



# Project Summary

Texas Department of Transportation

## 0-5532: Galveston Ferry Operation (GFO) Engine TxLED Failure Assessment, Solution and Implementation

### *Background*

Following the failures of all ten propulsion engines used at the Texas Department of Transportation's (TxDOT's) Galveston Ferry Operations (GFO) within months after switching from 2D on-road diesel fuel to an ultra-low sulfur diesel fuel (Texas Low Emissions Diesel, TxLED), the Center for Transportation Research (CTR) was awarded a contract to determine the root cause of the engine failures and to develop a solution that allowed continued use of TxLED.

### *What the Researchers Did*

CTR used Southwest Research Institute (SwRI) and Kibler Technologies as subcontractors on this project. Professors Ron Matthews and Matt Hall, of the UT Engines Research Program, led the CTR effort. John Hedrick led the SwRI effort, which consisted of determining the root cause of the failures of the locomotive engines used for propulsion in the GFO ferries and seeking a hardware solution to overcome these failures. Clark Kibler, of Kibler Technologies, specified the oils that were subjected to testing and aided in the analyses of the results from the oil tests.

### *What They Found*

The research team found that the failures were the result of three factors: 1) the poor ring pack design of these engines, which results in a high oil consumption rate, 2) the high ash content of the re-refined oil that was used in the ferries, and 3) the decreased flame temperature for TxLED relative to 2D on-road diesel.

The research team evaluated nine candidate oils as potential replacements for the re-refined oil that GFO was using. These oils were evaluated based upon their effects on the oil consumption rate, engine wear, and in-cylinder calcium deposits. All of the candidate oils performed much better than the re-refined oil in all metrics.

### *Research Performed by:*

Center for Transportation Research (CTR),  
The University of Texas at Austin

**Research Supervisor:**  
Ronald Matthews, CTR

**Researchers:**  
Matt Hall, CTR

**Project Completed:**  
8-31-07

## What This Means

The research team recommends that Galveston Ferry Operations begin using Exxon Elite 20W50 in all of its ferries. Although this is aviation piston engine oil, aircraft oils are necessarily designed to minimize wear due to the danger resulting from an engine failure at altitude. Thus, it was not surprising that this oil had the lowest rate of change of wear metals of all oils tested. Additionally, like all aviation piston engine oils, Exxon Elite has no ash whatsoever. Thus, it was also not surprising that Exxon Elite also had the lowest rate of accumulation of calcium deposits. Exxon Elite also had the second lowest oil consumption rate.

A hardware solution was also identified. A hardware solution is critical only if none of the candidate oils solve the problem of engine failures, which all of the candidate oils did. However, the hardware solution results in significantly decreased oil consumption, and thus is worthwhile. This hardware solution consists of a new and improved ring pack and cylinder liners with an improved finish. In addition to the improved rings and liners, the improved EMD 645 power cylinder assembly includes new and improved flat face valves and new valve rotators and springs.

### *For More Information:*

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