| Name(s)
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J0311 |

Project Title
Timing Is Everything: Geometry of 2-Stroke Model Engines

Abstract
Objectives/Goals
To optimize the performance of a 2-stroke model airplane engine for a specific application (e.g. high rpm for speed), the geometry of an engine's timing must be understood. Timing numbers can be determined by the position of the ports in the cylinder. Engine designers must know how to turn target timing numbers into dimensions for making or modifying a cylinder. In this project I set out to determine an equation linking the position of the piston in the cylinder and the crankshaft's angle of rotation, and to compare it with actual measurements.
OBJECTIVE: Derive an equation D(theta) that will solve for the piston's position in the cylinder for any angle of the crankshaft's rotation.
Methods/Materials
I derived a trigonometric equation for D(theta) from first principles. A Rossi-15N model engine was measured using a depth gauge and a circular protractor. I also derived the reverse equation Theta(D) which exactly calculated the inverse results from D(theta). Microsoft Excel was used to calculate solutions for the equations and to compare these with experimental data.
Results
Replicate depth versus angle data sets were measured, with averaged data plotted to compare with calculated values. Agreement between theoretical and measured results was excellent. I graphed a "difference plot" to look for any systematic errors, which suggested interesting possibilities. The effect on timing curves from changing the rod length was investigated using my derived equation.
Conclusions/Discussion
The equation derived for D(theta) matched the experimental data very accurately, meeting my objective. I now have an accurate method for designing and modifying my model engines for improved performance.

Summary Statement

By determining equations to define a 2-stroke engine's port timing, accurate design and modification of cylinder ports can be achieved.

Help Received

My Dad provided the engine and tools to measure it with, help with the computer graphics, and showed me how to use Microsoft Excel.