

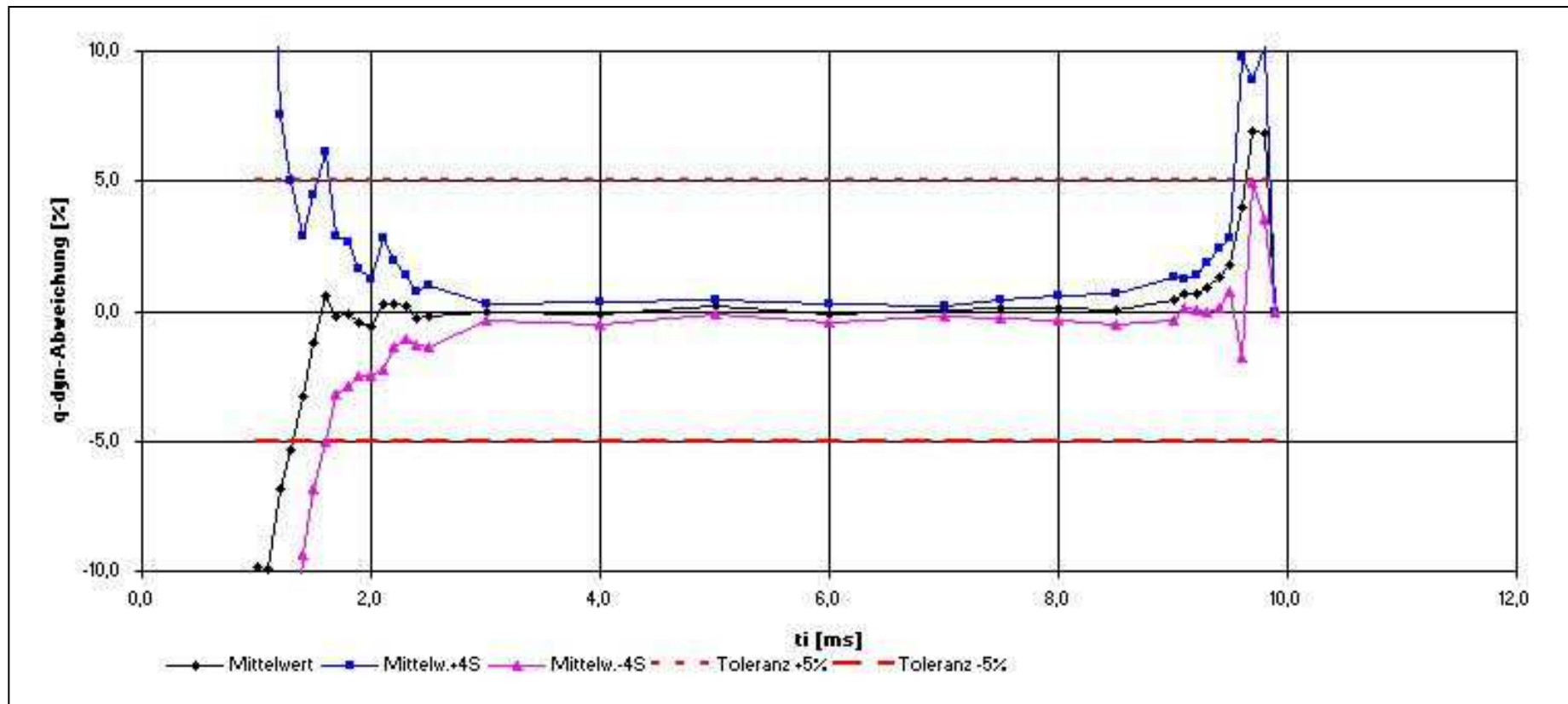
The parameter commonly known as "dead time" Bosch call "offset time".

This parameter is a more or less theoretical value of the flow over time curve of an injector. It defines the point where the linearized dynamic flow curve crosses the time axis. In practical terms it is the first time (t_i) when an injector delivers any amount of fuel. But this "dead time" does not give you an information about the usability and quality of an injector.

The more important parameter (for the low flow situations - e.g. smooth idle run) is the $t_{i,min}$ which is the first injection time the injector delivers a predictable flow. We define this point when the dynamic flow has a deviation of the linearized flow curve of less than 5%.

We do not put much emphasis on "dead time" adjustments, especially for high performance applications as a low "dead time" could indicate for example; a weak spring force (possibly caused buy people using a pressure back flushing system) or possibly a weak magnetic circuit.

The dynamic flow range and the deviation of the measured flow compared to the flow of an ideal injector is much more important for engines because this indicates the flow deviations from one injector to the other. Poor performance in this parameter could a more adverse affect on a performance engine much more than the "dead time/offset time".



This is a sample graph of the deviation a flow over pulse width curve have compared to the ideal linear behaviour (the points in the graph indicates the measured flows at the given t_i points - the curves in between the points are only shown for better understanding. You can see that around 1,0 ms the injector delivers fuel (data based on measures of 10 injectors). The mean deviation (black curve) is around -10%. The statistic deviation is much higher. That means at 1,0ms the flow deviation from one injector to another can be app. 10 - 20% or more! Think yourself what effect this behaviour has on the engine.

Here at app. $t_i=1,5$ ms the purple curve crosses the 5% deviation border. We define the minimum t_i at this point, because then it is statistically (with $\pm 4s$ which means 4 times standard deviation!) save that all the injectors in an engine delivers fuel in a flow accuracy that there is a smooth idle run.

For performance injectors the idle run might not be so important, but a short deadtime is even less important. For this engines I think the behaviour close to t_i, \max (which follows the same rules) is more worth to look at. Large deviations of flow (think about 10..20%more or less flow) from one injector to the other might lead to serious engine problems.

If you want to test injectors according to their dynamic flow quality you can use your own machine! It shows the flow deviations from one injector to the other in a very illustrative way because of the parallel testing and the fuel level in the glass tubes.