Balance Rates, the naked truth

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What is a balance rate and what does it mean? A balance rate is a status report generated, typically, by a $100 handheld diagnostic tool available at most neighborhood auto part stores that gives the state of each engine cylinder assembly. This "tool" does not measure, amongst other benchmarks, fuel injector output, and merely reads what the ECM (electronic control module) is commanding the injector to adjust which includes fuel output and timing. This means the whole picture is not being shown and more importantly, not being tested, and therefore cannot be analyzed, and consequently not addressed and or fixed.

Industry specific diesel fuel injector test bench calibration machines, measure fuel injector output with up to .01 cubic mm precision and have a starting cost upwards of $100,000 USD.

The balance rate is a very small snapshot of the myriad of things that are going on with the injector(s) in the engine under very limited conditions. These conditions typically only include operating temperature, foot on the brake, and at idle conditions. It does not typically consider, amongst many other contributing factors, engine load, fuel quality, and several other factors that can either enhance or stifle the injectors performance. Balance rates capture not much more than the ECM adjusting each injector by crank position resolution to achieve nominal cylinder balance.

Other considerations to keep in mind when looking for engine and injector sabotage culprits may include the quality of and state of cylinder compression including the quality of piston/rings and cylinder wall micro finish, connecting rod geometry, valve sealing qualities, cam lobe displacement/wear, bushing axial play, other cylinder possibly misfiring and throwing off the firing balance, fuel quality, air and pressure wave propagations influenced from pump, injectors, and filters. Many of these components, and or situations either individually or working in unison can affect and directly contribute to the issues observed and or complained of.

My balance rates are off, what can I do?

In the case of a GM LB7 engine model, balance rate limits with the vehicle at operating temperature are +/-4 at idle in park and +/-6 at idle in gear.

Balance rates are an indicator of how evenly each cylinder is accelerating the crankshaft. Anything that affects cylinder firing "strength" will affect the balance rate readings. We have heard of normal things, such as valve lash and low cylinder compression (copper seal, loose injector cup (LB7), rings, head gasket, etc...) affecting balance rates. Incorrect injector output codes or NIMA codes can throw off balance rates as well (see ref G). We have also seen a few unusual things such as bent connecting rods causing high balance rates. So, there are a number of things besides injectors affecting balance rates, and they should be eliminated as possible contributors before removing the injectors.

To help determine if the root cause is related to the injectors, or one of the other items mentioned above, exchange the injector in the questionable cylinder with one from another cylinder. If the excessive balance rate does not follow the injector to its new position, begin checking the engine related items listed above. If the balance rate does follow the injector, the injector may need to be repaired (if possible), or replaced.

Ref G

Do I have to enter the injector output codes or also identified as the "NIMA codes"?

When installing a set of modified injectors in an engine that is equipped with injector output codes or NIMA codes, it helps to set all of the cylinder codes to the same value. Once modified, it is likely the injector no longer has the output characteristics that are mapped in the factory NIMA code. Since Dieselogic has already balanced the injectors on the NEO (injector test bench), it is best to have the ECU treat them all the same rather than try to compensate for an output characteristic (high or low) that is no longer there. Pick any one of the codes off any one of the injectors and enter that code for all in the ECU.