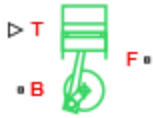


Piston

Piston mechanism of reciprocating combustion engine

Library

Engines



Description

This block represents the piston mechanism of a reciprocating combustion engine. The piston model accounts for the instantaneous torque transmitted to the engine crankshaft. The instantaneous torque enables you to model vibrations in the drivetrain due to piston revolution. To model a multipiston engine, use the [Piston Engine](#) block.

Port B represents the translating piston and port F the rotating crankshaft. The piston force follows from the cylinder pressure and cross-sectional area. The block obtains the combustion pressure from a lookup table parameterized in terms of the crank angle and, optionally, the crank angular velocity and engine throttle level.

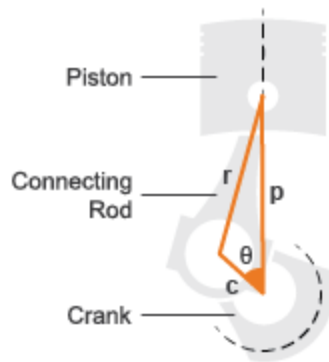
The crank torque follows from the piston force and crank angle as well as the crank and connecting rod lengths. In terms of these inputs, the ratio of the piston force and crank torque is

$$\frac{T_F}{F_B} = -c \left(\sin(\theta) + \frac{\sin(2\theta)}{2 \sqrt{\left(\frac{r}{c}\right)^2 - \sin^2(\theta)}} \right),$$

where:

- F_B is the instantaneous piston force associated with the base port.
- T_F is the instantaneous crank torque associated with the follower port.
- c is the crank length.
- θ is the instantaneous crank angle.
- r is the connecting rod length.

Piston Dimensions



Physical signal port T lets you specify the engine throttle level as a fraction between 0 and 1. This fraction corresponds to the percentage of full power generated. The block uses the physical signal input whenever the pressure lookup table in the block dialog box is parameterized only in terms of the crank angle.

Parameters

Cylinder bore

Internal diameter of the engine cylinder that the piston travels in. The default value is 0.10 m.

Piston stroke

Distance between the top dead center and bottom dead center piston positions. The default value is 0.06 m.

Piston rod length

Length of the connecting rod located between the engine piston and the crankshaft. The default value is 0.10 m.

Number of strokes per cycle

Number of strokes required to complete one engine cycle. One stroke corresponds to a full extension or retraction of the engine piston. A typical automobile engine is based on a four-stroke cycle with induction, compression, power, and exhaust stages. The default value is 4

Pressure parameterization

Engine variables that the cylinder pressure depends on. Options include `By crank angle`, `By crank angle and throttle`, `By crank angle, throttle, and crank velocity`. The default setting is `By crank angle`.

Crank angle vector

M -element vector of crank angles at which to specify the cylinder pressure. A zero angle corresponds to a piston at top dead center. The vector must range from $-S \cdot 180$ to $+S \cdot 180$ degrees, where S is the number of strokes per cycle. The default vector is an eight-element vector ranging in value from -360 to +360 deg, corresponding to a four-stroke cycle.

Throttle vector

N -element vector of engine throttle settings at which to specify the cylinder pressure. A value of 0 corresponds to no throttle and a value of 1 to full throttle. This parameter is active only when **Pressure parameterization** is set to `By crank angle and throttle` and `By crank angle, throttle,`

and crank velocity. The default vector is [0.0, 0.3, 0.8, 1.0].

Crank velocity vector

L-element vector of crankshaft angular velocities at which to specify the cylinder pressure. This parameter is active only when **Pressure parameterization** is set to `By crank angle, throttle, and crank velocity`. The default vector is [0.0, 1000.0, 6000.0] rpm.

Pressure vector

M-element vector of cylinder pressures corresponding to the crank angles specified in the **Crank angle vector** parameter. This parameter is active only when **Pressure parameterization** is set to `By crank angle`.

Pressure matrix (gauge)

M-by-*N* matrix of cylinder pressures corresponding to the crank angles and throttle settings specified in the **Crank angle vector** and **Throttle vector** parameters. This parameter is active only when **Pressure parameterization** is set to `By crank angle and throttle`. The default matrix is an 8-by-4 matrix ranging in value from 0 to 50 bar.

Pressure matrix 3D (gauge)

M-by-*N*-by-*L* matrix of cylinder pressures corresponding to the crank angles, throttle settings, and crank angular velocity values specified in the **Crank angle vector**, **Throttle vector**, and **Crank velocity vector** parameters. This parameter is active only when **Pressure parameterization** is set to `By crank angle, throttle, and crank velocity`. The default matrix is an 8-by-4-by-3 matrix ranging in value from 0 to 50 bar.

Bearing viscous friction coefficient

Aggregate viscous friction coefficient of the main and rod bearings. The block uses this parameter to compute the viscous power losses between the base and follower shafts. The default value is 0.001 N*m/(rad/s).

Offset angle

Point in the engine cycle when the piston reaches top dead center. The engine cycle spans in angle from $-S*180$ to $+S*180$ degrees, where *S* is the number of strokes per cycle. The default value is 0 deg, corresponding to a zero offset.

Initial crank angle

Crank angle at time zero relative to a top dead center position. The default value is 90 deg.

Ports

- B — Conserving rotational port representing the engine block
- F — Conserving rotational port representing the engine crankshaft
- T — Physical signal input port for specifying the engine throttle setting

See Also

[Generic Engine](#) | [Piston Engine](#)

