



University
of Windsor

Faculty of Engineering

Course Group Project

Engine Testing and Performance

MECH 8290-66-R-2022W

Instructor:

Dr. Usman Asad

Prepared By:

Kaivalya Bhavsar (110030931)

Aman Patel (110040705)

Date:

10th April 2022

Combustion Stability:

Combustion stability is defined in terms of the Coefficient of Variation of the Net IMEP.

Combustion Stability is pivotal for the determination of the stability of the engine. The main parameter used to evaluate the stability is the Coefficient of Variation (COV).

The COV is the ratio of the standard deviation normalized with respect to the mean value.

$$\% \text{ COV} = \sigma / \bar{x} * 100$$

The COV is an accepted indicator of combustion stability.

Numerous factors that influence the mode and extent of cycle-to-cycle variation have been identified.

These include fluctuations in the following parameters & factors:[1]

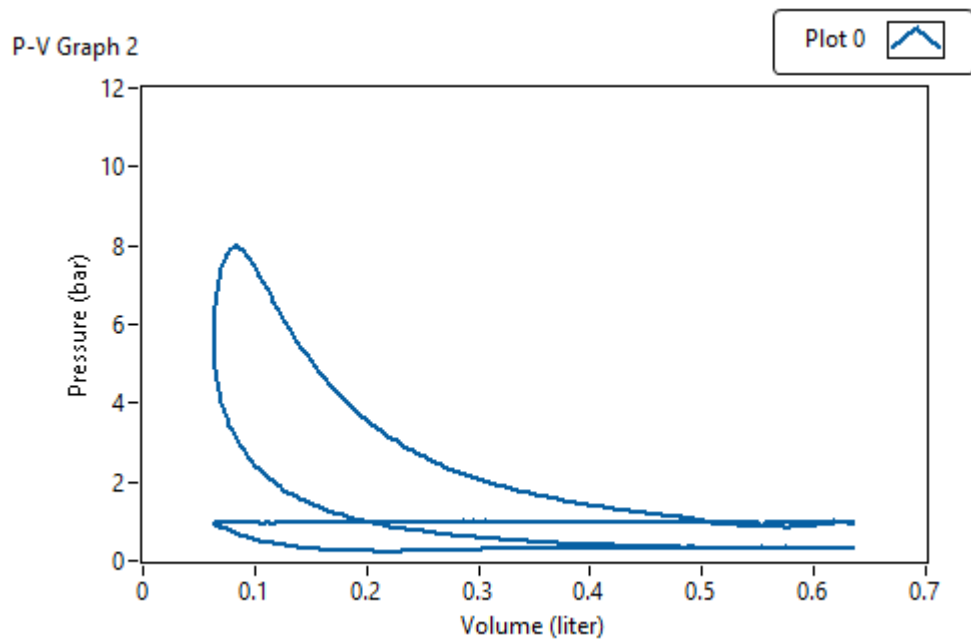
- Intake temperature and pressure
- Intake air/fuel ratio or fuel flow rate
- Coolant and lubrication oil temperatures
- The completeness of combustion in the preceding cycle
- Fuel mixing system

Combustion efficiency is calculated by the proportion of the total released energy to the total energy delivered to the cylinder between the start and end of combustion [2]. The start of combustion of charge mixture can be determined via the second derivative of cylinder pressure value which rises from negative to positive values.

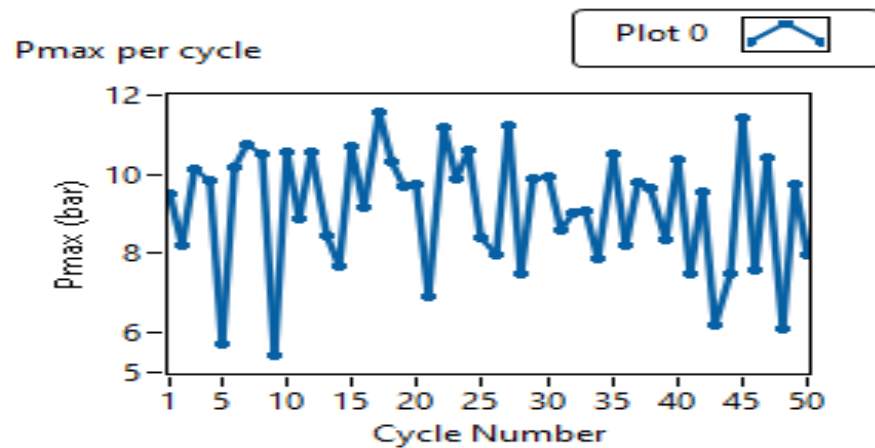
Given Data:

Compression Ratio	10:1
Bore	90 mm
Stroke	90 mm
l/a	3.2

1. PV diagram (pressure in a bar vs volume in liter) (program a 1-sec delay between consecutive cycles)



2. Graphs for Maximum cylinder pressure and its crank angle, maximum rate of pressure rise and its crank angle, and net IMEP are plotted below respectively.



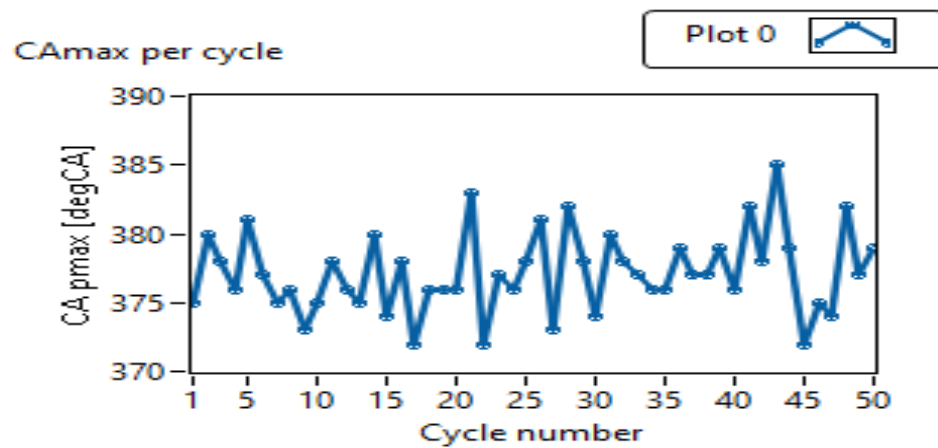


Figure 3: Crank angles per cycle for maximum pressure.

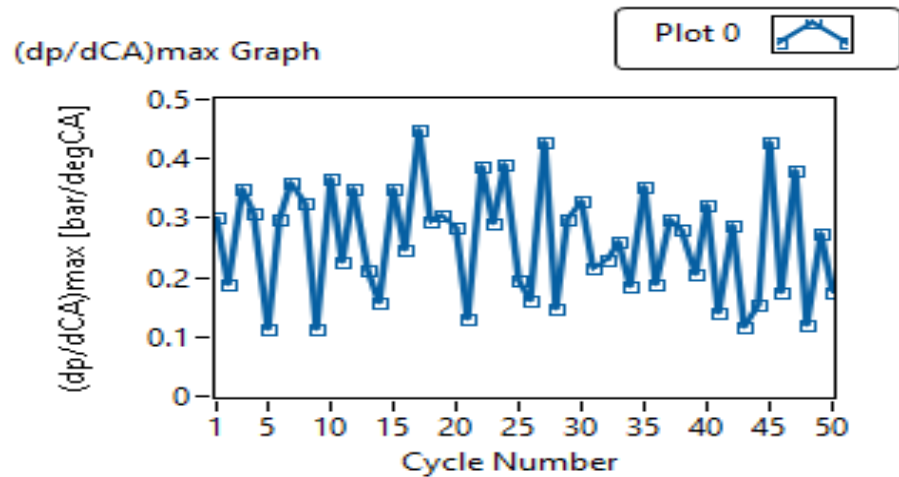


Figure 4: Maximum rate of pressure rise per cycle.

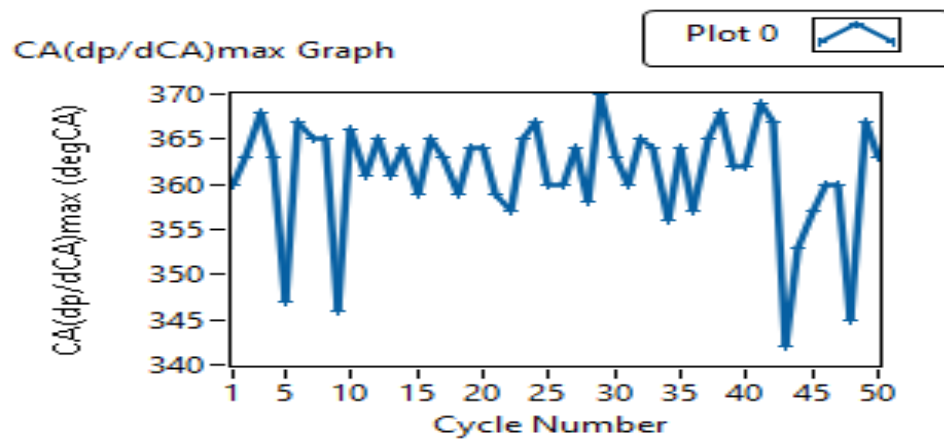
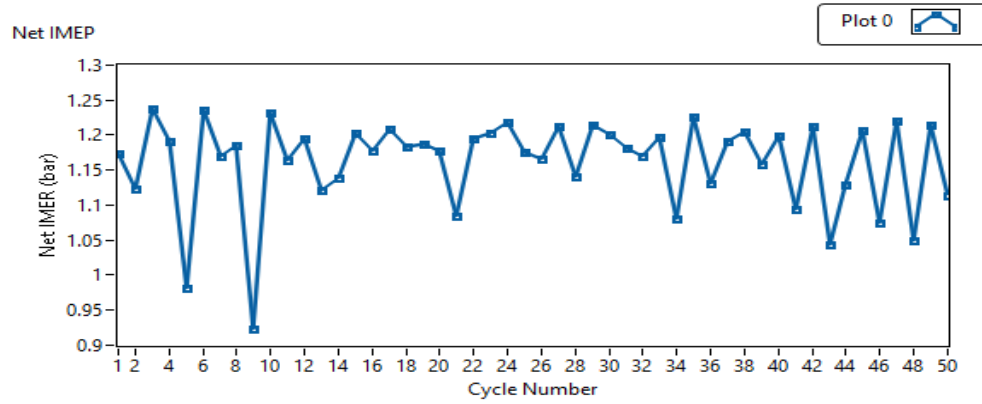


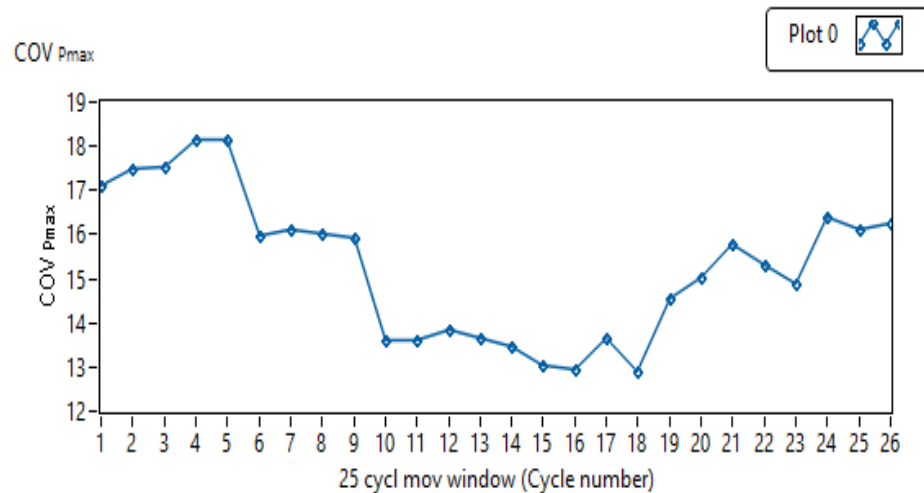
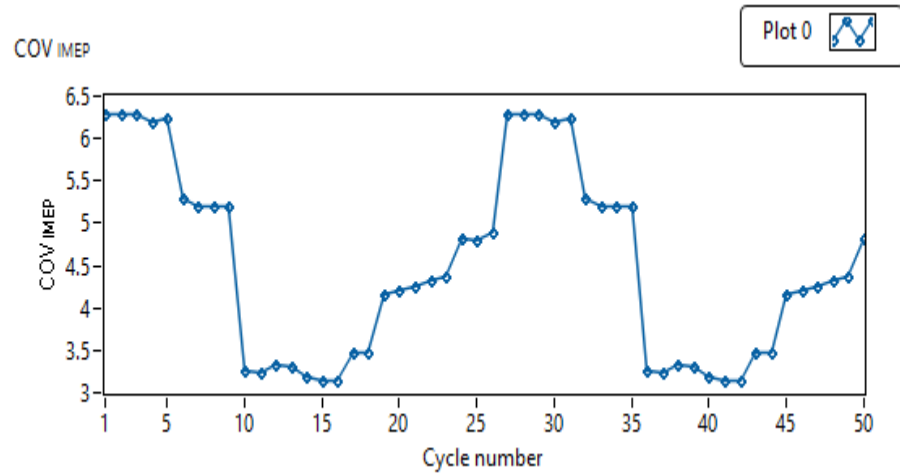
Figure 5: Crank angles per cycle for max. rate of pressure rise



3. Net IMEP:

4. Coefficient of variation: A statistical measure of the relative dispersion of data points in a data series around the mean is the coefficient of variation (CV).

$$COV = \frac{\sigma}{\bar{x}}$$



References:

- [1] X. Lou, W. Chen, and Z. Huang. "A fundamental study on the control of the HCCI combustion and emissions by fuel design concept combined with controllable EGR. Part 1. The basic characteristics of HCCI combustion". *Fuel*, 84(9):1074– 1083, 2005.
- [2] H. Li, W. Neill, and W. Chippior. "Cycle-to-cycle variation of an HCCI engine operated with n-heptane". In *Proceeding of Combustion Institute/Canadian Section (CI/CS) Spring Technical Conference*, 2007.