

PROJECT, ME 426 (Applied Combustion)

Instructor:

KNOCK IN SPARK-IGNITION ENGINE

In general, knock in spark-ignition engines is the term used to signify any unusual sound that arises because of autoignition in the combustion process.

Create a constant-volume model of the auto-ignition process for any fuel and determine

- 1- The temperature histories
- 2- The fuel and product concentration histories
- 3- The pressure rate (dP/dt) as a function of time
- 4- Use the model to explore the effects of P_o and T_o on combustion times and the maximum rates-of-pressure rise.
- 5- Plot the pressure vs. volume of three area in the combustion chamber that are influenced by autoignition
 - a) fuel and air mixture between spark plug
 - b) fuel and air mixture at the end of combustion chamber
 - c) fuel and air mixture at somewhere in the middle of combustion chamber
- 6- Discuss your results

Assumptions:

- i. One-step global reaction
- ii. Stoichiometric air-fuel ratio is A/F and restrict combustion to stoichiometric or lean conditions
- iii. Assume initial conditions corresponding to compression of a fuel-air mixture from T_0 K and P_0 atm to top-dead-center for a compression ratio of CR. The initial volume before compression is V_0 , which corresponds to an engine with a bore of (B) mm, and a stroke of (L) mm.

For the following case, solve this project:

$P_0=300$ K	$P_0=1$ at	CR=10
L=75 mm	B=75 mm	FUEL =Ethane
A/F=16	V at BDC= $3.68 \cdot 10^{-4}$ m ³	

Also, you may assume:

- a) The fuel, air, and products all have equal molecular weights; i.e., $MW_F = M_{O_2} = MW_{P_r} = 29$.
- b) The specific heats of the fuel, air, and products are constants and equal; that is, $C_{p,F} = C_{p,O_2} = C_{p,P_r} = 1200$ J/kg-K.
- c) The enthalpy of formation of the air and products are zero; the enthalpy of formation of the fuel is $4 \cdot 10^7$ J/kg.

Hint: You will need to decrease the time interval between output printings when combustion rates are rapid.