Load Bank Test on Caterpillar 3406 powered 300Kw generator

The final phase of the evaluation program of the FFC also occurred at Hawthorne Power Systems dyno facility in San Diego. In this case, fuel consumption of a generator powered by a 400hp Caterpillar 3406 engine was measured with a laboratory quality fuel flow meter manufactured by AIC Systems in Switzerland.

The AIC fuel meters use a piston displacement method to measure the suction of the fuel drawn from the tank to replenish fuel consumed by the engine. The return fuel is diverted back to the engine intact after passing through a heat exchanger to dissipate heat in the closed loop fuel supply. The accuracy and repeatability of the measurements obtained during tests with the AIC meter was better than 99%. Although the differences in fuel consumption observed at each of the five load points measured in the baseline and retrofit tests were small, they could be relied upon because of the extreme accuracy of the meter. Twenty readings were taken for each load point (0, 25, 50, 75 and 100%) and within each set there was never more than one-tenth of a gallon per hour (gph) variance in the readings.

In addition to the power data provided by a programmable resistive/reactive load bank, exhaust temperature (EGT) and other exhaust data were obtained with the e-Instruments Gas Analyzer used previously.

Caterpillar 3406 engine

End view of engine with AIC meter and FFC

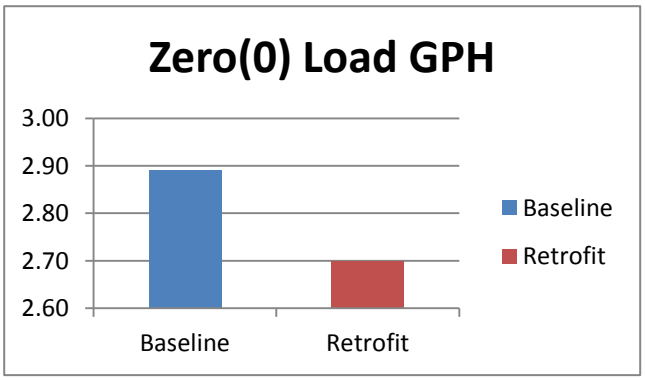
Some of the key elements of the load bank test are shown on this page. The load bank itself was a permanent unit located on top of the roof of the test bays. The operator pre-programmed the agreed upon test protocol into the computer control module. The test sequence was 20 minutes at each load point (0, 75, 150, 225 and 300 kilowatts) representing 0, 25, 50, 75 and 100 percent of maximum power.

The 200-gallon capacity day tank shown below was filled with ULSD#2 drawn from the facility's 4,000 gallon underground storage tank. Prior to starting the retrofit tests with the FFC, the remaining fuel in

the day tank was circulated through a second F150HDG unit (on corner of cart in front of tank) using a small transfer pump.

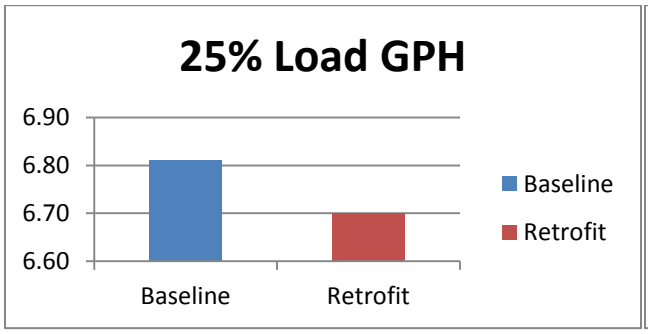
200 gallon day-tank used to supply ULSD#2 for test. Close-up of AIC-6008 fuel flow meter

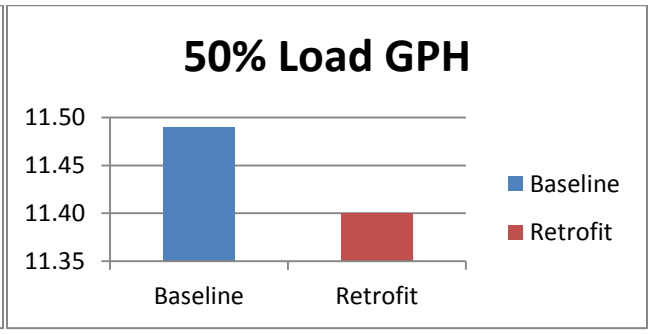
Fuel Measurement Results

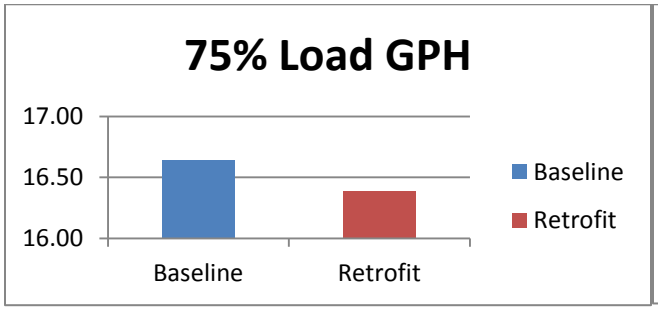


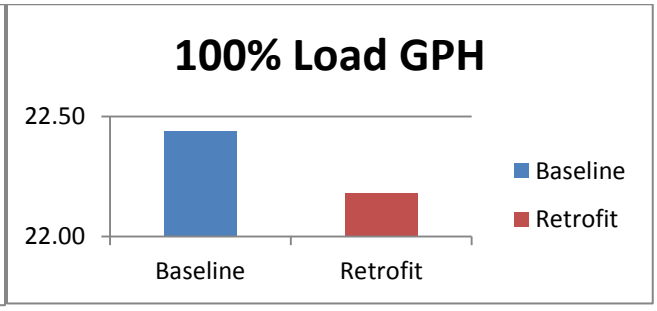
The engine was started and brought up to normal operating temperature prior to commencing the test for baseline and retrofit data collection. Upon starting of the pre-programmed script which controlled the load applied to the gen-set, data collection began.

A fuel consumption reading was taken each minute for each 20-minute segment. EGT and emission readings were taken with the portable Gas Analyzer every third reading.









The above charts illustrate a comparison of the average of the 20 readings taken at each load point. There was never more than one-tenth (0.10) gph range in any set of data. At least 18 of the 20 readings were exactly the same demonstrating the accuracy of the fuel meters used.

In all cases, the fuel consumption with the FFC was measurably less under identical load and operating conditions. On average, the improvement was ¼ gph. Another positive measurement was that the engine ran slightly cooler with the FFC as shown in the comparison of EGT temperature in the following table. It also appears the benefits of reduced fuel consumption, lower EGT and lower emission increased over time. The longer the engine ran with the FFC the greater the improvement observed.

Load %	**Zero**	**25**	**50**	**75**	**100.0**
FFC- ^{o}F	416.4	659.0	796.3	885.3	973.6
BL- ^{o}F	416.1	660.2	804.3	895.6	986.0
Diff- ^{o}F	0.3	-1.2	-8.0	-10.3	-12.4

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