to where the law says it should be: 6 degrees BTDC." We recorded the following:

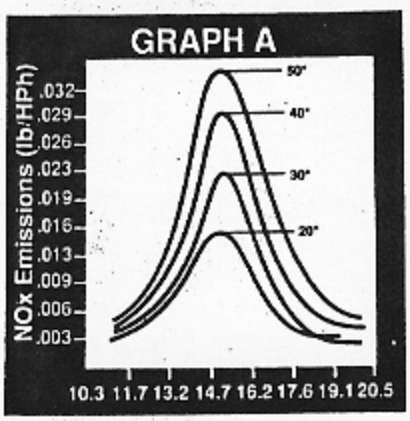
Idle: 869 rpm	Cruise: 2542 rpm
HC 60 ppm	HC 40 ppm
CO 2.36%	CO 1.93%
CO_2 12.06%	CO_2 12.68%
O_2 3.1%	O_2 1.5%

"Wow, these are really good numbers for what is on this car," said Kevin, as he checked the readout. "This thing is running extremely clean. It would pass California easy if it had an NOx system."

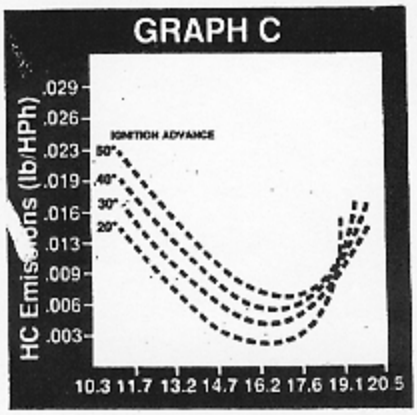
While the emissions levels are good news, the performance at this state of tune for this particular engine is on the down side. It runs pretty flat off the idle and tends to run warm with the timing retarded. Retarded timing causes the burn to occur late in the power stroke. The charge is still generating heat (burning) into the exhaust cycle, which introduces heat into the heads and valves. When you advance the timing, the burn takes place sooner in the power stroke so the fuel is mostly spent by the time it's exhausted. The heat is used to power the car instead of heating the heads and valves.

All things considered, Kevin felt that the combination was just about right for this car: the jetting, which is right-out-of-the-box Holley, and the cam, which isn't too radical for this size of motor. (Kevin said more cubic inches can tolerate additional camshaft duration and larger headers.) Paul said he runs 13.55 in the quarter-mile with a 14-degree advance, which isn't bad and adds credibility to the fact that the combination works.

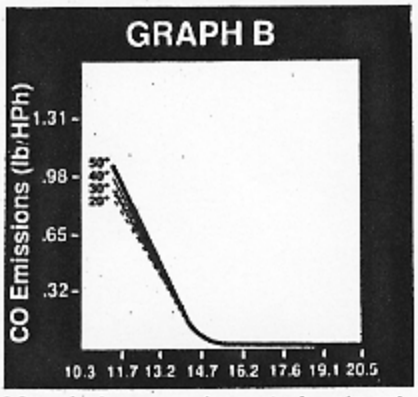
The lesson from this is that you can have a decent-performing machine that's relatively low in emissions. The stumbling block is that performance generally means higher combustion temperatures and pressures, which form NOx. But with a proper tune and A/F ratio management, we can have our hot Mustangs and breathe a little bit easier, also. *M*



This graph shows the relationship between ignition timing, air/fuel ratio, and NOx emissions. Notice that as the timing is advanced, NOx levels go up for all A/F ratios. NOx is associated with higher temperatures and pressures that occur in the combustion chamber under load or advanced ignition.



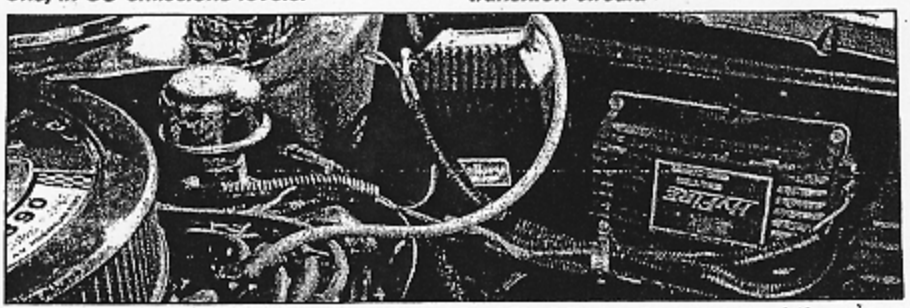
Here, the impact of ignition advance and A/F ratios on HC emissions is displayed. HC emissions tend to increase as timing is advanced until the A/F ratio is extremely lean.



CO emissions are shown to be almost exclusively the function of A/F ratios. Only when the engine is running rich does timing play a role, and a minor one, in CO emissions levels.

After retarding the timing to 6 degrees BTDC, the idle has to be set. This is tricky with the Holley because the vacuum-advance port is right off the throttle tip, which means that as you raise idle speed you start to get into the transition circuit.

Paul's combination turned out to be quite efficient. The equipment for this year of car is completely California legal, therefore, we assume that it would also pass most other states' requirements. However, he needs to install a retrofit anti-NOx device to pass the California visual inspection.



As the series of graphs illustrates, timing is critical for performance and the production of harmful emissions. The Mallory HyFire ignition system has a California Air Resources Board (CARB) exemption number. High-energy ignitions tend to reduce HC production, since they stabilize the ignition of the A/F mixture, promoting a smoother idle.