Air Fuel Ratio Controllers on Natural Gas Fired Internal Combustion Engines: Analysis of AQB Permitting Database

Brad Musick (with assistance from Genevieve Grant and Mike Schneider)
NMED Air Quality Bureau
March 5, 2008

In our discussion of ES-13 in the draft Oil and Gas Emissions Reductions report, we noted the lack of data on air fuel ratio controllers. We have now completed an analysis of data from the AQB permitting database that may provide some helpful background information on the percentage of permitted engines which have these devices. The analysis could not be completed in time for inclusion in the Final Report, so the results are being presented in this separate document.

Methods

We pulled from the database a list of natural gas fired internal combustion engines, along with information on make, model, horsepower, and control device type. Engines were tagged as having an AFR if any of the following applied:

1) make and model number were known to be universally equipped with AFR
2) control device list included AFR, or
3) control device list included catalytic converter or NSCR (because these require AFR for proper functioning).

The great majority of those tagged as having AFR were identified as such by make and model number.

Our identification of AFR-equipped engines is subject to several sources of error. Permit applications or permits may have incorrectly indicated the presence or absence of AFRs or catalytic control devices. Data entry errors may have incorrectly indicated presence or absence of AFRs or catalytic control devices, or may have incorrectly designated engine make, model, and horsepower. We may have incorrectly tagged AFR presence on the basis of engine make and model. Despite these possible sources of error, we think these are reasonably accurate data on AFR frequency in engines that are included in AQB permits.

Another limitation of the data is that it does not include smaller engines which 1) have potential emissions below NOI/permitting thresholds, and 2) are not combined with other emissions sources in a facility with emissions triggering NOI/permit requirements. For example, it is possible that an isolated 150 hp engine operating continuously all year, without controls, might not need a permit or NOI and would therefore not be in our database.

Results

Figure 1 shows the total number of engines in arbitrarily defined horsepower classes. Given that there are so many more small engines than large engines, we decided it was preferable to assess AFR prevalence by horsepower rather than by number of engines. We thought this would be a better indication of AFR impact on total emissions than if we simply added up the number of engines with and without AFRs. It also helps in displaying the results for all horsepower classes together.

Figure 2 shows the total horsepower of engines with and without AFRs. Overall, the percentage of horsepower with AFRs is 69.2%. For intermediate sized engines (500-1499 hp), the percentage is much higher, at 91.7%. Small engines (<500 hp) and large engines (>1500 hp) have the lowest percentage of horsepower with AFRs.

We believe the high prevalence of AFRs is driven by the need to reduce criteria pollutant emissions in order to meet air quality standards, particularly ambient air quality standards. Also, to some extent, AFR use may also be driven by a desire to keep facility emissions below Title V permitting thresholds. We have not assessed the future impact of new MACT and NESHAP standards on AFR use.

FIGURE 1. NG IC Engines by HP Class

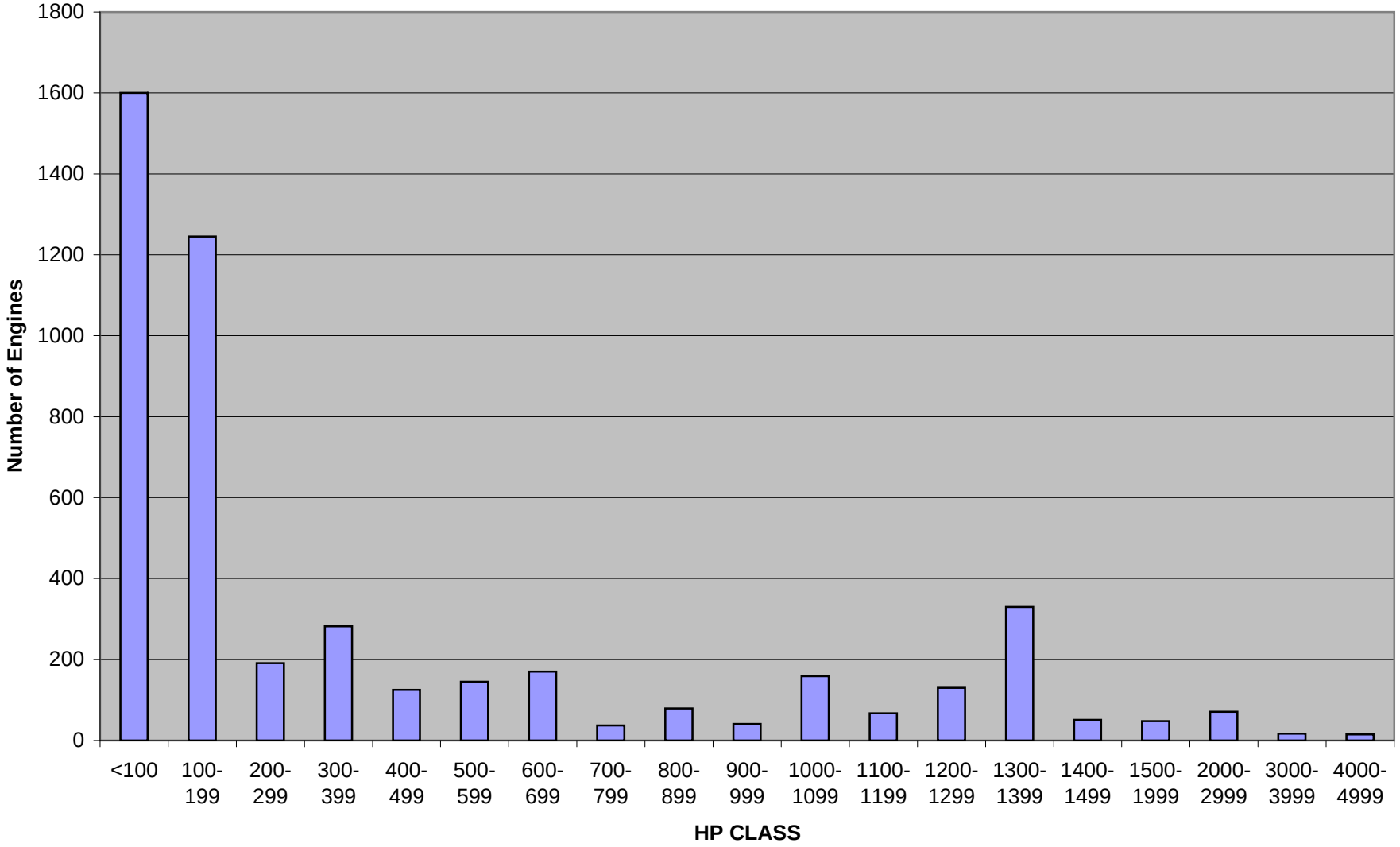

FIGURE 2. NATURAL GAS IC ENGINES WITH/WITHOUT AFR CONTROLLERS
(PERCENT OF HP WITH AFR: 69.2% OVERALL, 91.7% OF 500-1499 HP)