

MRT Tech Info

WRX Inlet Manifolds Discussed

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The standard manifold on the 01-05 WRX is a two piece alloy unit. The top runner is a cast piece machined to allow fitment of the throttle body and the lower TGV (Tumble Generator Valve) units. The lower TGV sections that bolt directly to the cylinder heads have a divider that runs around 8mm away from the injector boss and a butterfly that is electronically controlled to divert air down past the divider to increase air velocity. This improves atomization at startup when overall airflow into the engine is low, improving emissions on cold start.



On modified cars however, this poses a flow restriction right on the entry to the heads. Additionally, TGV angle fault codes are becoming common on earlier cars with the butterflies often stuck in one position or another.

The 01-05 STI however does not have the TGV butterflies and as such offers an easy path for improvement with use on the WRX manifold. When the time comes to rebuild the motor in the search for higher performance, it is highly recommended that the WRX TGV setup is replaced. Without the TGV butterflies or cast divider restricting flow, much greater flow is possible into the heads. These bolt straight to the WRX unit or alternatively you can source a complete STI inlet manifold to suit.



On the WRX, removing the TGV sensor and actuators from the inlet manifold will generally cause your ECU to throw a Check Engine Light on your dash. This however can generally be programmed out with changes to the factory management system via EcuTek software when retuning (and of course isn't an issue when using an aftermarket management system).

Many people believe that there is huge benefit to fitting a full STi manifold over their regular WRX manifold, however apart from the red paint job and the deleted TGV setup, there is little extra benefit. A regular silver WRX manifold with the TGV setup removed will provide the same flow capacity.

This does lead into the next point however, with a little known condition inside the manifold itself where air flow from one runner to the next varies very heavily due to poor manifold distribution. In testing, MRT have seen variation of up to 10% in air flow from the best cylinder to the worst on standard unmodified units. This situation leads to heavily varying air fuel ratios from cylinder to cylinder, leading to potentially dangerous (engine destroying) problems.

Often this is not picked up because when a car is tuned by a workshop, the wide band lambda sensor used when tuning is always placed in the exhaust (either just after turbo outlet, or in tailpipe near end of car). As a result of placement, it only samples the combined output from all 4 cylinders, masking the problem. Cars tuned within very fine tolerances will often be the first to fail (as one cylinder will run leaner than the others due to excessive air delivery in comparison to other cylinders, and fuel delivery from injectors remaining constant across all 4 cylinders).

MRT Fuel Rails

Another weakness in factory Subaru models is the design of the OEM fuel rail system. The standard system can suffer from poor fuel distribution due to the location of the single fuel pressure regulator on the end of the 2nd rail. MRT have addressed this with modified OEM fuel rails (including a second factory regulator) for all MY93-00 models. For MY01-05 models there is a complete replacement billet fuel rail set, with provision for a second factory regulator OR an aftermarket adjustable fuel pressure regulator as required. These kits improve fuel distribution and minimise potential variation in Air Fuel Ratio from cylinder to cylinder, meaning your tuner can more reliably tune your car for peak performance.



MY99-00 WRX/STi manifold



MY01-05 WRX/STi Manifold
(shown with billet fuel rail kit fitted)

The good news is that weaknesses in the factory manifold design can be rectified, with flow between runners balanced to ensure much more even air delivery to individual cylinders. This is completed via a process known as Extrude Honing, where an abrasive media is pumped through a given component (the manifold in this instance) in order to remove unwanted material. Correct selection of the actual media gives control over how much or how little is removed. This allows a variation in finish from minor polishing of the surface, right through to major removal of material.

Different grades of abrasive media can be used to balance the flow between individual runners, balancing distribution of air flow once refitted to the car. Initial flow figures, progress during extrusion, and final results are all checked on a flow bench to ensure accurate final flow figures.



To complete the process, a manifold is stripped of all components (including throttle body assembly, fuel rails, bolts, wiring, etc). The bare manifold is then setup on the flow bench for initial testing, where standard flow figures are checked. Once checked, the process to improve distribution and overall flow is started with the manifold setup for extrude honing and flow testing alternately until the desired results are achieved.

As an example, the manifold shown in the picture to the left saw the variation in flow from cylinder to cylinder reduced from 7% variation to less than 1% from best to worst! In addition, overall flow was increased by almost 10% over the best runner from the factory..!

In conjunction with the extrude honing process, the addition of small posts internally within the manifold to divert air is required in some instances to further balance and direct air flow within the manifold itself. With the MY01-on manifold, minimal changes are required with the main amount of time spent on the extrude honing process. However in earlier MY93-00 manifolds, several additional posts are required in individual runners (as a result of the manifold design) to ensure that the best results can be achieved. Outright flow figures are generally best in the MY01-on model manifold once runners have been balanced due to improved design over earlier specification.

As a result, we have both minimized the chance of the inlet manifold being a restriction in the new engine being built, and ensured that our indicative air/fuel ratios at the tail pipe (which are an average of all four cylinders) being a true indication of what is happening in each cylinder. When tuning, this extra comfort means the tuner can run the engine at a level aimed at achieving the engines maximum potential.

Changes in Design

Not all WRX manifolds are created equal. Early model GC series WRX manifolds (including the MY99-00 WRX and STI) show noticeably more difference in some runners than later model MY01-on spec manifolds. Balancing the flow of runners in earlier series manifolds can be done, but requires much more effort to balance and increase flow due to their more complex shape, and outright CFM flow is generally less than later spec manifolds. And before you ask, the manifolds aren't a direct swap due to changes in injector design, fuel rail setup, etc (but can be done if you are REALLY keen)!

MRT Performance can complete any of the above work, including supply of fuel rail kits or pre balanced manifolds to suit your requirements. For further information please contact MRT Performance at www.mrtrally.com.au or on +61 2 9767 4545.

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