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The Effects of G-Forces on the Oil in Your Pan.

In our quest to build the best possible turbochargers on the market we have learned a couple important lessons about the EVO 8/9 platform that may surprise a lot of people. We at Forced Performance have always been about educating our customers and pushing whatever platform we support to the next level. This article will cover what effect sustained high g-forces have on the oil in your pan and subsequent systems relying on a clean, steady supply of oil.

At power levels above and about 500WHP (double the factory HP,) or with some suspension wizardy, the car suddenly becomes capable of pulling 1g sustained during the launch and during hard cornering. So you may say to yourself "that's friggin awesome" but the engineers at Mitsubishi did not design our oil pan and pick up with 500WHP+ in mind, same with the factory exhaust, fuel pump, injectors, cams, intercooler, etc. We outfitted our own test vehicle with accelerometers and monitored oil pressure a thousand times a second at a few different locations and set out to find at where exactly it becomes a problem.

We found out at around .7g's during a launch or a hard right hander we would partially uncover the oil pickup tube in the EVO and would affect oil supply. At this point the oil is still being fed but it's mostly aerated oil that just can't support the high thrust loads and shaft speed of a journal bearing turbocharger. So instead of nice clean oil the turbocharger and other components are being fed bubbles and foam. This can cause instant and irreparable damage to a journal bearing turbocharger. It may not destroy it right away but the turbos days are numbered.

The real aha moment came when we reached 1g the oil pick up tube was completely uncovered stopping oil flow during the most critical moment for the turbocharger, high shaft speed and thrust load. The majority of people won't have any problems but some do.

So you might say "well I make 500WHP and I've never had a problem" and that might be true but again it's not the HP figure that matters, it's the G-forces that the car is capable of due to that power level. So while you might make the power you may never see the G's necessary to cause damage. You might also say "well I'm sure plenty of people are pulling that kind of G's why aren't their motors blowing up" and that's an easy question to answer, their cranks aren't turning at 70,000-140,000RPM and rod and main bearings have a much larger surface area than turbochargers. Journal bearing turbochargers have a relatively small surface area when compared to a main or rod bearing and cannot tolerate inadequate oiling in the same manner. Typically a journal bearing turbocharger capable of exceeding 500WHP is spinning around 20X's faster than the crank is which makes for some interesting failures if you suddenly interrupt its oil supply.

The turbocharger is not the only victim of pumping foam. The EVO 9 MIVEC system uses oil to hold the camshaft in position. When data logging actual camshaft position compared to the target position, it is easy to see that the foam has a huge impact on cam location error. The camshaft is not held in position well at all, making rapid high frequency erratic movements during these oil pickup issue events. It should be no surprise that MIVEC camshafts also fail under this abuse. People have observed the results of oil pickup issues for years, perhaps not connecting the cause to the effect. Broken turbos, oil pumps, and MIVEC intake camshafts are not a mystery, they are a result of physics.

To illustrate our point we setup a bit of a test to show you what it looks like in your pan at .7g's. To simulate your oil pan and pickup at .7gs we filled an oil pan with water and corn starch to make it easy to see and photograph. We then filled the pan with 2 quarts of liquid to simulate 7000RPM we set it to 30* and the below pictures show what's happening during a hard launch. The oil pick up would be partially uncovered allowing for the oil to become aerated. It gets worse at 45* the entire oil pick up is uncovered and oil flow is interrupted to critical systems.

The next question is how do you fix it? Well from our point of view it's put a ball bearing turbocharger on the car. Ball bearing turbochargers can live with intermittent oil supply without any damage. From the complete systems perspective the answer isn't so obvious. Baffle the oil pan, relocate the oil pick up towards the middle/back of the pan, install a dry sump, or operate at 275hp so that the oil system can operate as it was designed , but that's no fun.

We hope this helps educate you a little further and helps you understand the forces at play in building a high horse power car. As always have fun and boost on!