UE2060250 STIRLING ENGINE G

EXPERIMENT PROCEDURE:

- **Record a *p-V* diagram.**
- **Determine the mechanical power associated with a full cycle and calculate the mechanical work.**

OBJECTIVE

Record a *p-V* diagram.

SUMMARY

Cyclic processes in thermodynamics can be plotted as a closed loop in a *p-V* diagram. The area enclosed by the curve corresponds to the mechanical work taken from the system. Alternatively, the mechanical power associated with a complete cycle can be determined and then the mechanical work can be calculated from that by means of an integration over time. This will be investigated in the course of an experiment using a Stirling engine.

REQUIRED APPARATUS

Quantity	Description	Number	
1	Stirling Engine G	**1002594**	
1	Sensor Holder for Stirling Engine G	**1008500**	
1	Displacement Sensor	**1000568**	
1	Relative Pressure Sensor, ±1000 hPa	**1000548**	
1	3B NET*lab*™	**1000544**	
1	3B NET*log*™ (230 V, 50/60 Hz)	**1000540**	**or**
1	3B NET*log*™ (115 V, 50/60 Hz)	**1000539**	
1	DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)	**1003312**	**or**
1	DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)	**1003311**	
1	Pair of Safety Experimental Leads, 75cm, red/blue	**1017718**	

BASIC PRINCIPLES

Cyclic processes in thermodynamics can be plotted as a closed loop in a *p-V* diagram. The area enclosed by the curve corresponds to the mechanical work *W* taken from the system. Alternatively, the mechanical power *P* associated with a complete cycle can be determined and then the mechanical work can be calculated from that by means of an integration over time.

The following equations apply:

(1) $W = \oint_V p\mathrm{d}V$

oder

(2) $W = \int_{t1}^{t2} P\mathrm{d}t$ mit $P(t) = p\frac{dV}{dt}$

For the experiment we will choose the second variant to determine the mechanical power output in each cycle by a glass Stirling engine specifically designed for educational purposes. To determine the pressure *p* in the main cylinder, a relative pressure sensor is fitted, which measures the difference in cylinder pressure from the ambient pressure. The volume *V* is calculated from the distance *s* travelled by the main piston and its cross-sectional area *A*. A displacement sensor is attached to the main piston for this purpose.

EVALUATION

To verify the cyclic process, the measurement results are plotted in a *p-V* diagram. In order to determine the mechanical power output, it is plotted in a second graph as a function of time. On this second graph, it is easy to identify the cycles of the process. This is important when choosing the limits for the integration in order to calculate the mechanical work per cycle, see (2).

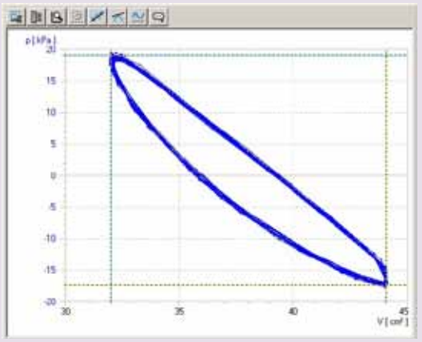

Fig. 1: *p-V* diagram for Stirling engine G

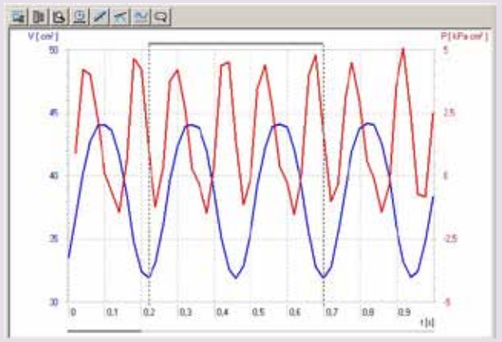

Fig. 2: *p(t), V(t)* and *P(t)* plot for Stirling engine G.