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Abstract

Development and Demonstration of a Low Emission Four-Stroke Outboard Marine Engine Utilizing Catalyst Technology

A conceptual project aimed at understanding the fundamental design considerations concerning the implementation of catalyst systems on outboard marine engines was carried out by Mercury Marine, with the support of the California Air Resources Board. In order to keep a reasonable project scope, only electronic fuel injected four-stroke outboards were considered. While they represent a significant portion of the total number of outboard engines sold in the United States, carbureted four-strokes and direct injected two-strokes pose their own sets of design constraints and were considered to be outside the scope of this study.

The integration of catalyst systems on outboards is much more challenging than on other marine propulsion alternatives. Sterndrive and inboard engines are horizontal crankshaft engine derivatives of an automotive counterpart. Outboards on the other hand utilize a vertical crankshaft, open loop cooling, and consist almost entirely of components that were specifically designed for a marine outboard engine application.

This report will show how Mercury Marine successfully designed a catalyst system targeting combined hydrocarbon and oxides of nitrogen emissions performance equivalent to the sterndrive and inboard standard of 5 grams per kilowatt-hour for two families of outboard engines utilizing state of the art processes and design analysis tools. Prototypes of one of the designs were constructed and tested. Results of that testing will be shown that highlight the potential to meet four-star emissions levels and the challenges that will face commercializing this technology.