

6.11 Exercise I: Project Work

There are several additional experiments and demonstrations that are possible using the multi-pump test rig. Once students have completed the basic experiments for the available pumps as described in this manual, and are familiar with the operation of the equipment and the characteristics of each pump, then it is possible to undertake project work devising further experiments using the same equipment.

For example:

- By repeating the pump characteristic curve experiment at a range of constant pump speeds for a given pump, it is possible to construct graphs on which lines of constant efficiency or power may be plotted.
- By closing the inlet valve in small steps, it is possible to investigate the effect of changing inlet head on pump performance.

Not all pumps are suitable for this type of investigation. In particular, Armfield does NOT recommend the use of any of the positive displacement pumps (gear pump, plunger pump, diaphragm pump, flexible impeller pump).

The centrifugal pump is suggested as the best choice for this investigation. Students must be made aware of the possibility of cavitation when restricting the inlet (suction) head of any pump. The restriction at the pump inlet should be removed as soon as any sign of cavitation is noted in order to prevent damage to the equipment.

- As part of the previous project, or as a separate exercise, students may calculate the Net Positive Suction Head available (NPSHa) for each pump using the standard equation

$$\text{NPSHa} = H_{\text{atmos}} - H_{\text{vapour}} \pm H_{\text{in}} + H_v$$

where H_v is the velocity head of the fluid, $\frac{V_{\text{in}}^2}{2g}$, with V calculated from the flow rate.

This may be plotted against pump capacity as a measure of pump performance within a specific system.

- System losses within the valves and pipework (excluding the pumps) may be calculated using standard equations and coefficients, such as the Hazen-Williams equation. The results obtained using different techniques may be compared, as may the results for each pump circuit. Students may also devise methods for investigating the accuracy of the results.
- As a long term project in areas where the climate is suitable, the effect of ambient conditions on pump performance may be studied by performing the same experiment at different points throughout the year. For example, results may be taken during a hot summer, and a second set at identical pump settings and inlet tank level may be taken during a cold winter. Any changes due to differing ambient temperature and barometric pressure may then be studied