ANALYSIS OF SOME PERFORMANCE PARAMETERS OF F2L DEUTZ DIESEL ENGINES

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ABSTRACT

Performance test on 36 nos. of F2L Deutz Diesel Engine of 27 BHP and 24 nos. of F2L Deutz Diesel Engine of 31.5 BHP were carried out on a hydraulic test bench at Bangladesh Diesel Plant at Joydevpur. All the engines were tested at variable load and at 2250 rpm. During the tests the values of the different parameters namely, load, rpm, fuel consumption, exhaust temperature, room dry bulb and wet bulb temperatures and lubricating oil temperature were recorded. The information thus obtained were used to compute the performance parameters and using IBM 370 computer and SPSS package correlation equations have been developed. These correlations are written in the form of emperical equations to predict bhp from fuel consumption and exhaust temperature. The frictional horsepower of the engines were also computed from experimental data.

Introduction

Testing of a diesel engine for determination of the performance characteristics is a straight forward job. Test facility comprises dynamometer, measuring devices and equipment/instrument for fuel flow rate, different temperatures, speed of engine and room condition.

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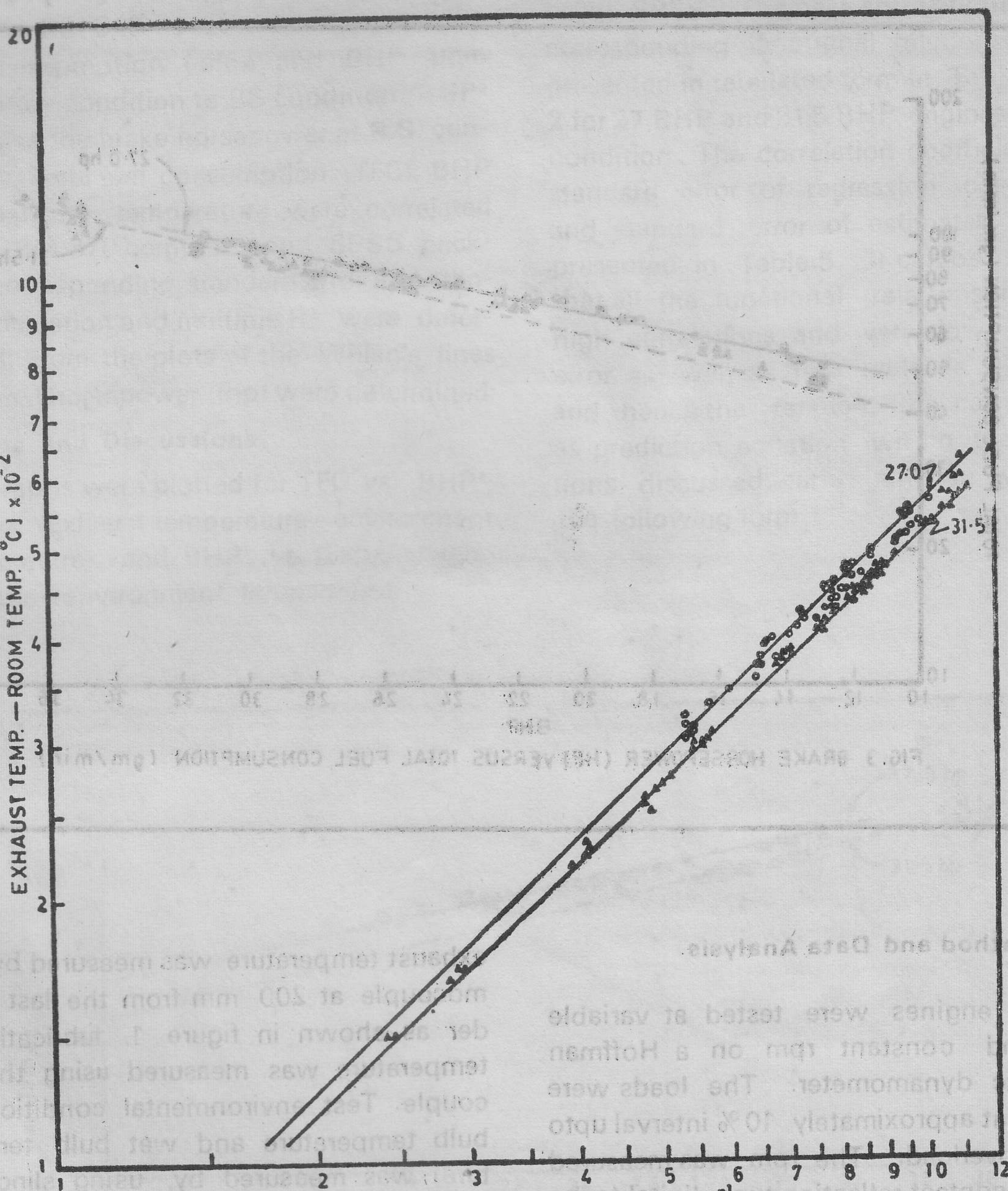

FIG. 2 TOTAL FUEL CONSUMPTION (gm/min) VERSUS DIFFERENCE OF EXHAUST AND ROOM TEMP

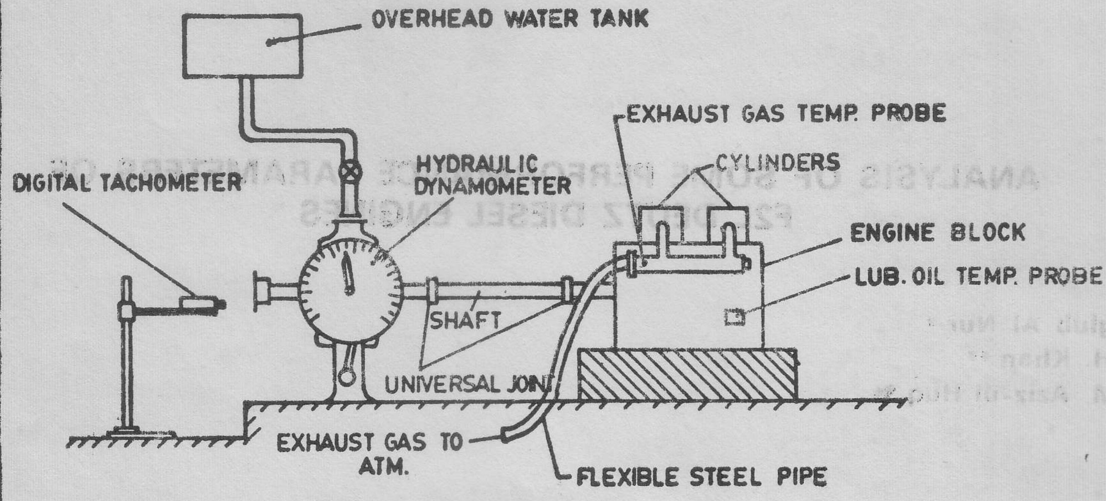

FIG. 1 SCHEMATIC DIAGRAM OF THE SET-UP

Testing of a large sample of a particular model of engine can give information and insight regarding the performance characteristics of that model, and with appropriate statistical analysis, it is possible to write equations to predict the performance parameters, viz., BHP from other more easily measurable related parameters, i.e. fuel consumption rate, exhaust temperature etc. of that particular model.

However, the application of the above equations to predict the performance parameters of the engine operating in the field has limitations. The environmental condition in the field can be handled by introducing proper correction factors but the operating characteristics of the engines do change as the engines wear out. So, the application of the prediction equation using the data taken from the engine after it has been overhauled has limitations. Apart from these uncertainties. the prediction equation can give information regarding the performance of the engine in the field within a reasonable limit of accuracy. Some data will be better than no data in the field.

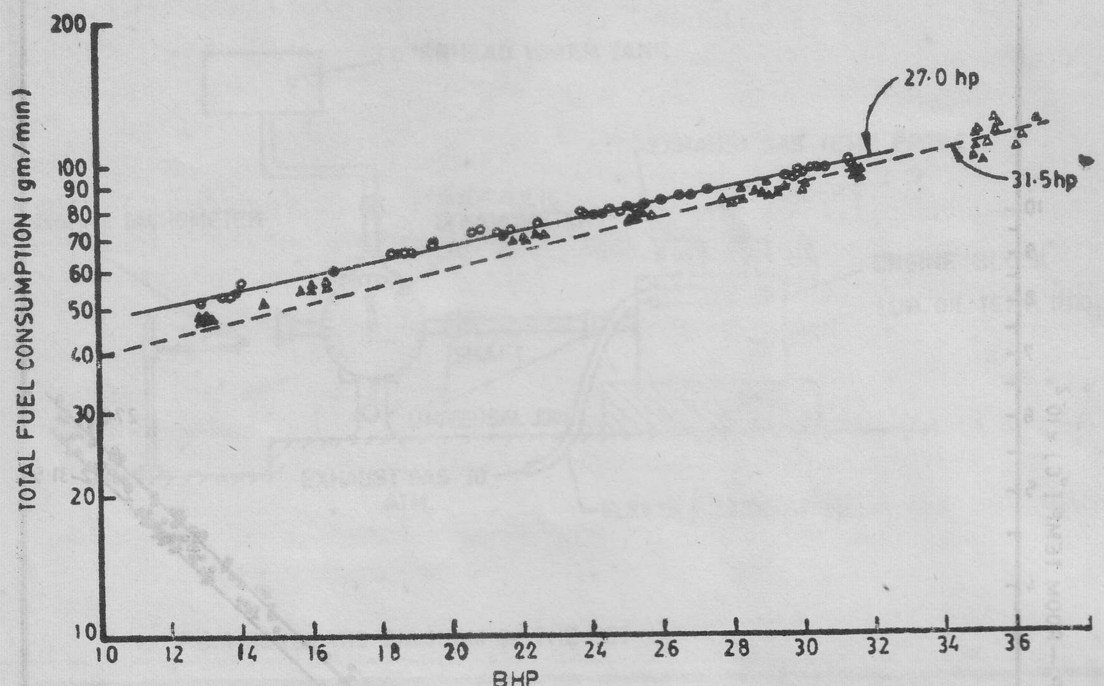

FIG. 3 BRAKE HORSEPOWER (HP) VERSUS TOTAL FUEL CONSUMPTION (gm/min)

Test Method and Data Analysis

The engines were tested at variable load and constant rpm on a Hoffman hydraulic dynamometer. The loads were applied at approximately 10% interval upto 110% overload. The rpm was measured by non-contact reflection type digital tachometer, fuel consumption rate was measured volumetrically, the specific gravity of the fuel was measured at corresponding room temperature using ZEAL S29.8 hydrometer, exhaust temperature was measured by thermocouple at 200 mm from the last cylinder as shown in figure 1, lubricating oil temperature was measured using thermocouple. Test environmental condition (dry bulb temperature and wet bulb temperature) was measured by using sling psychrometer at regular interval.

A total 36 nos. of F2L Deutz Diesel Engine of 27 BHP and 24 nos. of F2L Deutz Diesel Engine of 31.5 BHP were tested From the test data specific fuel consumption and BHP were calculated and corresponding derating was done according to BS 649 to convert the specific fuel consumption (sfc) and BHP from laboratory condition to BS condition. BHP* indicates the brake horsepower at B.S. condition. Total fuel consumption (TFC), BHP and exhaust tempereture were correlated using IBM 370 computer and SPSS package, corresponding standard error and standard deviation and multiple R^2 were determined. From the plots of the Willan's lines frictional horsepower (fhp) were determined.

Results and Discussions

Graphs were plotted for TFC vs. BHP*, TFC vs. (Exhaust temperature—environment temperature), and BHP* vs. (Exhaust temperature—environment temperature).

Different functional relationships and corresponding correlation coefficients were tested to correlate the above mentioned sets using SPSS. The best correlations and the corresponding functional relationships are presented in tabulated form in Tables 1 and 2 for 27 BHP and 31.5 BHP engines for B.S. condition. The correlation coefficients, the standard error of regression coefficients, and standard error of estimates are also presented in Table 5. It can be observed that all the functional relationships have high correlations and very low standard error as well as high multiple R^2 values and hence the relationships can be used as prediction equation within the limitations discussed earlier and are written in the following form :

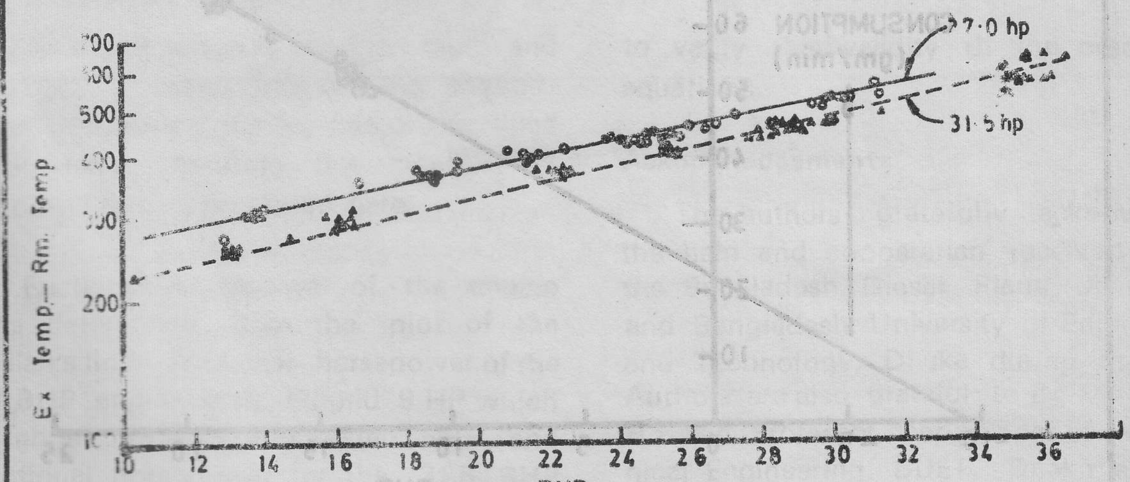

FIG 4 BRAKE HORSEPOWER (HP) VERSUS DIFFERENCE OF EXHAUST AND ROOM TEMP

$$\ln(TFC) = -1.989 + 1.045\ (\text{Exhaust temp.} - \text{Environment temp.}) \quad \ldots (1)$$

$$BHP^{*} = -99.932 + 28.506 \ln(TFC) \quad \ldots (2)$$

$$BHP^{*} = -155.977 + 29.670\ (\text{Exhaust temp.} - \text{Environment temp.}) \quad \ldots (3)$$

where temperatures are in °C.

By measuring the exhaust temperature at 200 mm from the last cylinder and the environment temperature, it is possible to predict the TFC and BHP* of the engine from the equations (1) and (3) respectively. By measuring total fuel consumption in gm/min it is possible to predict BHP* from equation (2).

By knowing BHP* it is also possible to estimate BHP at any other site condition by multiplying BHP* by the corresponding percentage derating factors according to BS 649 for humidity and temperature. Derating for temperature is done at the rate of 2% for every 10°F rise of environment temperature above 85°F. Derating for humidity is rather

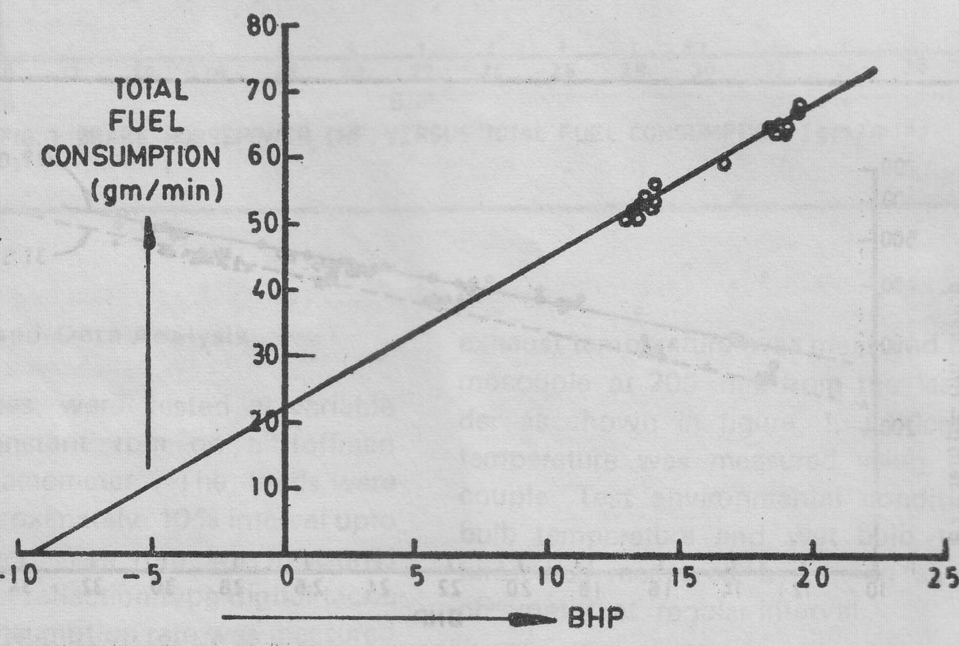

FIG. 5 WILLAN'S LINE, 27·0 HP: DEUTZ DIESEL ENGINE, MODEL-F2L 912

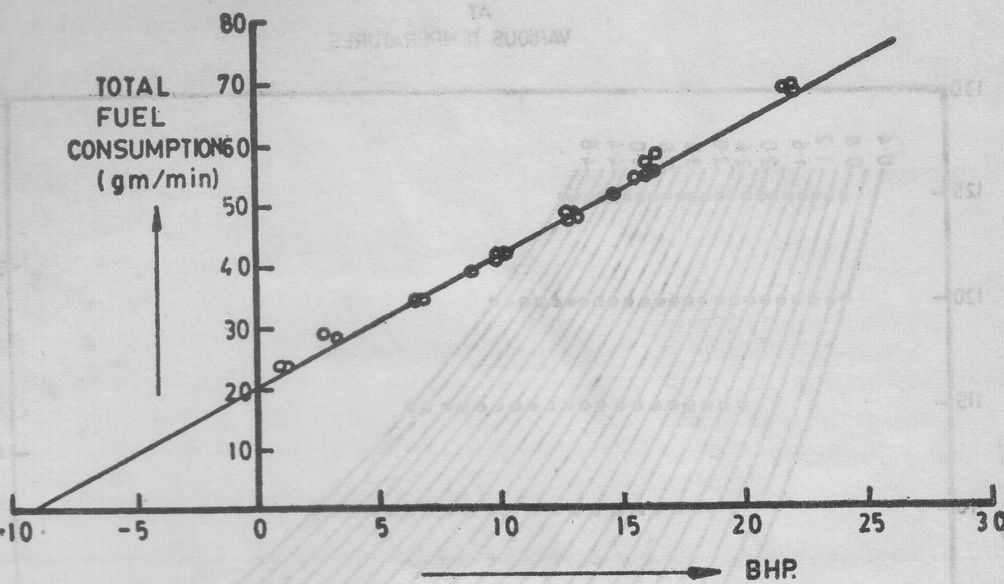

FIG 6 WILLAN'S LINE, 31·5 HP: DEUTZ DIESEL ENGINE, MODEL-F2L 912

involved and requires the dry bulb and wet bulb temperatures of the environment. Following the BS 649, a simplified approximate derating for humidity in graphical form is presented here.

Frictional horsepower of the engine was determined from the plot of the Willan's line. Frictional horsepower of the 27 BHP engine was around 9 HP which is about 33% of the rated BHP, and frictional horsepower for the 31.5 BHP engine was about 9.5 HP which is about 28% of the rated BHP. For further work it is suggested that data from the field may be taken for TFC and exhaust temperatures to verify the validity of the prediction equations.

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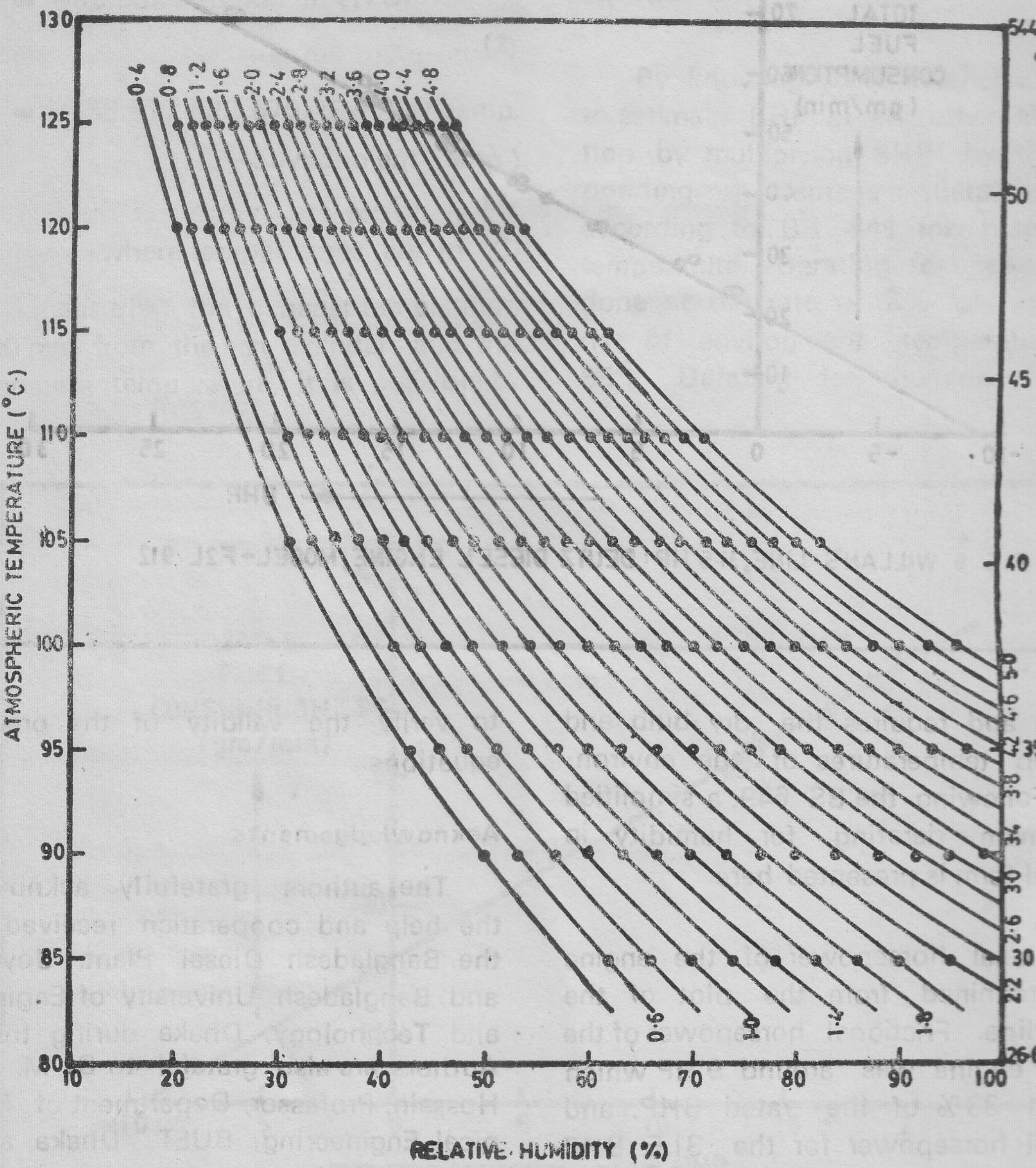
PERCENTAGE DERATING FOR ATMOSPHERIC HUMIDITY AT VARIOUS TEMPERATURES



APPENDIX A: FIG. A