Safety Strategies for a BMW Turbo Control System

Recent postings have suggested that Dinan is backing off on power aggressively with our 3.0L twin turbo software when the engine heat soaks. This is completely false.

First off, temperature and safety correction logic in the software are actually written by BMW, not Dinan, and are in both the Dinan and stock software. Dinan does not adjust the stock corrections or any other safety logic because we deem such actions unnecessary and potentially unsafe for the engine.

The software's strategies are as follows

1. **Ambient Air Temperature** There is a standard correction for air inlet temperature for both fuel mixture and ignition timing. These are based on air density and are standard for all engine calibrations regardless of manufacturer or fuel injection brand. These corrections work the same on both naturally aspirated and forced induction engines.
    a. Basically, colder air is denser, which means there are more oxygen molecules going into the engine. Because of this, more fuel must be injected to maintain the proper air fuel ratio. The opposite occurs when the air is hot, in which case less fuel is injected into the engine.
    b. A colder charge is less prone to detonation, so the ignition timing is advanced with cold air and retarded with hot air to protect the engine.

2. **Overheat Protection** There is also heat exchanger efficiency software that protects the engine if it gets hot. Laws of thermodynamics tell us that to exchange heat there must be a differential in temperature, and the greater the differential the more heat is exchanged. These corrections work the same on both naturally aspirated and forced induction engines.
    a. On a cold day when the radiator is working very well and is much colder than the block temperature, the ECU will lean out the mixture and advance the timing.
    b. On a hot day when the radiator gets closer to the engine block temperature and the block temperature rises because of radiator inefficiency, the software anticipates the engine overheating and retards the ignition timing so the engine loses power and thereby produces less heat. In addition, the fuel mixture is richened to absorb combustion chamber heat (fuel cooling). This fuel cooling also quenches the combustion chamber and reduces the tendency to detonate or ping.

3. **Detonation** When the engine is detonating (pinging) due to poor fuel quality or excess cylinder pressure, the knock control system will retard the ignition timing so the engine loses power, reducing the tendency to detonate. In addition, the fuel mixture is richened to absorb combustion chamber heat (fuel cooling) and reduce the hot metal's tendency to cause detonation.

4. **Catalyst protection** When the engine's duty cycle is high (high rpm, and especially at wide open throttle in high gear), there is less time for the catalyst to cool between cylinder firings. This puts more load or heat on the catalyst, so the fuel mixture is richened to quench the catalyst in order to keep it below the temperature where it will get damaged.

Some additional points:

The Dyno Run verses the Road When you put your car on a chassis dyno it is impossible to get the same level of air flow that the car will experience on the road. It would require a fan the size of a wind tunnel. As cars get smarter, accurate dynamometer testing gets harder. While we have the largest fan I have ever seen on a chassis dyno, it still will produce significantly less air flow than driving the car down the road. This will give you the triple whammy.

a. Both the intercooler and the radiator will be less efficient, and as a result the engine will detonate more. So when repeated runs are made, the engine goes into save-its-life mode, aggressively reducing power by retarding the ignition timing and richening the fuel mixture as well as possibly lowering the boost depending on how extreme the condition is.
b. If the piggy back boxes are not losing as much power as a stock or Dinan car on the dyno, you should be afraid because this means that your engine is in jeopardy as a result of these safety controls being compromised. Maybe not on purpose, but none the less compromised.
c. The same conditions are seldom seen on the road, so the correction while driving will not be as aggressive as you will see on the dyno. You can verify that this is true by the glowing reports of the cars performance on the road and the track. (JP posting and the video).

Getting the most power As you can tell, these corrections are a good thing. Having said that, more power can be safely achieved by correcting the conditions that the ECU is correcting for.

d. A better intercooler will reduce inlet temperature, advance the timing, and lean the mixture
e. A better oil cooler will reduce engine temperature, advance the timing, and lean the mixture
f. Higher octane fuel will reduce detonation, advance the timing, and lean the mixture.
g. This is why we require an intercooler and oil cooler for our Stage 3 software, to protect your investment and extract the most power. We also recommend using unleaded racing fuel whenever you do a track day.

I hope this helps you to understand what is going on inside the incredible engine control system that BMW has put on your engine.