

# INTRODUCTION TO NITROUS OXIDE SYSTEMS

just out to make a quick buck, and; f) amateur experimenters. The early problems were caused primarily by the nitrous kit companies, which didn't understand enough about the application and use of nitrous oxide. Unfortunately, when design flaws became apparent, they were ignored by most companies and tolerated by mass consumers. This meant the problems were accepted and became synonymous with nitrous oxide itself rather than the companies that were responsible.

As mentioned earlier, the first use of nitrous oxide for automotive applications was in the USA, and, as a consequence, most nitrous systems were, and still are, manufactured by American companies. Although 25 years have passed since its inception, the design of most kit components has remained stagnant, with the majority of companies still using the same outdated designs.

In the early days, people and companies used any components they could get hold of that appeared to be suitable for the application, myself included. Not only were companies using components of a less than ideal design, but the choice of materials was limited to those that were unsuitable for the purpose. However, rather than finance the development and manufacture of purpose-designed alternatives, they continued to use the same substandard components. My own first experiences of using early American-made solenoids were almost catastrophic. At the time I had no idea why, but each time I activated the system it resulted in a huge backfire, which caused the bike to catch light. Subsequently, I discovered that the fuel solenoid seal material had reacted with the petrol, causing it to expand and shut off the fuel flow. The lack of fuel supply caused the mixture to run extremely lean, resulting in a huge backfire, a damaged piston, and,

worst of all, a fire. Many years later I discovered that the fuel used in the USA is different to that used in the UK and different sealing materials are required for each.

However, determined that I wasn't going to risk causing such damage again, I came up with the idea of combining a fire extinguisher valve and a pneumatic manual valve to control the nitrous and fuel flow. The two were activated together by a single lever and, although crude, the concept was effectual and solved all of the problems. It was then that I got my first successful result, proving that all that was needed for a safe and reliable system was the right component design/materials. Had I not realised that the inappropriate seal material was the cause of the problem, the blame would automatically have been placed on nitrous oxide, exacerbating its already bad reputation through my ignorance.

The potential pitfalls of using generic solenoids (in particular) resulted in my decision to design my own nitrous control valves. With my limited knowledge at that time, I realised that I was taking a risk by manufacturing my own components. However, as there was no other reliable system on the market, I felt that I had no other option.

**Caution!** – I do strongly advise anyone against concocting their own system, for their own safety and their engine's reliability, as it has taken many years of intensive research and development to achieve the understanding required to design a safe and efficient nitrous system.

By the end of 1982 I had perfected my first valve design and it was in regular use, producing reliable and outstanding performances. There was so much interest shown in my system, that I began to manufacture systems for customers. These first valves were



General view of the combined valves that were originally cable-operated.



To make my first valves more flexible I added a pneumatic ram so customers had the option of cable-operation or push button pneumatic operation (mainly used on bikes).



The first combined fuel and nitrous valve I manufactured, with the valves stacked on top of each other. This basic design was offered in 3 different operating formats.

manually activated fuel and nitrous valves, which were joined and operated by a common lever. Although these worked very well, I soon realised that a

# Chapter 2

## A basic 'wet' nitrous oxide system

### HOW A BASIC, SINGLE INJECTOR NITROUS SYSTEM WORKS

Before going any further, I'd like to ensure that anyone reading this book has an adequate understanding of how

the most basic nitrous oxide systems function. If you have any doubts about how a basic system works, please take the time to read this section. It's important to understand and have a full command of the basics of nitrous



The most popular wet system in the UK, the WON Street-Blaster 100i single injector system.



A typical budget wet kit with generic solenoids from Cold Fusion. (Courtesy Mashamoto)

injection, before learning the higher end of the subject. If you want to get the best from your nitrous system and your vehicle, you need to be sure your work is based on a good foundation.

The basic nitrous system consists of 2 separate but interdependent delivery systems: one for the nitrous oxide; and one for the additional fuel. I'll start with the route the extra fuel takes from the vehicle's existing fuel supply to arrive at



**The QA inline flow control valve unique to WON. This valve can be used to control the nitrous flow rather than using the bottle valve or, alternatively, it can be arranged to purge the line contents.**

the opposite direction to unlatch and close the solenoid.

There are 2 reasons why I don't advise the use of such devices:

- They cause a further obstruction to the flow of nitrous oxide through the system, causing a reduction in density, i.e. some of the nitrous will change from liquid to gas.
- They are a hindrance when trying to refill the cylinder as they have to be disconnected completely before the cylinder can be filled.

WON currently offers a manually-operated, in-line QA valve, which is positioned beside the driver's seat. The bottle valve can be left permanently open



**Electric bottle control solenoid from Cold Fusion. (Courtesy Mashamoto)**

and, by opening and closing the in-line valve, you can turn the gas supply to the nitrous system on and off as required. The advantages of an in-line valve are:

- It is much cheaper.
- Its lifespan will be much greater than electrical systems currently on the market.
- The volume of gas that could leak into the engine is reduced as the pipe length between the on/off valve and solenoid is reduced by approximately half.
- It's much quicker and easier to fit than an electrical system.
- It doesn't obstruct the flow of nitrous oxide and doesn't cause phase change.
- As it's not connected to the cylinder valve it doesn't interfere with refilling.
- Turning the lever on and off is as quick and easy as flicking a switch.

The only real advantage of an electronic device is that the switch can be positioned neatly on the dashboard. For some, a switch is more appealing than a valve, despite the advantages of the valve far outweighing those of the current electrical devices.

### REFILLING THE NITROUS CYLINDER

Two grades of nitrous are available, medical and industrial, and both are suitable for our purpose as they are basically the same. Medical grade is of a slightly higher purity and is stored in sterilised vessels, whereas the purity of industrial grade is more flexible, although still higher than 99%, and little concern is given to the condition of the containers. In some countries, however, industrial grade contains sulphur dioxide (the stuff that smells like bad eggs) to deter people from inhaling it.

Large (donor) cylinders from gas companies are supplied either with a siphon tube so the bottle remains upright



**Weighing the bottle before and after a nitrous fill is essential.**

to dispense liquid or without a siphon tube, which means the bottle will need to be inverted with the valve towards the ground to deliver liquid nitrous oxide. The first option is the easiest and most convenient type to use, but it is not as effective at filling small cylinders. The second option is more difficult because the cylinders are so large and heavy to turn upside down, though this option does result in better filling and less waste left in the donor cylinder. WON has designed a device that easily inverts the cylinder, secures it, and indicates the remaining liquid nitrous contents, to make this job easier.

If the cylinder you receive from your supplier has a painted white line on the outside, it indicates that the cylinder is fitted with a siphon tube and will deliver liquid nitrous in its upright position. To get the most efficient fills and maximum nitrous oxide for your money, always opt for a cylinder without a siphon tube. There are 2 methods of filling a nitrous cylinder, the use of a pump is one option, but it's very uncommon in the DIY arena. The second method is gravity (or siphoning) which is by far the most commonly used method, as it is the cheapest and, in some respects, the



The pipe has to be carefully routed from the nitrous cylinder to the nitrous solenoid.



Remove the carpet securing trim.



A sequence of shots showing how to first position the nitrous cylinder and bracket in the boot to mark the position of the securing screws ...

... before attaching the bracket base to the bodywork.

to bleed off excess 'gaseous' pressure above 1000psi but can also be adjusted up to 1700psi if required.

**Warning!** – If the bottle is disconnected from the system, remember to open the valve with the outlet aimed into open space or, if you have the cylinder connected to the solenoid supply pipe (but not the solenoid), securely hold the open end of the pipe (using a glove).

### Supply line routing

If you have chosen a WON system, you'll most likely have been supplied with the high pressure 5mm nylon pipe to connect the nitrous cylinder to the nitrous solenoid. It is essential that this pipe be routed as shown in the accompanying picture. The pipe must be routed away from any heat sources and take a cool route through the inside of the car with the wiring loom. It should then run either into the scuttle (between



Thread the pipe under the carpet, then replace the trim.

the cylinder as shown, it is acceptable to mount the nitrous cylinder in other ways. All you need to remember is that the valve must be higher than the base of the cylinder, with the outlet pointing downwards and in such a position that G forces don't prevent the liquid nitrous from flowing through the dip tube. If in doubt please ask your supplier for advice.

The Max Flow bottle valve has a built in SPRV and, as standard, is set

the windscreen and engine bay), or to the front of the engine bay (via the wheel side of the inner wing). By avoiding the hottest areas of the car as much as possible, even more of the nitrous oxide will enter the induction system as dense liquid.

When routing the pipe, take care not to bend it too tightly as this could damage and weaken it. This will inevitably lead to the pipe bursting at the weakened point when filled with high

# NITROUS SYSTEMS IN USE

cope with the extra demand. Therefore, anyone wanting to boost the power output of the E36 by any means, is advised to replace the fuel pump with one rated to 500 or 600bhp.

The configuration of the inline 6 cylinder engine with this style of plenum chamber is not the best configuration for use with a single injector system. A direct port system with 6 injectors is essential, and particular attention must be made to keeping the feed line lengths equal and as short as possible.

**Estimated power levels:** 50-75bhp non-progressive. 75-100bhp progressive. 100-150bhp progressive with uprated fuel pump.

### Other popular installs

Mercedes 500SL, Jaguar XJ6R

## EXPERIENCES WITH NITROUS INJECTION

### Rod Tarry

Vehicle make	Ford
Vehicle model	Saphire
Engine	Cosworth Turbo
Mods	Everything
System type	SB100i-4
Engine bhp	660 @ 550lb torque
Nitrous bhp	150bhp
Rwhp (nitrous)	850 @ 750lb torque
¼ mile (std)	12.1 @ 127mph
With nitrous	11.5 @ 138mph

"I have used this nitrous now for 3 years and started as a complete novice. These are the improvements I've achieved by adding nitrous oxide to my car, I'm sure you'll agree, they speak for themselves."

Without nitrous	
0-60	4.3 seconds
0-100	8.1 seconds
0-150	16.0 seconds
Top speed	200mph



The fastest (regularly used) nitrous-assisted street car in Europe, with a top speed in excess of 210mph.



You'll need to look closely to spot the WON nitrous components.

With nitrous	
0-60	4.1 seconds
0-100	7.1 seconds
0-150	13.3 seconds
Top speed	210mph

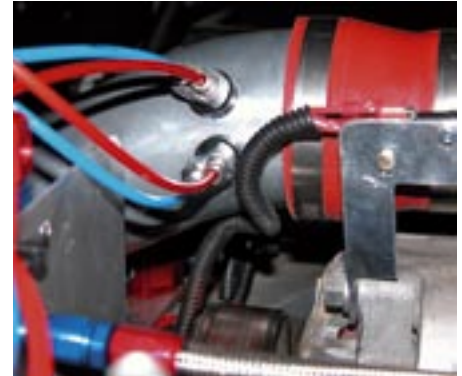
### Jack Bene

Vehicle make	Dodge
Vehicle model	Viper
Engine	V10 engine
Mods	
System type	2 Stage SB300i-2
Engine bhp	480bhp @ 520lb torque
Nitrous bhp	350bhp
Rwhp (nitrous)	825bhp @ 1000lb torque
¼ mile (std)	
With nitrous	10.3 @ 146mph

"I've used most types of nitrous kits over the years but none have been anything like the WON system in any way. The



An outstanding example of the Viper, a high-performance American muscle car.



A close-up showing the angles of the Crossfire injectors intended to achieve optimum mixing and distribution.



This is a unique 2 stage WON system fitted to Viper V10 (one injector per bank per stage).

components are unique and the power delivery is deceptively smooth and makes more torque than I ever imagined possible. I'm confident that next season my car will run deep in to the 9 second bracket for the quarter mile."

### Tony Cooper

Vehicle make	Ford
Vehicle model	Capri
Engine	3.9 V8 EFI