Stirling Engine

P6-7100

INSTRUCTIONAL GUIDE

Contents

- Stirling Engine Model
- Alcohol Lamp
- Spare Glass Hot Gas Container
- Spare LED

Fuel is not included! 70% Isopropyl alcohol works well and is readily available. Other alcohols should work as well.

Background

The Stirling Engine is a unique heat engine invented in 1816 by Robert Stirling. It is a great method to show students how thermal expansion and contraction can be harnessed to convert heat into mechanical energy and subsequently into light.

The Stirling Engine is a unique heat engine because its theoretical efficiency is nearly equal to the theoretical maximum efficiency, called Carnot Cycle Efficiency. Stirling Engines generate power through gas thermal expansion and contraction. It is an external combustion engine, requiring fuel to burn continuously. The piston moves because of a continuous cycle of air expansion in the main cylinder and cooling in the cold chamber.

Set-Up

1. Place the engine model in front of you on a flat, sturdy surface.
2. Gently test the connection rods and the flywheel. Ensure that the two connection rods are connected properly and linked to the crank at 90-degree angles. If not, adjust the connection rods. Check if the wheel is rotating smoothly by slowly turning it with your hands. If there is friction, check if the connection rods are connected properly and if there is oil on the piston of the cold cylinder or spindle of copper sets. If there is oil on these parts, use a clean cloth to wipe the piston and the outer wall of the spindle to ensure that there is no oil or foreign matter on them that could cause friction. Also check the main cylinder for foreign objects and wipe clean if necessary. Keep turning the flywheel until it is rotating effortlessly.
3. Fill the small alcohol lamp container with alcohol.
4. Slowly place the alcohol lamp under the head of the main cylinder of the engine.
5. Carefully light the alcohol lamp.

6. Let the flame of the alcohol lamp heat the cylinder for about 20 seconds, then gently turn the flywheel until it starts rotating independently.
7. During the heating process, always keep hands away from the cylinder to prevent burns. The cylinder will be hot!
8. After use, let the alcohol lamp and the engine model cool.
9. If you need to stop the process manually, blow out the alcohol lamp first, then let the model and lamp cool naturally.

Safety

- Children should only use the engine model under close adult supervision to avoid burns or cuts from glass pieces. Keep the engine model out of reach of children during the cool down period and when the engine is not in use.
- Only add more alcohol to the lamp when the alcohol lamp is extinguished. To add alcohol: first blow out the lamp, open the lamp container, add the alcohol, replace the wick, and then light the lamp again.
- If any alcohol accidentally spills into the model base or on any other parts or surfaces, wait for the alcohol to volatilize or wipe away the alcohol before lighting the alcohol lamp.
- Do not let the alcohol lamp wick touch the glass tube as the wick produces vapor when burning; if the wick and glass tube touch, the vapor will make the tube burst.
- The engine model can rotate at high speeds, which can cause the model to vibrate. Ensure that the engine model is placed far enough from the surface edge to prevent the model from falling.
- When in use, the engine model will get hot! Handle with care to prevent burns.

Related Products

Reversible Thermoelectric Demonstrator (P6-2700) Bring the 2nd Law of Thermodynamics to life using this reversible device that can act as a refrigerator or a heat engine. Immerse the two aluminum legs in baths of different temperatures, and produce electrical energy that turns the turbine!

Fire Syringe (P1-2020) A smokin' example of an adiabatic process. Using the Fire Syringe to compress air into a smaller volume is a classic example of how rapidly doing work on a gas results in an increase in temperature.

Ice Melting Blocks (P6-7060) Cool experiment kit! Touch these two black blocks, and one feels cooler. This discrepant event introduces many concepts, including heat transfer, change of state, and thermal conductivity.