# The Effects of Increased Ignition Energy on Cold Start Hydrocarbon Emissions

by

Raymond L. Slaughter, Jr.

Thesis Submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements of the degree of
MASTER OF SCIENCE
in
Mechanical Engineering

Alan A. Kornhauser Co-Chairmen
Uri Vandsburger Co-Chairmen
Douglas J. Nelson

**September 1998**
**Blacksburg, Virginia**

# The Effects of Increased Ignition Energy on Cold Start Hydrocarbon Emissions

by

Raymond L. Slaughter, Jr.

Committee: Co-Chairmen: Alan A. Kornhauser and Uri Vandsburger

Mechanical Engineering

## (Abstract)

A study on the effects of increased ignition energy on cold start hydrocarbon emissions was conducted. The tests were conducted on a single cylinder ASTM-CFR engine. The engine was outfitted with EFI, exhaust analyzers, and temperature probes. The engine was also modified to produce cold start conditions rapidly after each run. For the experiment the engine was started from 18° C using three increasing ignition energy levels. The first level of ignition energy was the ignition energy produced by the stock CFR engine's ignition system. The second and third increased ignition energy levels were obtained by adding 0.387 joules and 1.187 joules to the stock output through a supplementary ignition system. Startup emissions and the number of cycles until the first successful fire were measured.

The results of the tests show a 14% decrease in the average peak hydrocarbon (HC) concentration levels at the highest ignition energy. Overall reduction in HC was less. The variance in the peak HC levels was reduced at the highest ignition energy setting. CO production was increased in response to the increase in HC consumption. The spread in measured number of cycles until first fire was decreased at the highest ignition energy level.

Although positive results were obtained, the test apparatus had some problem areas that may have reduced the effectiveness of the high energy ignition system. Based on what was learned recommendations on apparatus refinements and further tests were included.

# Acknowledgments

First I want to thank my co-advisors, Dr. Alan A. Kornhauser and Dr. Uri Vandsburger for all the guidance I received. Thank you for exposing me to new things. I want thank Dr. Douglas Nelson for serving on my committee and for the use of Hybrid Electric Vehicle equipment. Dr. Gregg Harrell, thank you for helping sort out the A/C system and bringing a laugh to the lab.

I would also like to thank the students on '98 Mini-Baja team for helping me build parts and for supplying me with parts. Thanks is also in order for the students in the Reacting Flows Laboratory for their help throughout the project.

Of course I have to give thanks to my parents Raymond and June Slaughter for supporting me and keeping my spirits high. Thanks for giving me the opportunity to be free.

# Table Of Contents

Page

# List Of Figures

# List Of Tables