Requirements Specification:

Fault Tolerant Fuel Control System

Disclaimer: This requirement document is not complete and it is used for illustration of typical system requirements and it is to be for feature demonstration purposes only.

Date: October 7, 2009

Version: 1.0

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# Functional Requirements

## Normal Mode of Operation

During the normal mode of operation the Fault Tolerant Fuel Control System shall determine the fuel rate which is injected at the valves.

### Stoichiometric mixture ratio

During normal model of operation the System shall maintain the stoichiometric mixture target ratio of 14.6.

### Oxygen Sensor (EGO)

The System shall determine the amount of residual oxygen present in the exhaust gas (EGO) by reading the value of the EGO sensor. During a calibratible warm up period the oxygen sensor correction shall be disabled.  

### High Oxygen Level

If the EGO sensor determines a high oxygen level present in the exhaust gas, the System shall increase the fuel rate in order to maintain the stochiometric mixture target ratio.

### Fuel-rich Mixture

If the EGO sensor determines a low oxygen level present in the exhaust gas, the System shall decrease the fuel rate in order to maintain the stochiometric mixture target ratio.

### Manifold Pressure Sensor (MAP)

The System shall use readings from the MAP sensor to calculate air density and determine the engine's air mass flow rate.

### Throttle Sensor

#### Throttle Sensor Nominal Normal Mode Ranges

Throttle Sensor will be considered as operating correctly if the throttle position sensor value is greater than the minimum allowable value of 3% and if the throttle position sensor value is less than the maximum allowable value of 90%

#### Throttle Sensor on Power-up

On power-up the reading of the throttle position sensor shall be set to 0.

## Failure Mode of Operation

### Single Sensor Failure

In case of a single sensor failure the air/fuel mixture will be set to enriched fuel mixture to allow smoother running at the cost of higher emissions.

### Multiple Sensor Failure

In case of the multiple sensor failure the engine enters the emergency mode and initiates a safe shuts down sequence when the engine speed is at 0km/h.

### Overspeed Failure

The System shall disable fuel delivery whenever the engine speed exceeds a calibratible threshold.

### Throttle Sensor Failure

When measured values of the Throttle Sensor fall outside of their nominal ranges the system shall detect throttle sensor failures within the Failure Detection Time and the System shall revert to the estimated throttle position based on measured engine speed and manifold pressure. The Throttle Sensor shall be considered as failed if the throttle position sensor value is greater than the maximum allowable value of 90% or if the throttle position sensor value is less than the minimum allowable value of 3%. The System shall detect the failure within 100ms.

### MAP Sensor failure

When measured values of the MAP Sensor fall outside of their Nominal Normal Mode Ranges the System shall detect MAP Sensor failures within the Failure Detection Time of 100 ms and the System shall revert to an estimated throttle position based on engine speed and manifold pressure.

### Speed Sensor Failure

When measured values of the Speed Sensor is 0 and manifold pressure is below a calibratible threshold the System shall detect the failure within the Failure Detection Time of 100ms and revert to an estimated speed value based on manifold pressure and throttle position.

### Oxygen sensor failure

The System shall detect the failure within 100mSec and trigger the airflow estimation and closed loop correction algorithm which is based on the manifold pressure, engine speed and throttle position

The oxygen sensor also has a nominal range for failure conditions but, because zero is both the minimum signal level and the bottom of the range, failure shall be detected only when it exceeds the upper limit.