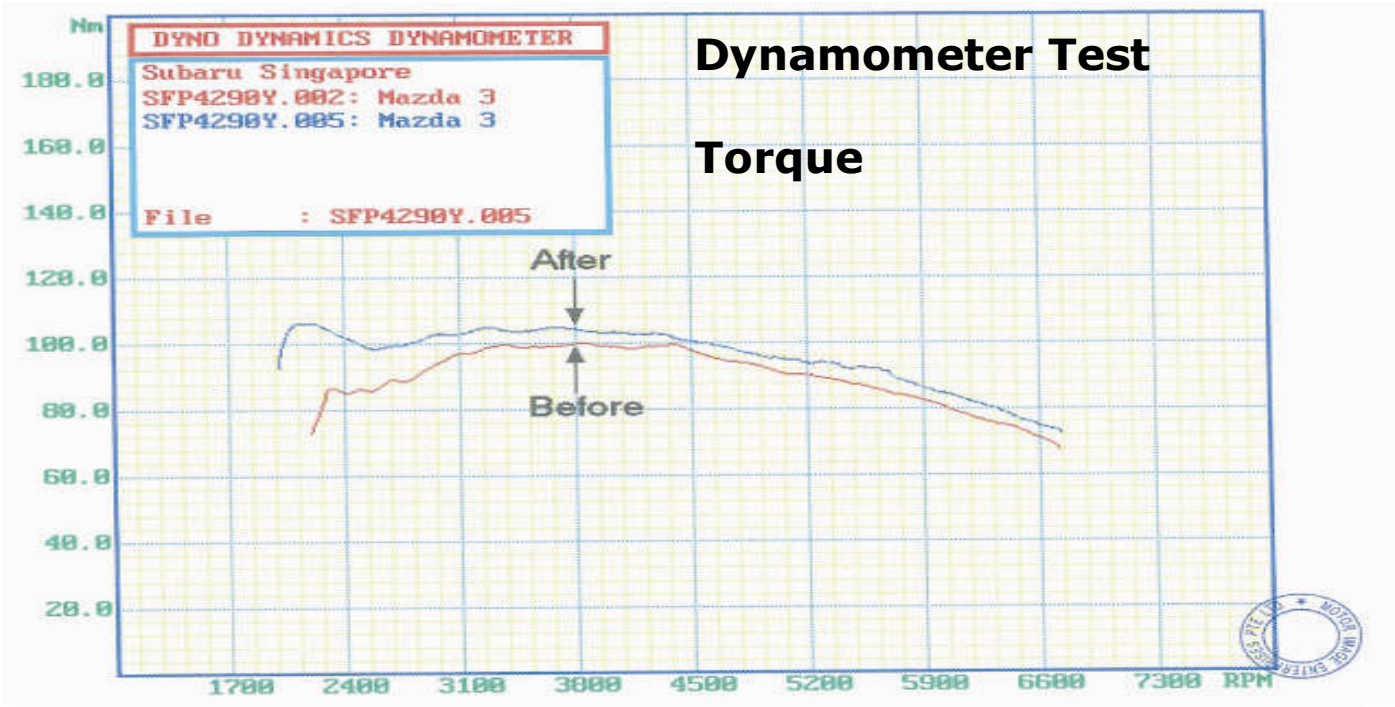
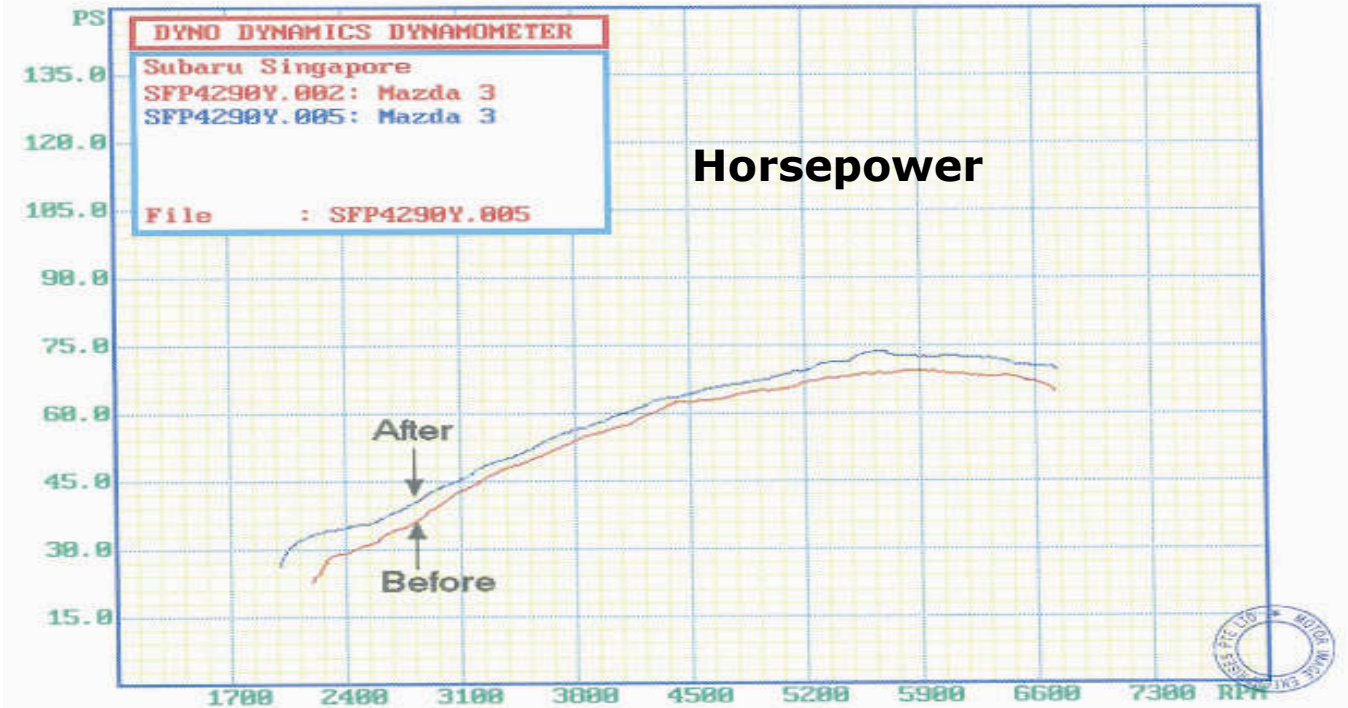

GREEN PLUS

Dyno & Engine Pressure Analysis

- Dynamometer Test
  - Subaru – Motor Image Enterprises
  - Dyno Used – Dyno Dynamics
  - Car Tested – Mazda 3

- Engine Pressure Analysis
  - UM2 Performance Tuning
  - Car Tested – Toyota Wish


Nm
DYNO DYNAMICS DYNAMOMETER
Subaru Singapore
SFP4290Y.002: Mazda 3
SFP4290Y.005: Mazda 3
File : SFP4290Y.005
Dynamometer Test
Torque
After
Before
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
1700
2400
3100
3800
4500
5200
5900
6600
7300
RPM


PS
DYNO DYNAMICS DYNAMOMETER
Subaru Singapore
SFP4290Y.002: Mazda 3
SFP4290Y.005: Mazda 3
File : SFP4290Y.005
Horsepower
After
Before
135.0
120.0
105.0
90.0
75.0
60.0
45.0
30.0
15.0
1700
2400
3100
3800
4500
5200
5900
6600
7300
RPM

Engine Pressure Analysis

Used by major OEM manufacturers and F1 Racing teams to study the in cylinder combustion process.

Utilising pressure sensors located in the combustion chamber to record pressure data. It is akin to having a window to the combustion chamber.

Engine Pressure Analysis provides insights of what the activities in the combustion chamber during combustion which no other equipment can do.

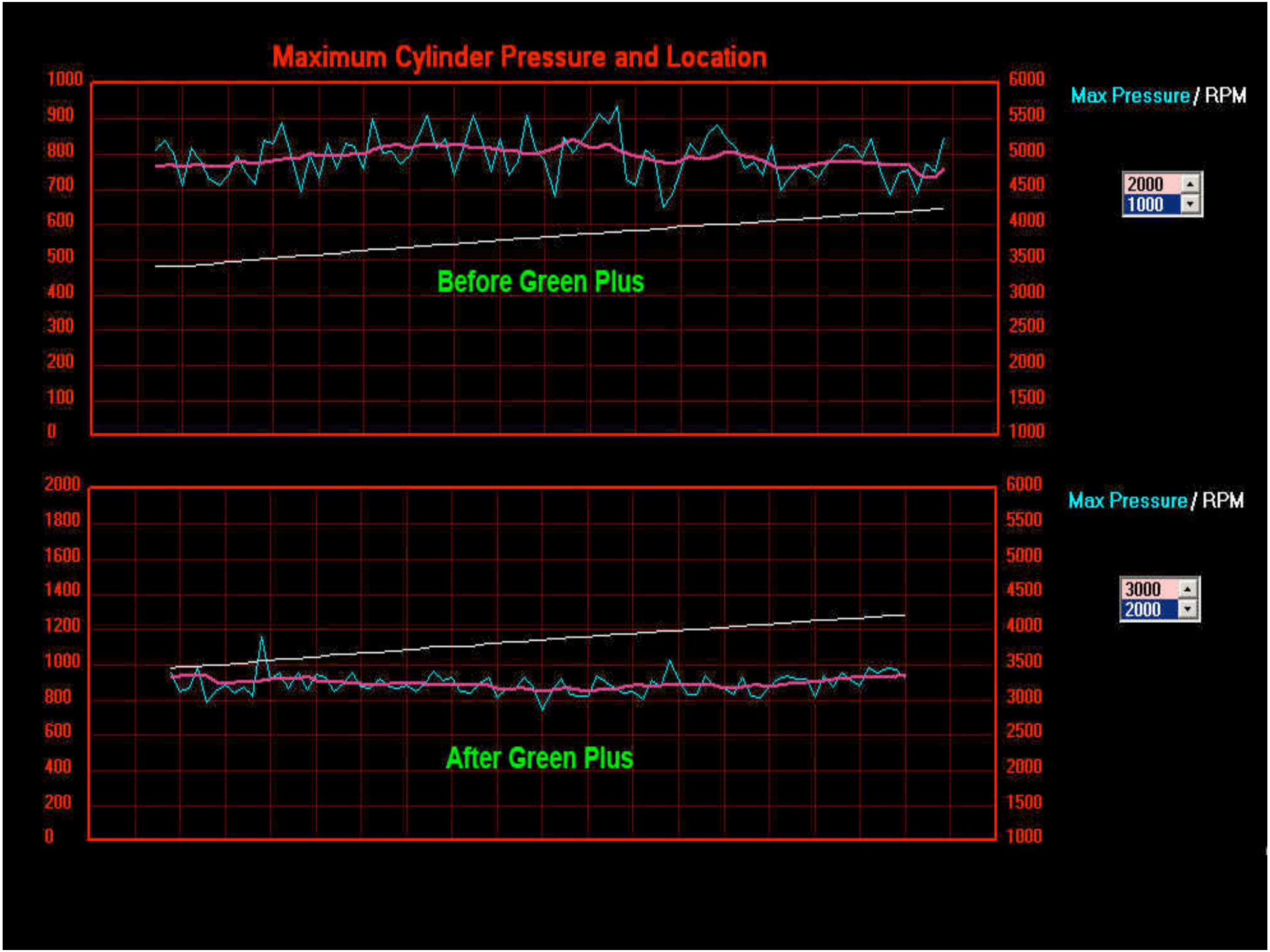
The various graphs and data will assist the user in understanding and explaining what is/are the exact causes of higher or lower horsepower and torque.

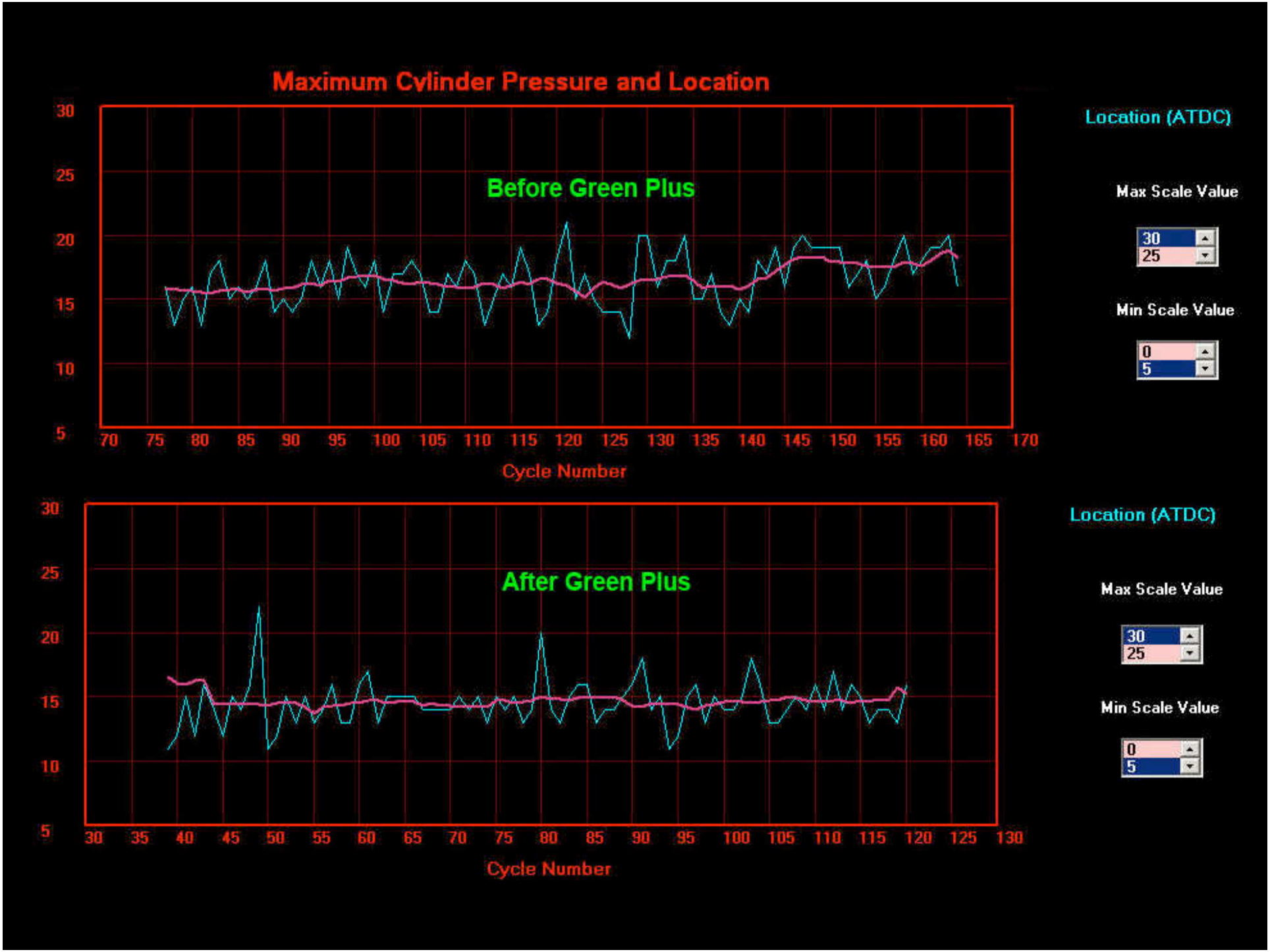
Equipment

- A spark plug with a fibre optic pressure sensor inserted
- A crank sensor
- A crank trigger wheel
- Data Logger
- Software to interpret the data

Procedure

- Conduct a before and after treatment data logging runs
- 2 types of run will be recorded; Steady State Load and Wide Open Throttle (WOT)
- Each log will consist of about 5 to 8 seconds worth of data


Maximum Cylinder Pressure and Location
1000
900
800
700
600
500
400
300
200
100
0
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
Max Pressure / RPM
2000
1000
Before Green Plus
2000
1800
1600
1400
1200
1000
800
600
400
200
0
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
Max Pressure / RPM
3000
2000
After Green Plus


Maximum Cylinder Pressure and Location
Before Green Plus
30
25
20
15
10
5
70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170
Cycle Number
Location (ATDC)
Max Scale Value
30
25
Min Scale Value
0
5
After Green Plus
30
25
20
15
10
5
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130
Cycle Number
Location (ATDC)
Max Scale Value
30
25
Min Scale Value
0
5

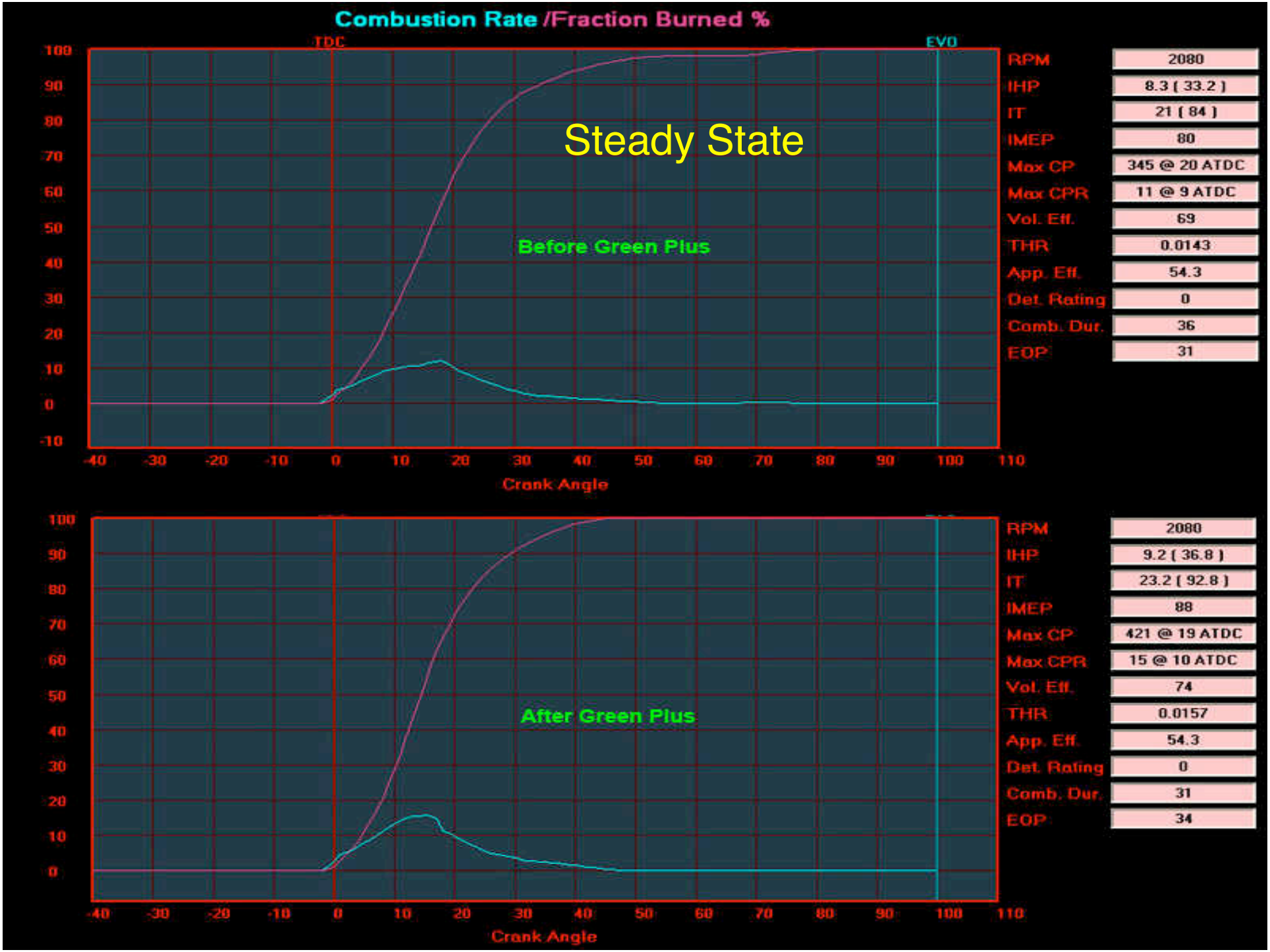
Maximum Cylinder Pressure and Location

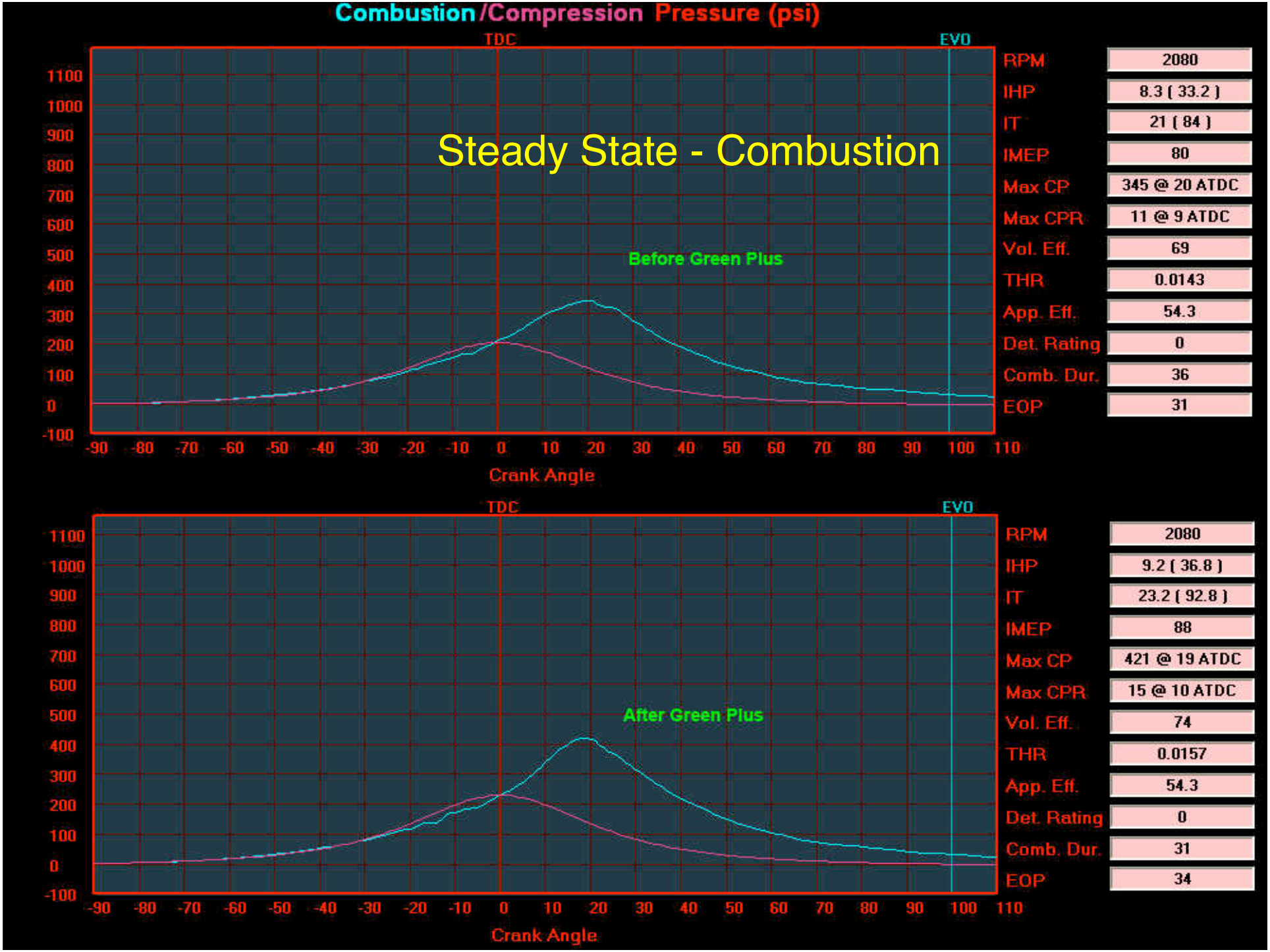
- Graph shows maximum pressure and location of maximum pressure relative to TDC (Top Dead Center)
- White line is RPM (Revolution Per Minute)
- Blue line is the value for each cycle
- Pink line is the average value

Differences between before and after:

- Less variation between each cycle
- Higher average value
- Ascending average value at higher RPM
- Maximum pressure occurring earlier for fuel with catalyst particularly at higher RPM
- Maximum pressure occurring later for non treated fuel particularly at higher RPM

Individual Graphs at Particular RPM


Combustion Rate /Fraction Burned %
TDC
EVO
Steady State
Before Green Plus
RPM 2080
IHP 8.3 (33.2)
IT 21 (84)
IMEP 80
Max CP 345 @ 20 ATDC
Max CPR 11 @ 9 ATDC
Vol. Eff. 69
THR 0.0143
App. Eff. 54.3
Det. Rating 0
Comb. Dur. 36
EOP 31
Crank Angle
After Green Plus
RPM 2080
IHP 9.2 (36.8)
IT 23.2 (92.8)
IMEP 88
Max CP 421 @ 19 ATDC
Max CPR 15 @ 10 ATDC
Vol. Eff. 74
THR 0.0157
App. Eff. 54.3
Det. Rating 0
Comb. Dur. 31
EOP 34
Crank Angle

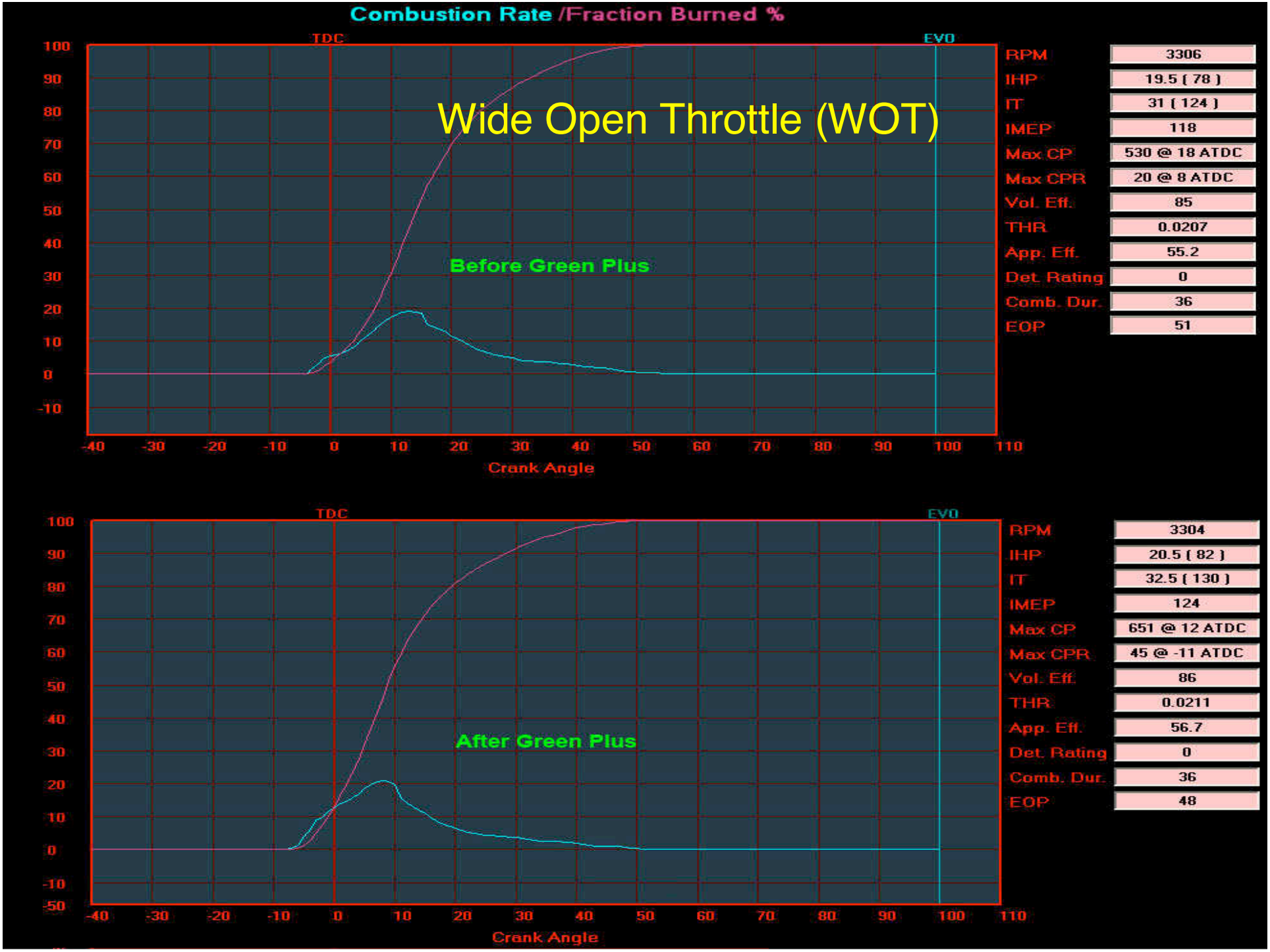

Combustion/Compression Pressure (psi)
TDC
EVO
Steady State - Combustion
Before Green Plus
RPM 2080
IHP 8.3 (33.2)
IT 21 (84)
IMEP 80
Max CP 345 @ 20 ATDC
Max CPR 11 @ 9 ATDC
Vol. Eff. 69
THR 0.0143
App. Eff. 54.3
Det. Rating 0
Comb. Dur. 36
EOP 31
1100 1000 900 800 700 600 500 400 300 200 100 0 -100
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
Crank Angle
TDC
EVO
After Green Plus
RPM 2080
IHP 9.2 (36.8)
IT 23.2 (92.8)
IMEP 88
Max CP 421 @ 19 ATDC
Max CPR 15 @ 10 ATDC
Vol. Eff. 74
THR 0.0157
App. Eff. 54.3
Det. Rating 0
Comb. Dur. 31
EOP 34
1100 1000 900 800 700 600 500 400 300 200 100 0 -100
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110
Crank Angle

Steady Load Before Treatment vs After Treatment

	Before Green Plus	After Green Plus
RPM	2080	2080
IHP	8.3 (33.2)	9.2 (36.8)
IT	21 (84)	23.2 (92.8)
IMEP	80	88
Max CP	345 at 20 ATDC	421 at 19 ATDC
Vol Eff	69	74
THR	0.0143	0.0157
App Eff	54.3	54.3

Summary:

- Indicated Horsepower, Torque and Max Compression Pressure are higher after treatment.
- Maximum Compression Pressure occurring earlier – faster burn rate
- Increased in volumetric efficiency
- More heat is produced as indicated by higher THR


Combustion Rate /Fraction Burned %
TDC
EVO
Wide Open Throttle (WOT)
Before Green Plus
Crank Angle
RPM 3306
IHP 19.5 (78)
IT 31 (124)
IMEP 118
Max CP 530 @ 18 ATDC
Max CPR 20 @ 8 ATDC
Vol. Eff. 85
THR 0.0207
App. Eff. 55.2
Det. Rating 0
Comb. Dur. 36
EOP 51
TDC
EVO
After Green Plus
Crank Angle
RPM 3304
IHP 20.5 (82)
IT 32.5 (130)
IMEP 124
Max CP 651 @ 12 ATDC
Max CPR 45 @ -11 ATDC
Vol. Eff. 86
THR 0.0211
App. Eff. 56.7
Det. Rating 0
Comb. Dur. 36
EOP 48

Wide Open Throttle Before Treatment vs After Treatment

	Before Green Plus	After Green Plus
RPM	3306	3304
IHP	19.5 (78)	20.5 (82)
IT	31(124)	32.5(130)
IMEP	118	124
Max CP	530 at 18 ATDC	651 at 12 ATDC
Vol Eff	85	86
THR	0.0207	0.0211
App Eff	55.2	56.7

Summary:

- Indicated Horsepower, Torque and Max Compression Pressure are higher after treatment.
- Maximum Compression Pressure occurring earlier – faster burn rate
- More heat is produced as indicated by higher THR

Conclusion

The catalyst clearly does make a difference to the max pressure. Maximum pressure is higher and occurs earlier. This is particularly true at higher engine speed where the non-treated fuel max pressure location starts to occur later and later. The burn rate is faster with the additive and the amount of energy release is greater.

Due to the more stable peak to peak combustion cycles, it also indicates that the treated fuel will result in a smoother running engine.

Further the spark plugs from the tested engine have lesser carbon deposit versus plugs from a non fuel-treated engine.

In conclusion, using the treated fuel, one would expect a cleaner and smoother running engine with an increase of about 5% in horsepower and torque.