ANALYSIS OF FUEL TANK AND HOSE CLEANING IN GENERATOR

Giri.t
Mechanical Engineering
Sengunthar Engineering College
(Autonomous)
Tiruchengode, Namakkal
19lme01scteng.co.in

Gowrisankar.s
Mechanical Engineering
Sengunthar Engineering College
(Autonomous)
Tiruchengode, Namakkal
19lme02@scteng.co.in

karthi.s
Mechanical Engineering
Sengunthar Engineering College
(Autonomous)
Tiruchengode, Namakkal
19lme03@scteng.co.in

Mr.C.Karthick.,M.E
Assistant Professor
Mechanical Engineering
Sengunthar Engineering College
(Autonomous)
Tiruchengode, Namakkal
nsaravanan.mech@scteng.co.in

Abstract— ***The attached report, titled "Advanced Algorithm Development and Implementation of Enclosed Operation Detection and Shutoff for Portable Gasoline Powered Generators," summarises the findings of research conducted by the University of Alabama College of Engineering (UA) under a contract agreement with the United States Consumer Product Safety Commission (CPSC). 2 This study was conducted in support of the Consumer Product Safety Commission's (CPSC) advance notice of proposed rulemaking (ANPR) to address the carbon monoxide (CO) poisoning risk linked with the usage of portable generators.***

I. INTRODUCTION

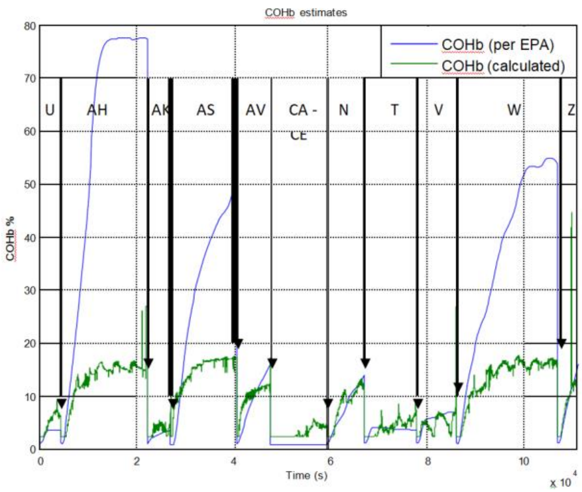
This is the project's final technical report, Advanced Algorithm Development and Implementation of Enclosed Operation Detection and Shutoff for Portable Gasoline Powered Generators. 1 The University of Alabama (UA) completed this project for the Consumer Product Safety Commission of the United States (CPSC). The project is a follow-on to contract CPSC-S-06-0079, which required UA to develop, test, and install an automatic engine shutoff (or shutdown, as the case may be) feature on a prototype generator built to operate with the same stoichiometric fuel control strategy and catalyst as the durability-tested prototype described in [1]. The purpose of this feature is to shut the engine off before the generator creates an unacceptable carbon monoxide (CO) exposure environment in the possible event that, when the prototype generator is operated in an oxygen depleted environment, its ability to meet its target CO emission rate is compromised.

II . ENGINEMANAGEMENT SYSTEM

It is vital to note that specific trade names (e.g., Nova, Labview, Matlab, etc.) or business products are stated throughout this book to sufficiently define the experimental processes and equipment used before moving on to the implementation details and experimental protocols. In no event does such identification imply University of Alabama staff sponsorship or recommendation, nor does it imply that the equipment is the best available for the job. The engine management system (EMS) of a gasoline-powered engine is designed to handle a variety of duties, including tracking engine position and synchronising fuel and spark timing. The engine control unit (ECU) is an electronic system with many inputs and outputs that improves engine performance. The ECU is responsible for controlling associated outputs to accomplish desired engine functioning and for executing pre-programmed computations based on data provided by engine sensors. The modular ECU's various inputs and outputs are detailed in the table below, which is comparable to the I/O list from the previous system.

METHODOLOGY:

A missing tooth, or gap, on the crank wheel is used as a reference point by the crank position sensor for determining several useful parameters. First, the missing tooth is used to establish a reference point for determining when the piston is at top dead center (TDC). In the present strategy, the positioning of the piston at TDC is inferred by the falling edge of the 9th tooth after the gap on the 24 tooth crank wheel, due to its specific alignment with respect to the engine. In addition, the missing tooth and crankshaft synchronization system are used to ensure that, at minimum pressure on the engine's intake stroke, the MAP read crank angle can be determined. Due to MAP signal fluctuation, caused by the singlecylinder engine, a MAP read crank angle algorithm is required for establishing a common MAP determination point. The MAP read crank angle is a function of speed and load, which requires a calibration lookup table. Since MAP is the primary variable used to indicate load, MAP read crank angle, sampled once per two engine revolutions at minimum pressure, is based upon MAP itself .



ANALYSIS OF FUEL TANK AND HOUSE CLEANING IN GENERATOR:

DESCRIPTION OF THEORETICAL ECU:

Throughout the two contracts with the CPSC for the purpose of developing an oxygen depletion safety shutdown feature, two different engine controllers were used; however, the fundamental bases on which they operate are the same, as the modular ECU uses the same speeddensity method as the previous MT05. As explained in [6, 7, 8], a parallel deterministic technique and set of principle equations are utilised to manage the mass of fuel provided using the primary inputs of engine speed and a load variable based on MAP. The ideal gas law is used to compute the quantity of air entering the engine, resulting in a stoichiometric fuel mixture being delivered to the engine. Equation 2.1 depicts the ideal gas law, where (P) represents pressure, (V) represents volume, (m) represents mass, (R) represents the air gas constant, and (T) represents temperature. The volumetric efficiency is defined as the actual mass of air entering the cylinder divided by the theoretical mass of air entering the cylinder, as indicated in Equation 2.2. the theoretical mass of air entering the cylinder is equal to the product of the air density entering the cylinder (ρair) and the engine displacement volume (VD). As part of the calibration procedure, the volumetric efficiency is determined as a function of engine speed and load and entered into a lookup table for use by the algorithm as partof the air flow calculation

OPERATION:

The calculated mass of air entering the cylinder is used by the ECU to determine the desired mass of fuel to be supplied to the engine, shown in Equation 2.5, based on the desired AFR set point. The desired AFR set point for this project is 14.6 to 1, stoichiometric for gasoline powered engines, for every operating condition. Equation 2.5 can be combined with equation 2.4 to express the desired mass of fuel to be supplied to the engine (per cycle) in terms of parameters measured as the engine operates (Pman, Tman), obtained from a calibration lookup table (VE, AFR) as a function of speed and load, and constant values (VD, R)

MT05 ECU DESCRIPTION:

As described in [6], the previously used MT05 ECU, shown was a replacement, and upgrade, for the obsolete IMEC-168 ECU. The MT05 ECU provided a slimmer design, which allowed for the controller to be mounted inside of the generator frame, helping to eliminate unintended damage. Also, the MT05 ECU utilized an external MAP sensor, unlike its predecessor, in order to increase the MAP signal consistency from the IMEC-168 system by eliminating the 300 mm MAP tube and being placed directly above the engine's existing MAP port. Allowing for a more reliable MAP signal was vital, as it is used for calculating many engine control parameters. The MT05 ECU possessed a 20 MHz microprocessor with 512 bytes of EEPROM memory space and 256 Kbytes of flash EEPROM memory space. A controller area network (CAN) was used as communication link between the ECU and laptop computer. The associated software contained a calibration toolbox, which was used for real-time data logging, data playback, and exporting data. As previously mentioned, the MT05 system utilized an external MAP sensor, as well as a heated oxygen sensor. Also, an upgrade on the MT05 ECU was the ability to modify the look-up table axes for improved engine performance [6, 9]. Despite the fact that the MT05 ECU was a significant increase over the IMEC-168 ECU, it lacked the potential to be updated as an opensource controller. Following the completion of the prior oxygen depletion shutdown procedure, which was based on data post-processing, a submission to the manufacturer for deployment was necessary. This ruled out the idea of modifying the shutdown method based on current test results.

BATTERY

Batteries are used in various things that we use in our house. Batteries are used to power things like remote controls, torches, wall clocks, flashlights, hearing aids, weight scales, etc. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties.

MODULAR ECU DESCRIPTION:

The newly acquired modular EMS controller, , is based on a National Instruments Compact RIO (reconfigurable input / output) NI cRIO-9022 which allows for real-time deterministic control, data logging, and a wide variety of engine management tasks such as tracking engine position and engine synchronization of fuel delivery and spark control. These ECU operations are based on field programmable gate arrays (FPGA) [4, 5]. also depicts the attached chassis with four control modules and one NI module for additional data acquisition. The primary advantage of the modular ECU is that it is a mostly opensource controller that provides the ability for modifications and additions to the existing ECU source code through the LabVIEWbased software which accompanies each individual control module present in the chassis. In addition, the modular ECU still possessed the main upgrade features of the previous MT05 ECU such as an external MAP sensor and the ability to modify the look-up table axes for increased resolution and engine performance. One notable difference from the previous MT05 ECU is the modular system's location with respect to the generator itself. Due to the system's larger size, it cannot be mounted directly on the generator and must be placed inside of a protective box, as, to limit exposure to potentially harmful elements and prevent any accidental damage.

EXPERIMENTAL RESULT:

CONCLUSION:

This work has addressed the issues associated with the previous implementation of an algorithm to shut off the engine on a portable gasoline powered generator prior to creating an unacceptable carbon monoxide (CO) exposure environment when operated indoors. CPSC specifically requested that the algorithm be programmed into the prototype generator's engine control unit (ECU) and that it have the ability to be enabled and disabled for testing purposes. CPSC also specifically directed that the algorithm rely only on data already existing in the ECU and not use any additional sensors. The newly developed algorithm addresses issues from the original work that surfaced during testing at NIST:

1. When operating unconfined in the outdoors, the algorithm might occasionally force the engine to shut off due to sudden and severe load changes, as well as under constant load (though less frequently).
2. In an enclosed setting with very light loads, the algorithm would only seldom force the engine to shut off.
3. When operating in an enclosed area, the algorithm would not always cut off the engine, even when under heavy load.

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