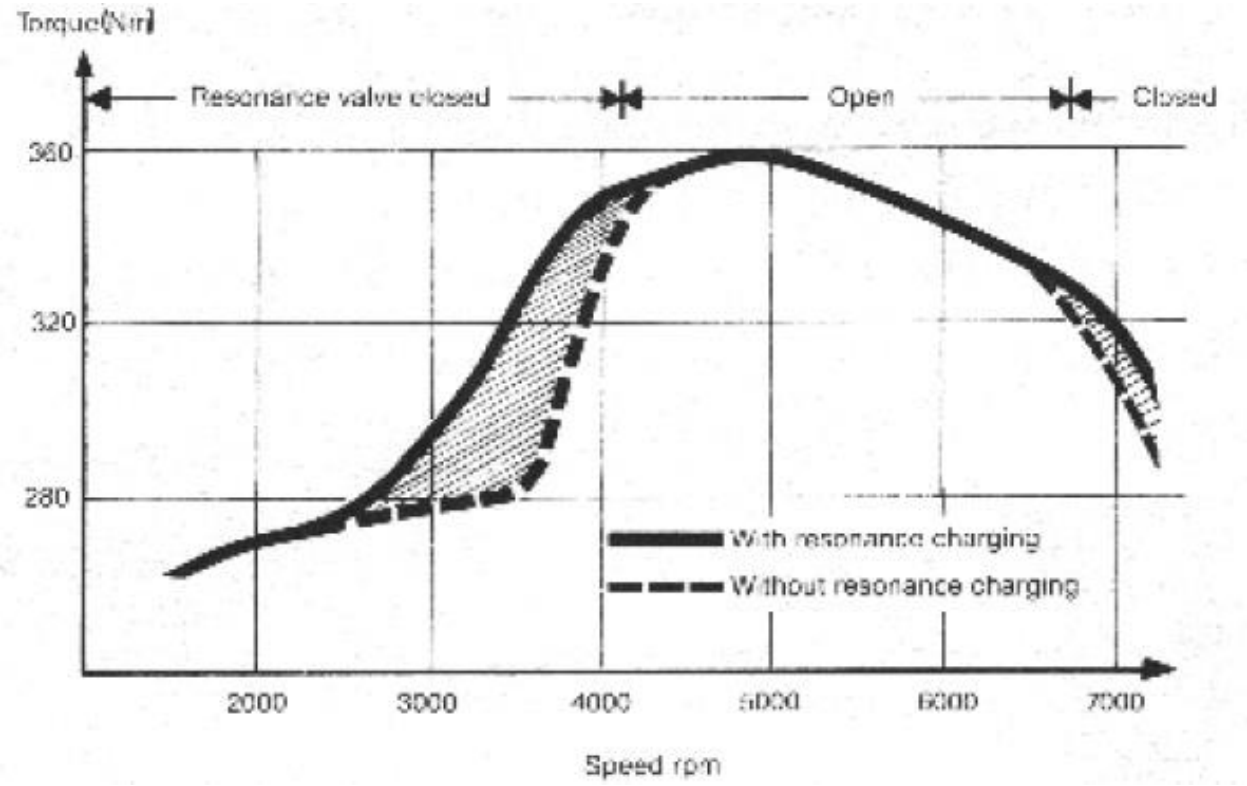
Tech Tuesday

S38B36 & B38 Variable Resonance System | March 2020



This page left intentionally blank.

From all of the asses at Angry Ass, thanks for joining us on this Tech Tuesday!

We're diving into the variable resonance system that's integrated into the intake plenum of the S38B36 and S38B38 engines motivating the E34 M5. Incorrectly, many conflate this type of system with variable length intake runners, which admittedly serve a similar purpose; but that purpose is achieved via different methods.

We'll be referencing the venerated leather-bound volume, BMW's Technical Reference Information Bulletin Number 11 02 90 (2099), to expound on the details of this system. This will include the components that make up the whole, along with a brief education on the evolution between the S38B36 and S38B38 variable resonance systems.

So, go grab a few refreshing beverages – and let's get to it!

Angry Ass

Before we get ahead of ourselves, a basic understanding of the internals of the S38 plenum lays the foundation for our later learning. Behold, a cutaway image of the intake plenum split at the seams, showing the internal layout, in Figure 1.

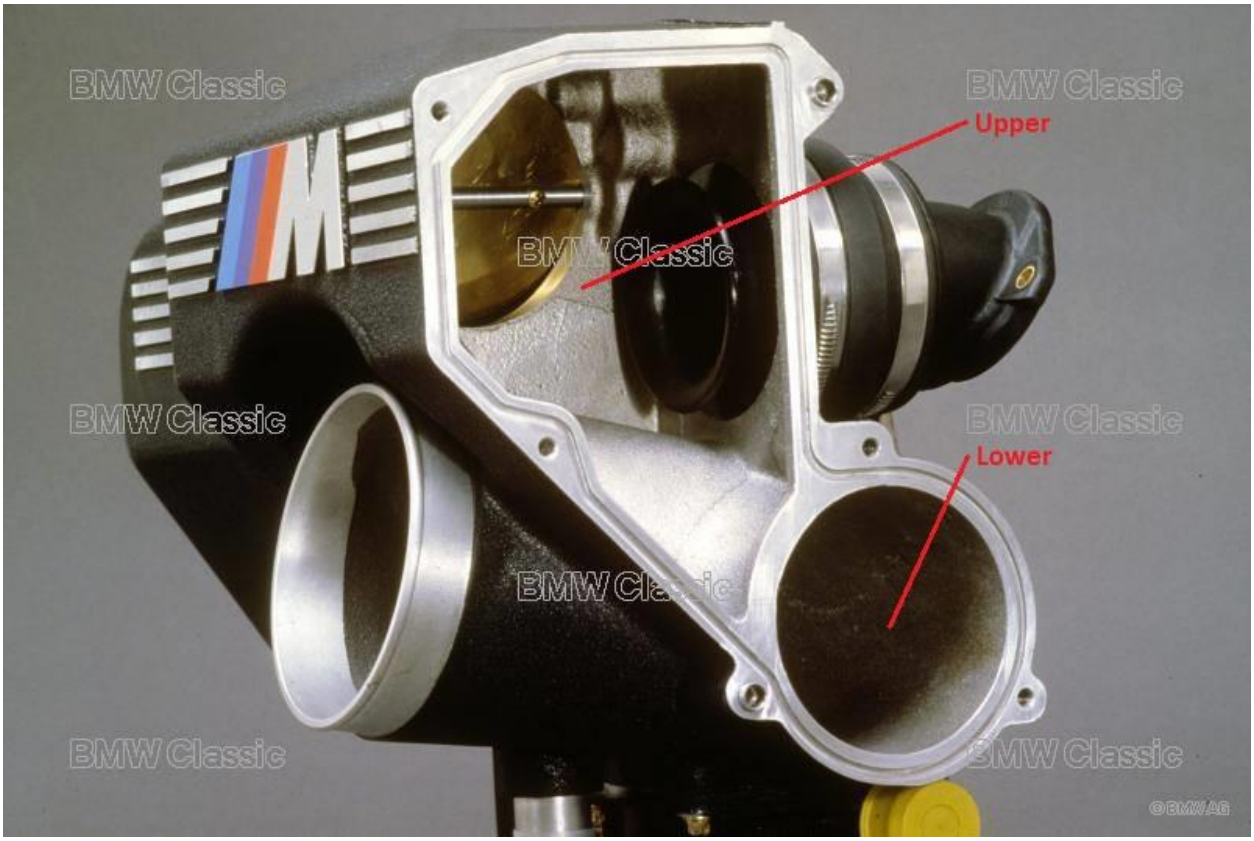


Figure 1

The plenum is made up of two chambers: the upper chamber contains the resonance flap, and feeds all 6 individual throttle bodies via velocity stacks. The lower chamber consists of the main plenum inlet, feeding into the resonance tube that distributes air to the upper plenum and acts as a path for the pressure waves. Funny thing about this cutaway in Figure 1 (well, funny to enginerds like Greg) is that the o-ring groove you see doesn't actually exist on the production units! We are guessing this was an early BMW press release photo.

Another interesting factoid you can use to bore guests at your next dinner party is that in the lower chamber, BMW found it worthwhile to include bell-mouthed openings as is commonly seen on velocity stacks – to improve flow from the upper chamber to the lower chamber. In the course of development of our larger volume, composite intake plenum that maintains this variable resonance system, we dissected a stock plenum. This was the only way to ensure we didn't miss incorporating a single feature of this highly-developed OEM plenum, including the bell mouth feature located on either end of the lower chamber.

Figure 2 on the next page catalogs our irreversible destruction of a plenum – for science!

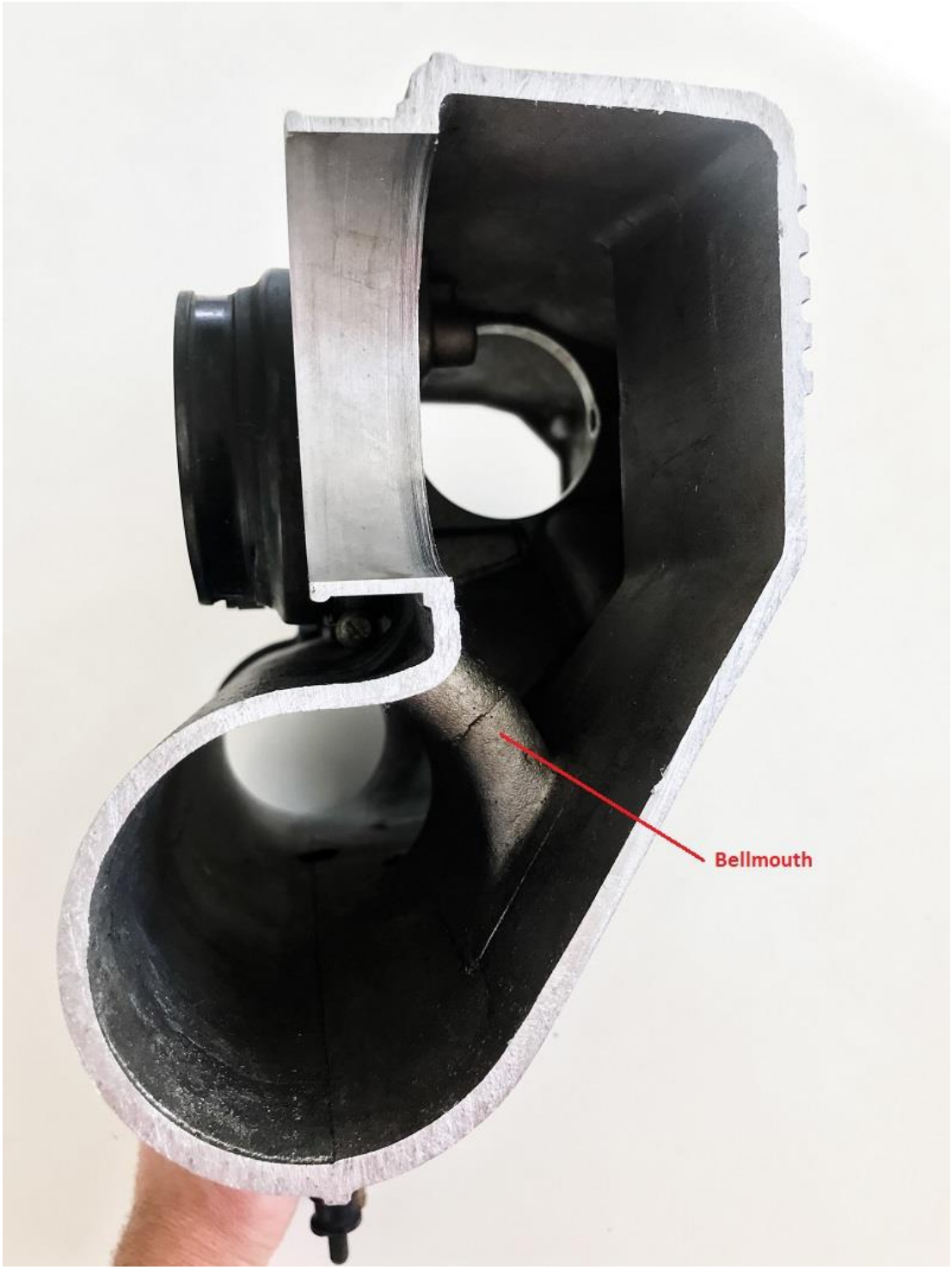
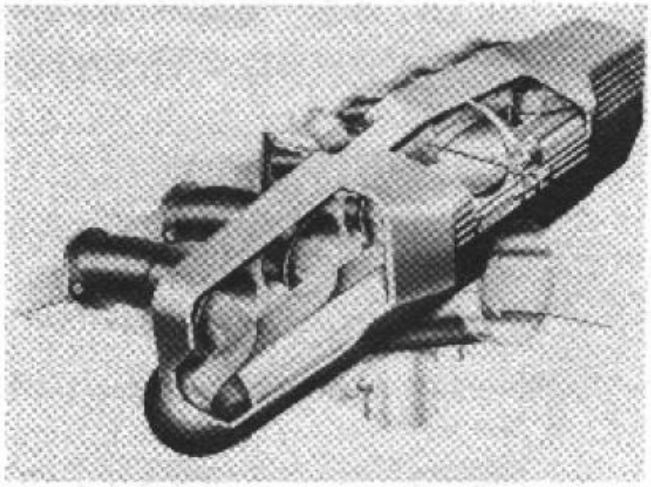


Figure 2

Enough talk of bell mouths: let's move on to the variable resonance system function, located in the upper chamber. This brings us to page 2 of the BMW technical bulletin, in which the system was complex enough to make the BMW technical writer hedge their explanation by starting their sentence with "Basically".



Basically, it varies the effective length of the induction system depending on engine speed, load and ignition switch position in order to obtain an improved torque spread over a wide speed range.

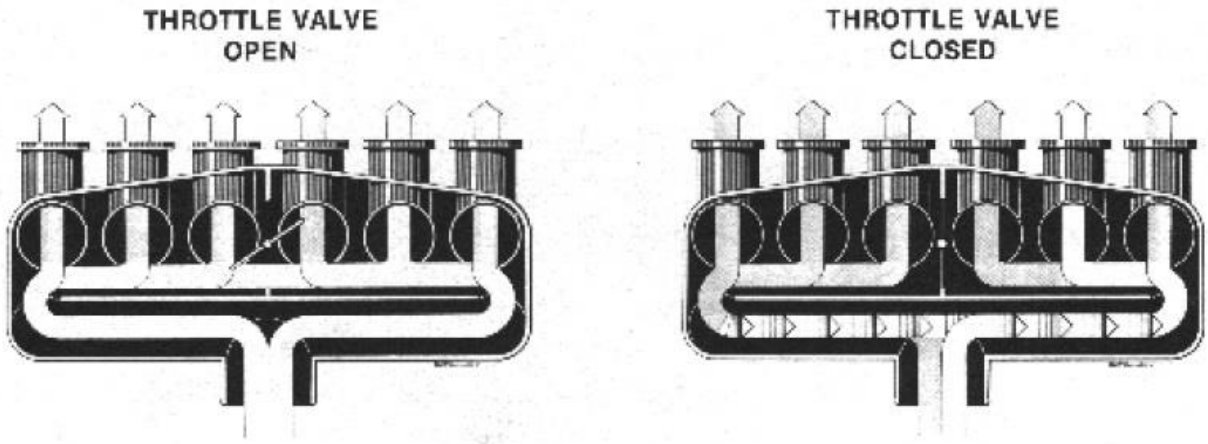


Figure 3

In Figure 3 above, the diagram details how the resonance flap divides the upper chamber depending on conditions such as engine speed and throttle position. Basically.

A logical next question you might be asking yourself, is why one would want to divide the upper chamber at all? The goal is to influence the path of the pressure waves created from the sudden closure of the intake valves, orchestrated by the firing order of the S38 (1-5-3-6-2-4). Splitting the upper chamber between cylinders #3 and #4 forces pressure waves to travel through the remaining available path – via the lower chamber.

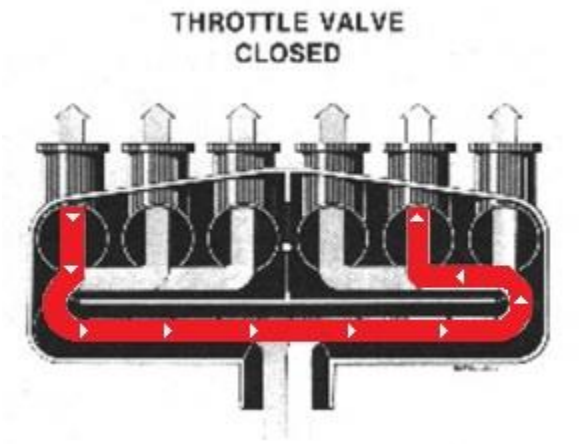


Figure 4

With this simple division of chambers, BMW gamed the pressure waves of cylinder #1 to positively influence the filling of the next firing cylinder (#5); and then #5 influenced #3, and so on. Now, back to bell mouths (in Figure 2): remember, BMW added them to the ends of the lower chamber, which seems a bit extra at first glance. But the main purpose is in fact to ensure clean flow from cylinder to cylinder to maximize the benefit of this elegant system! Basically.

With the groundwork laid of how this tricky plenum functions with the resonance flap closed, let's look at the conditions in which that valve remains closed or actuates open, and how that takes place.

Figure 5 below is also from BMW's technical bulletin, and shows how the resonance flap is controlled and actuated on the S38B36.

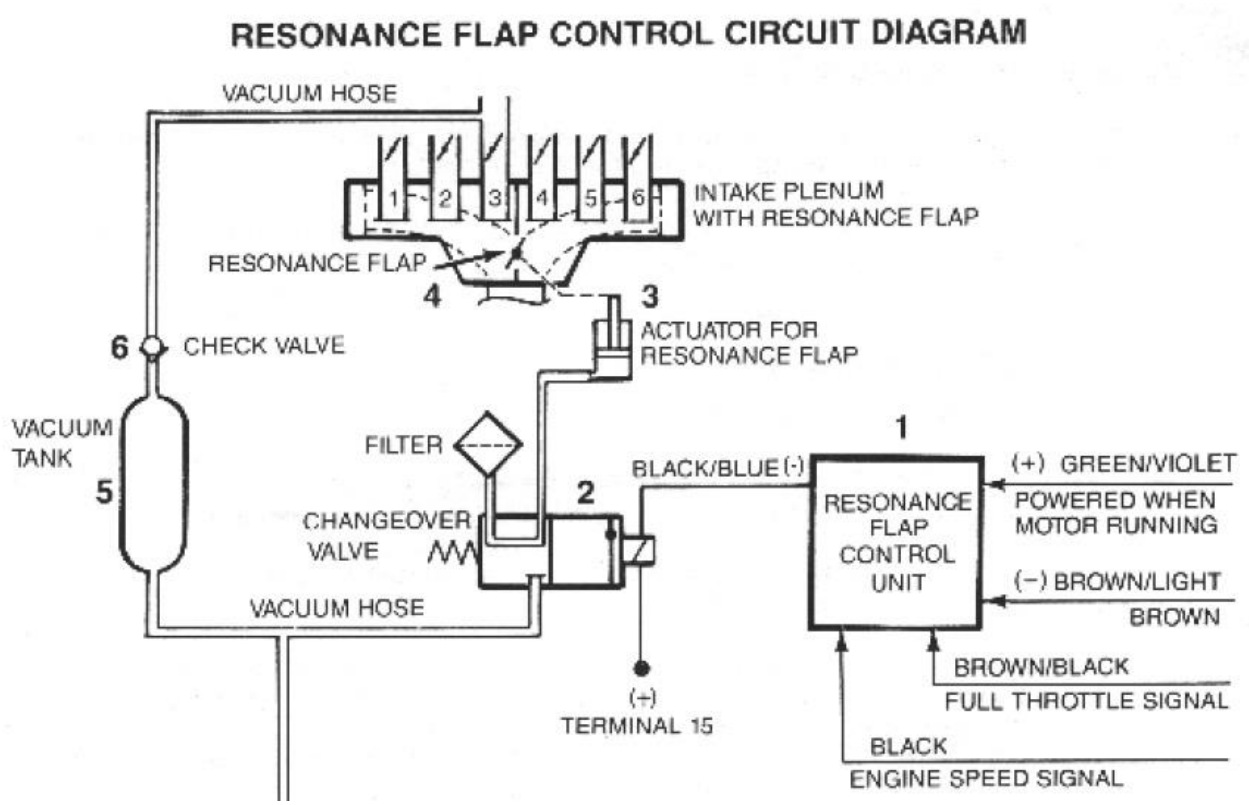


Figure 5

The S38B36 resonance flap is electronically controlled, but vacuum actuated. The S38B38 differs from the S38B36 in that BMW added direct control of the resonance flap to the ECU. This eliminated the need for the B36's separate control unit, but besides this difference, the physical actuation of the flap is the same between the two engines.

Angry Ass

Control strategy for the resonance flap, as well as component locations (See Figure 5 above), are outlined in Figure 6 below.

A. **RESONANCE FLAP CONTROL**

The Resonance Flap Control Unit (1) is located beneath the three relays in the E-Box, between the Motronic control unit and the SRS control unit.

Based on both the full throttle signal and the engine speed signal, it will ground the lead to the changeover valve (2) and thus energize it.

The necessary conditions for such an action are:

— engine speed less than 4,120 RPM **and** full throttle; or

— engine speed greater than 6,720 RPM **and** full throttle.

Unless either of the above conditions are met, the changeover valve will **not** be energized (via grounding by the resonance flap control unit) and the resonance flap (4) remains open.

Energizing the changeover valve (2) will connect the actuator (3) to the vacuum tank (5) and the flap (4) will be closed.

NOTE: Upon start-up of the engine, the Resonance Flap Control Unit will perform a self-diagnostic check of the system and close and open the resonance flap twice. This can easily be checked by observing the linkage between the actuator (3) and the flap (4). However, there is no fault storage and a diagnostic check cannot be performed using the MODIC or BMW Tester.

Component Location:

(1) Resonance Flap Control Unit: E-Box beneath relays.

(2) Changeover valve (resonance flap control): mounted to underside of plenum (next to oil separator).

(3) Actuator for resonance flap: bolted to upper side plenum.

(4) Resonance flap: inside plenum.

(5) Vacuum tank: beneath #5 intake runner.

A built-in hysteresis of 60 RPM (delay of switchpoint depending on whether approaching from lower or higher engine speeds) around each of the two speed values will prevent the flap from constantly switching between open and closed position, should the engine be operated at exactly the speeds of either 4,120 or 6,720 RPM.

Figure 6

Highlighted in the red box (laudable MS Paint skills, Greg) in Figure 6 above are the conditions under which the resonance flap will close: two points of RPM, coupled with full throttle.

Detailing the added benefit of this system, in Figure 7 BMW handily graphed the difference between a functional variable resonance system (resonance "charging"), and going without the system entirely.

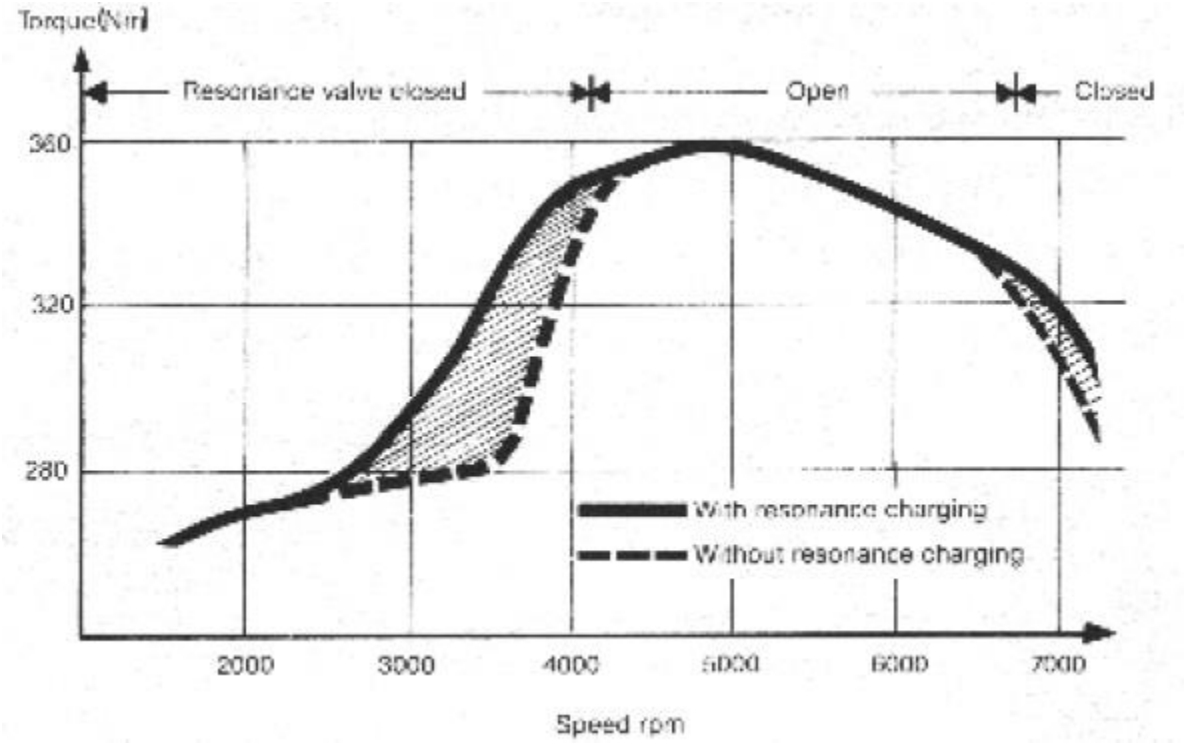


Figure 7

Here we arrive at another departure of the S38B38 from the S38B36: BMW found it beneficial to add another RPM switch point (at 2480 RPM) to the B38, as seen in Figure 8. Notice the additional bump.

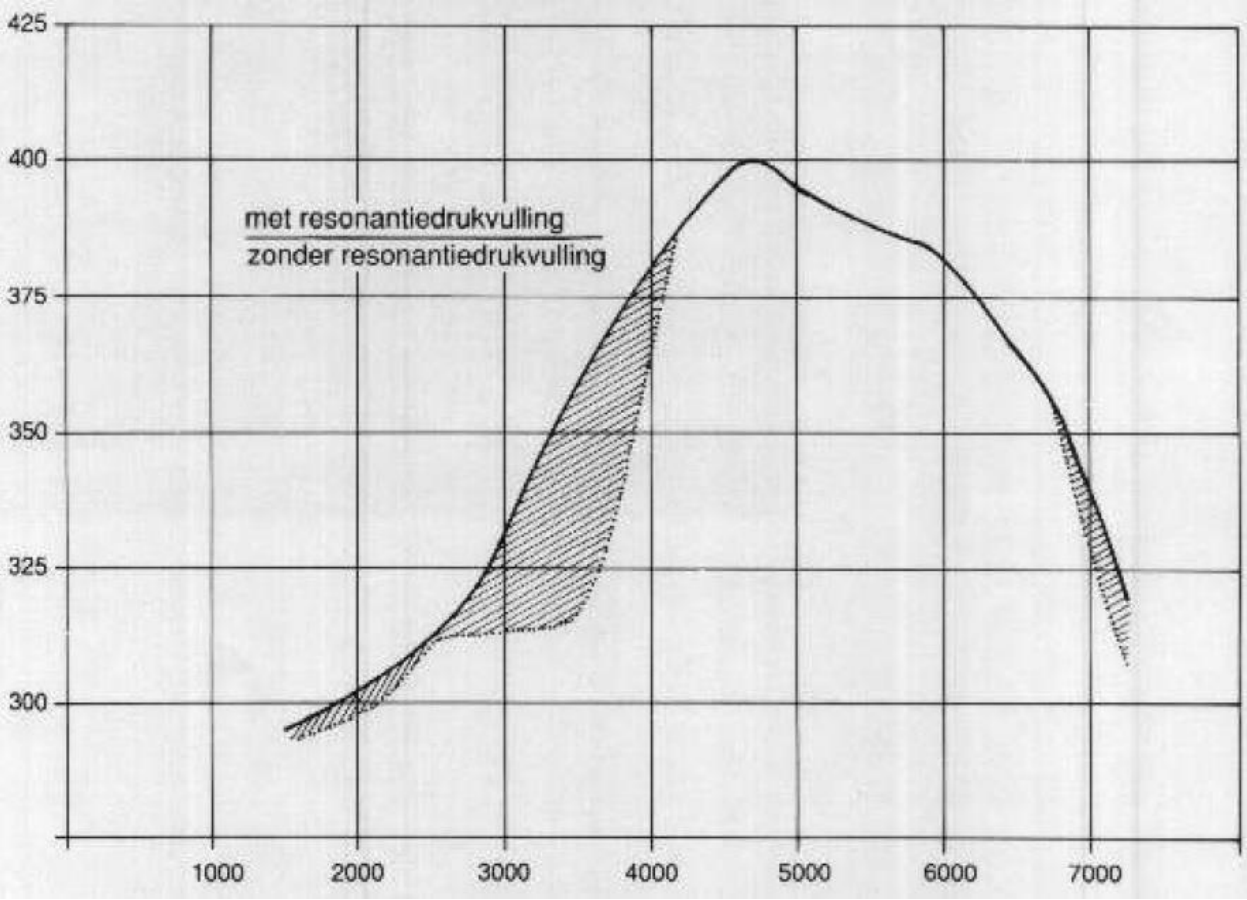


Figure 8

People, you should be nearing the bottom of those refreshing beverages!

Armed with a basic understanding of how the variable resonance system works, and the noteworthy benefits it provides, you might be wondering what you can do to maintain this beneficial system.

As shown in Figure 5, the system is actuated by vacuum, so if your engine has any vacuum leaks, the resonance flap will fail to function. We highly suggest our S38 Intake System Vacuum Maintenance Kits, assembled for this very purpose and taking the guesswork out of parts diagram searching. Our kit offers options for upgraded components that are more durable than the BMW parts, extending the life of this valuable system.

If your vacuum system is in good shape, but you're still diagnosing actuator issues, check the resonance actuator itself. Disconnect the unit at the ball joint from the resonance flap and apply vacuum (suck on the tube) to ensure the diaphragm isn't cracked (the most common failure), and that the unit is still functioning. If your actuator has failed, we have you covered there as well with our S38 Intake Actuator, a 100% new part that apes the NLA BMW part so well, BMW dealer techs have bought it for install on customer cars.

If for any reason both the vacuum system and hardware appear to be in good shape, but you are still having actuator issues, email us - we're happy to help!

Still have refreshing beverage left because you were so drawn in by our rambling that you forgot to drink/breathe? Watch the test bed for our resonance flap actuator during development testing . . .

If you'd like to see anything else covered in the future, please let us know, and we'll do our best to accommodate requests.

Thanks for reading!

- Angry Ass