

CHAPTER 10: POWER BOOSTER

During Phase I focus group activities, equipment operators expressed a desire for more horsepower during certain operating situations; e.g., plowing snow while going uphill, entering traffic with a full load, changing lanes, and accelerating to travel speeds in high traffic conditions. The transit industry had already been using a power booster system to increase engine horsepower during peak demand periods. Fossean Manufacturing's engine booster, the DriverMax/Hydrofire system, had successfully been installed on transit buses in Des Moines and Cedar Rapids, Iowa, and was the candidate for this study.

OBJECTIVE

Conduct proof of concept regarding implementing an engine power booster to increase the horsepower of a winter maintenance vehicle during peak engine demand periods.

MEASUREMENT

The Hydrofire system is successfully installed on the prototype vehicles and operates as expected; that is, wheel horsepower is higher on the prototype vehicle when the power booster system is engaged.

DISCUSSION

Fossean Manufacturing & Development Ltd. (Fossean), located in Radcliffe, Iowa, supplied a custom-built "Hydrous-Ethanol Hydrofire Injection System and Power Booster" for each prototype vehicle. The Hydrofire fuel injection system consists of an electronic control unit (DriverMax) in the cab; an auxiliary fuel tank mounted on the outside of the vehicle; and a pump to inject fuel from the auxiliary tank into the engine's airstream intake, along with related plumbing and exhaust treatment devices, under the vehicle's hood. The auxiliary tank contains Hydrofire Fluid, a water-alcohol-lubricant blend fuel. Hydrofire is pre-mixed and provided by Fossean. DriverMax, the electronic fuel controller, has pre-set values that determine when the engine needs more power and then engages turbo boost pressure to automatically inject the Hydrofire.

The injection of hydrous-ethanol results in a cleaner running engine with a longer engine life. Increased engine performance, longer life, decreased nitrogen oxide emissions, particulate matter reduction, and savings of petroleum fuels are among the benefits of the Hydrofire injection system. During tests conducted by Fossean Manufacturing and Five Seasons Transit in Cedar Rapids, Iowa, the hydrous-ethanol was injected into a diesel engine under heavy load conditions.

The approximate dimensions of the DriverMax control box are six inches by two inches by four inches. Iowa DOT mechanics encountered challenges with the capacity and the location of the alcohol tank for Fossean's Hydrofire engine booster system. The Iowa prototype vehicle first arrived from the fabricator with an eight-gallon alcohol tank, mounted on the driver's side behind the cab. Due to the relatively small capacity of this tank and high rate of fuel

consumption, Iowa DOT mechanics replaced the eight-gallon tank with a 30-gallon tank. They selected the 30-gallon tank not only because of its higher capacity but also because it could easily be installed in a new location—on the passenger side, beneath the cab. Iowa DOT mechanics built a custom shield to protect the container and its contents from the heat of the exhaust system, running within six inches of the tank.

Michigan DOT mechanics moved the engine power booster system to a more protected and convenient location on top of the diesel fuel tank and plans to install a larger power booster fuel tank at a later date. In addition, a ladder was installed on the side of the liquid tank to make it easier and safer to fill. The Michigan and Minnesota vehicles have eight-gallon tanks.

Figure 10-1 shows the location of the power booster fuel tank installed Iowa's prototype vehicle.



Figure 10-1 Alcohol tank, Iowa prototype vehicle

The engine power booster on Iowa's prototype vehicle was first tested in Des Moines, Iowa, on June 23 and 24, 1997. The vehicle was placed on a dynamometer and tested three times, first without any alteration to the vehicle, second with the installation of the supplemental injectors and manifold but using only diesel fuel, and finally with the new Hydrofire parts and alcohol-based fuel additive. The tests with the with new Hydrofire system resulted not only in an increase in engine horsepower but also in a drop in exhaust gas temperature.

Fosseen next examined the effects of the engine power booster on wheel horsepower using dynamometer tests on all three prototype vehicles. Iowa's (230-horsepower Navistar 466 engine) was tested on July 22, 1997; Minnesota's (230-horsepower Cat 3176B engine) was tested on October 7, 1997; and Michigan's (300-horsepower Cummins L10 engine) was tested on November 1, 1997. The tests of all vehicles indicated a boost in wheel horsepower by about 20 horsepower, and a decrease in exhaust temperatures by 50 to 75° F. Refer to Figures 10-2, 10-3, and 10-4 for graphs of test results for the Iowa, Minnesota, and Michigan prototype trucks,

respectively. Correspondence with data files from the three Fosseen tests is included in Appendix H.

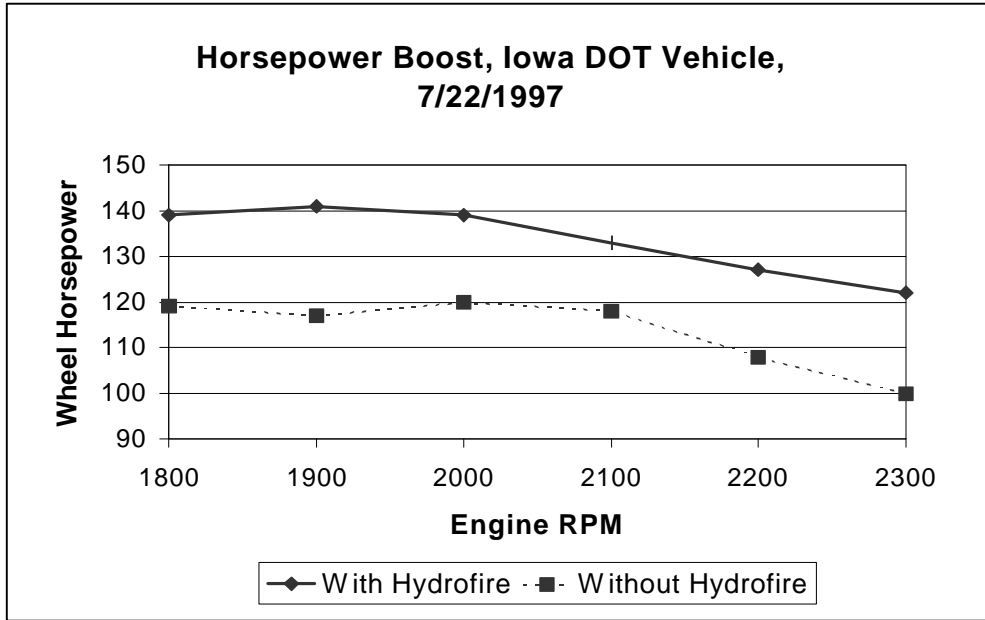


Figure 10-2 Horsepower boost, Iowa DOT vehicle, July 22, 1997

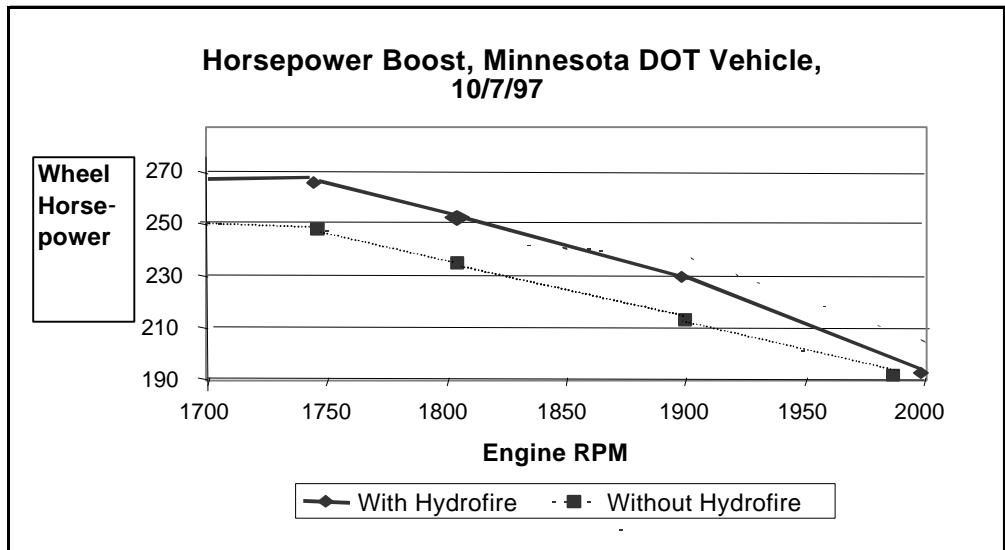


Figure 10-3 Horsepower boost, Minnesota DOT vehicle, October 7, 1997

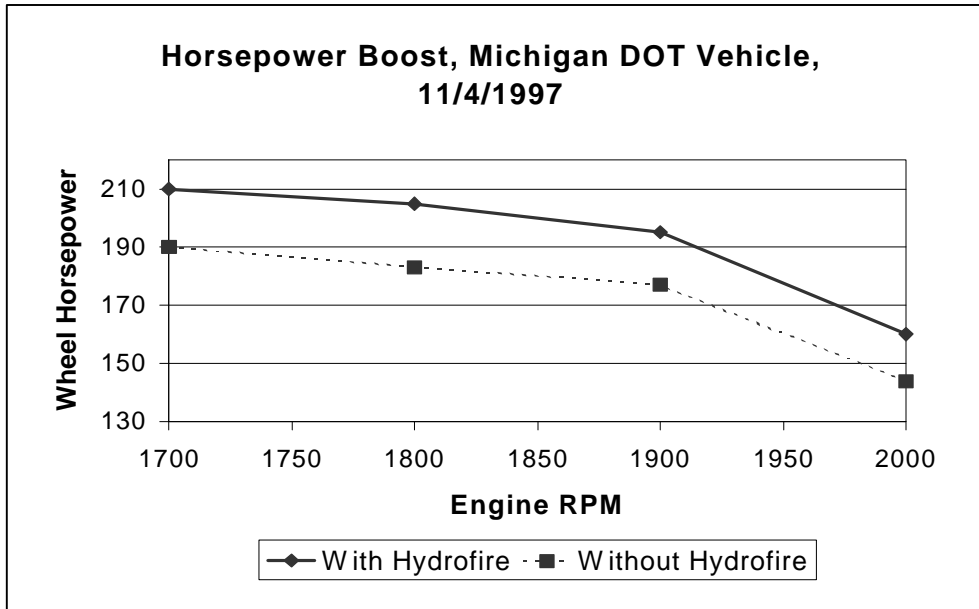


Figure 10-4 Horsepower Boost, Michigan DOT Vehicle, November 4, 1997

On Minnesota's vehicle, the extra wheel horsepower provided by the Hydrofire system fell as engine RPMs approached 2000. The greater manifold pressure of this particular engine works against the injection pressure of the additive, particularly at the highest RPMs. Fosseen reports that the injection pressure can be increased for this and similar engines to provide continuing wheel horsepower increases at high RPMs.

OBSERVATIONS

Proof of concept was successful. The power boosters were successfully installed on all three prototype vehicles, and wheel horsepower measured higher when the power booster system was active on all three vehicles.