

## 7. EXPERIMENTATION

### 7.1 Overview

Tests on the engine were performed at two throttle positions; one-half and two-thirds throttle respectively. This was in keeping with testing conventions for spark ignition engines where experiments were undertaken as a function of throttle position.

At each throttle position, engine torque was varied and tests were undertaken at a number of distinct torque settings. It should be noted that these torque values were not necessarily constant for each test as the dynamometer controller did not have sufficient resolution to allow this.

Approximately five emissions readings were taken at each throttle and torque setting in order to obtain accurate, reliable data.

### 7.2 Procedure

1. The equipment was calibrated as detailed in Appendix D.
2. The Gas Analyser was turned on at least an hour before testing was to commence so as to allow it sufficient time to warm up. The three component analysers were switched on while their pumps remained off. Once the analyser was at the correct temperature, the reference cylinders were opened and each unit was calibrated. A comprehensive description of the calibration and procedures can be found in Appendix E.
3. The computers and electronic equipment were switched on.
4. The dynamometer controller was set to its zero torque position.
5. The emissions data acquisition PC was set up as per Appendix F.
6. The water supply to the dynamometer was turned on.



7. The water flow from the dynamometer drain was regulated by means of a ball valve.
8. The cooling fans were switched on.
9. The butterfly valve underneath the petrol tank was opened.
10. The pipette was filled with fuel from the tank and the three-way valve set to supply fuel from the tank only upon start-up.
11. The throttle on the engine was set at approximately half open throttle and the red "On" button was activated.
12. The engine was choked and cranked simultaneously. Upon firing the choke was returned to its normal position and the throttle set to the desired opening.
13. The required fuel source was then selected.
14. If the fuel choice was combined hydrogen and petroleum fuelling, steps 15 to 18 were performed in addition to the common functions relating to both fuelling scenarios.
15. The water level sensor circuit, circulating pump and circuit cooling fans were switched on and the generator was allowed to fill with water
16. The power supply voltage and current dials were set to zero and the power supply and hydrogen generating circuit were turned on.
17. The voltage and current of the power supply driving the generating circuit was set to 12 volts and 4 amperes respectively.
18. The ball valve attached to the gas carburettor was opened.
19. The three-way valve on the pipette was set to supply petrol from the pipette only and the stopwatch was started as the fuel level reached the marked level on the pipette.
20. The stroboscope was switched on and was directed at the engine/dynamometer coupling in order to determine engine speed.
21. Readings from the electronic manometer were recorded.
22. The time taken to consume 50 millilitres of petrol was determined from the stopwatch.
23. The readings on the emissions PC were allowed to settle down to a steady state.
24. At least five sets of data for emissions were recorded. Values of load, speed, air flowrate, fuel flowrate and emissions averages were written down for further reference.
25. The torque was varied and data was taken at each interval.



26. Once testing had ceased, engine speed and torque were decreased and the engine was turned off.
27. The electronic circuitry was turned off and the water supply to the dynamometer was discontinued.

## **7.3 Precautions**

### **7.3.1 Equipment Precautions**

The following precautions were heeded to prevent damage to the equipment:

- Water tank and generator water levels were checked.
- The engine sump oil level was inspected.
- The batteries on all electronic equipment were checked.
- The generator drain valve was checked to ensure that it was closed.
- A sufficient supply of fuel for the test was ascertained as tests could not be restarted due to inconsistencies in the results.
- All fluid lines were properly secured and all hose clamps and connection points checked for leaks.

### **7.3.2 Testing Procedure Precautions**

- Engine temperatures and emissions were allowed to settle before readings were taken.
- Hydrogen generating circuit temperatures were monitored so as to prevent damage to electronic chips.
- Dynamometer cooling water and drain levels were constantly monitored.
- Three-way valve sealing was constantly checked as it had a tendency to leak if handled roughly.