



Technical Bulletin TB 04-2019 FE / FE 2 / ESR Fuel

There has been some confusion about the fuel requirements for an FE vs FE2 vs ESR. We need to begin by discussing how each engine was tuned.

FE 2.3

The 2.3 MZR/Duratec used in a standard FE, (except for the dry sump, intake manifold, EFI and header) is pretty much just as it would be in a small truck like the Ford Ranger.

The engine is in an OEM state of tune, including the cam timing. When the engine was first tuned for the FE back in the early 2000's it was thought that 100 Oct unleaded was the safest fuel for the engine.

The original ECU was an MBE 967 batch fire controller, meaning it fires all the injectors at the same time, every time. The ignition is run in wasted spark, meaning it fires 2 spark plugs at the same time, every time, from one half of the coil pack and alternates between Coil 1 and Coil 2. Cylinders 1&4 and 2&3 function in pairs, this is still very common today.

Over the years the FE 2.3 MBE calibration has been improved and was last updated in 2012 for the F2000 pro series. At that time, we made the pro and club tune file the same calibration. Tuning was always done on 100 Oct unleaded.

This was also the last Spec tune for the **ESR** until the ESR was adapted as a P2 class car.

FE / W PE ECU

As an incremental step in the upgrade to an FE2, also obsolescence of the OEM throttle body, we made an ECU/throttle body update kit for the FE 2.3. The FE 2.3 was always tuned on 100 unleaded, and we needed the PE ECU to match the MBE ecu power curve. The PE ecu still requires 100 Oct unleaded.

FE2

The FE2 with the MZR 2.0 (the newer, smaller MZR) has a forged crank and rods as well as a higher compression ratio than the 2.3.



The 2.0 MZR is also in OEM tune, (except the dry sump, intake manifold, deleted VCT, EFI and header) it is pretty much just as it would be in 2.0 Miata.

We took full advantage of the stronger bottom end, and with cam timing focused the power output in the upper RPM range. Keeping operating costs in mind, we used 2 heat range colder spark plugs than OEM and tuned the engine for 93 unleaded.

As part of the FE2 conversion, the ECU is updated to a PE 3 8400 and is part of the reason we could tune the 2.0 with 93 unleaded.

The PE 3 8400 is a sequential fire controller, meaning it fires each injector during a cylinder's intake stroke and is more efficient than the MBE batch fire controller. It also runs the ignition in wasted spark.

The second major upgrade of the PE ECU is that it can run in closed loop, meaning it uses feedback from the O2 sensor and adjusts the A/F ratio (*with-in limits*) as the car runs around the track. While this control is very good, it has no way of reading the octane or ethanol content of the fuel. It is still up to the driver/crew to use the proper fuel. 93 Unleaded.

ESR

Updates were made to the **ESR** to make it a more competitive car classed in P2. Those include the intake manifold, throttle body, PE ECU and cam timing.

The cam timing is a major change from the 2.3 used in the FE. Just like the FE2, power was focused to the upper RPM range to improve HP as reliably as possible.

Because of the higher RPM and known history of the 2.3 it is still tuned on 100 Octane unleaded fuel, or better.

In summary fuel should be used as follows:

FE 2.3 with an MBE or PE ECU	100 unleaded
FE2 2.0 with a PE ECU	93 unleaded
ESR with MBE	100 unleaded
ESR with P2 updates	100 unleaded or better