

# Application of Nitrous Oxide in Automobiles

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**Abstract**—Nitrous oxide, also known as dinitrogen oxide or dinitrogen monoxide, is a chemical compound with chemical formula  $N_2O$ . Under room conditions it is a colourless non-flammable gas, with a pleasant slightly sweet odor. It is commonly known as laughing gas due to the exhilarating effects of inhaling it, and because it can cause spontaneous laughter in some users. It is used in surgery and dentistry for its anaesthetic and analgesic effects. Nitrous oxide is present in the atmosphere where it acts as a powerful greenhouse gas. In modern automobiles, nitrous oxide (often just "nitrous" or "nitro" in this context) is sometimes injected into the intake manifold (or just prior to the intake manifold) to increase power: even though the gas itself is not flammable, it delivers more oxygen than atmospheric air by breaking down at elevated temperatures, thus allowing the engine to burn more fuel and air. Additionally, since nitrous oxide is stored as a liquid, the evaporation of liquid nitrous oxide in the intake manifold causes a large drop in intake charge temperature. This RESULTS IN A SMALLER, DENSER CHARGE, AND CAN REDUCE DETONATION, AS well as increase power available to the engine.

**Index Terms**—Nitrous oxide, Chemical formula and atmosphere.

## I. INTRODUCTION

Nitrous oxide also known as nitrogen oxide or nitrogen monoxide with chemical formula  $N_2O$ . was discovered by Joseph priestley in 1772. This gas was tested by Humphry Davy in the 1790s, he tested it on himself and some of his friends and realised that nitrous oxide considerably dulled the sensation of pain, even if the inhaler were still semi-conscious and so it came into use as an anesthetic in medical operations and other medical fields such as dentistry etc. it can be used as an oxidizer in rocket engines other uses are for aerosolpackaging, electronics etc.

The urge to obtain fairly large amount of speed in the very small interval of time gave rise to devise this technology in automobiles, Nitrous oxide gas is the modern technology used in automobiles to increase the power by injecting it into the cylinder.

PROPERTIES

Name	Dinitrogen Oxide
Chemical formula	$N_2O$
Appearance	Colourless gas

At about 565 degree F. Nitrous oxide breaks down into nitrogen and oxygen. This property is exploited for gaining the additional speed in automobiles

### Chemistry

The structure of the nitrous oxide molecule is a linear chain of a nitrogen atom bound to a second nitrogen, which in turn is bound to an oxygen atom. It can be considered a resonance hybrid of



Nitrous oxide  $N_2O$  should not be confused with the other nitrogen oxides such as nitric oxide  $NO$  and nitrogen dioxide  $NO_2$ . Nitrous oxide can be used to produce nitrites by mixing it with boiling alkali metals, and to oxidize organic compounds at high temperatures.

Nitrous kit basically contains nitrous oxide which is an oxygen bearing compound its chemical formula is  $N_2O$  each nitrous oxygen molecule has two nitrogen atoms and one oxygen atom.

## II. TYPES OF NITROUS SYSTEMS

The nitrous Delivery systems are concerned primarily with introducing fuel and nitrous into the engine's cylinders, and then combining them for more efficient combustion. There are two common types of Delivery systems.

The dry systems and the wet systems

1. Wet System: A mixture of fuel and Nitrous oxide are introduced to the primary part of the intake. The wet system produces slightly more power than dry though this cannot be applied to an engine with a dry intake typically most fuel injected engines. A properly introduced wet system is the best way to inject nitrous oxide into an engine.

2. Dry System: The  $N_2O$  is injected into dry air (without fuel) upstream in the manifold. At the injectors, it mixes the injectors of the car then delivers the extra fuel required to maintain the burn balance from lean to Rich. The primary part of the intake is kept dry of fuel.

## III. WORKING PRICIPLE OF NITROUS OXIDE

Nitrous oxide is a cryogenic gas composed of 2 molecules of nitrogen and 1 molecule of oxygen. By weight it is 36% of oxygen. It is non-flammable by itself and it is stored as a compressed liquid.

Nitrous oxide exists in two grades (i) USP (ii) Nitrous plus

I. U.S.P- This is medical grade nitrous oxide. It is used as anesthetics. It is illegal in some places like in some part of United States to possess it for the purposes of inhaling or ingesting if not under the care of a physician or dentist. This would lower the engine's intake air temperature and produces a dense inlet charge. Also we know that air contains only about 23% oxygen by weight whereas nitrous contains about 36% oxygen by weight, if nitrous is added, it will increase the total mixture of oxygen of the inlet charge. This would result also in the increase in the rate at which combustion occurs in the engine's cylinders.

During the combustion process in an engine, at about 572 degrees F, nitrous breaks down and releases oxygen. This extra oxygen creates additional power by allowing more fuel

to be burned so the injection of nitrous oxide into an engine means that more oxygen is available during combustion because you have more oxygen, you can also inject more fuel, allowing the same engine to produce more power. Nitrous oxide is one of the simplest ways to provide a significant horse power boost to any gasoline engine.

Nitrous oxide has another effect that improves performance even more when it vaporizes, nitrous oxide provides a significant cooling effect on the intake air, when you reduce the intake air temp, you increase the air's density and this produces more oxygen inside the cylinder. Nitrogen acts to buffer or damage the increased cylinder pressure helping to control the combustion process. Nitrous also can reduce the intake charge temp by 60 to 75 degree. F.

Nitrous oxide is best applied at wide open throttle (unless a progressive controlled is used). Nitrous can be safely applied above 2500 RPM under full throttle conditions one problem with nitrous oxide is that it is fairly bulky, and then engine requires a lot of it. A car normally carries only a few minutes of nitrous oxide, and the driver uses it very selectively by pushing a button.

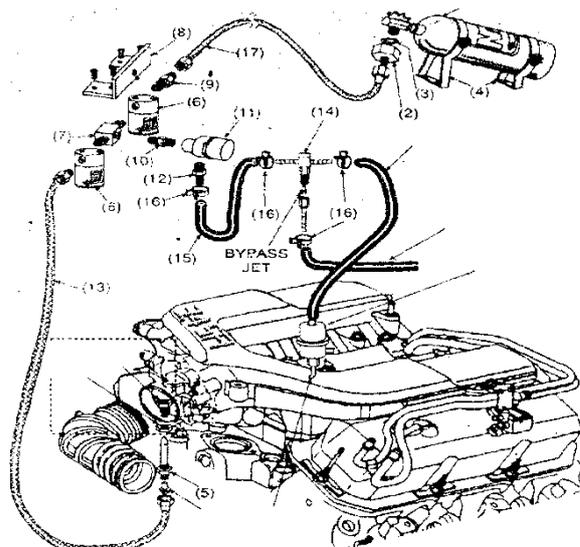
In order to produce efficient combustion, when using nitrous oxide, ensure it operates at the proper air/fuel ratio. The stoichiometric ratio is 14.7 parts air to 1 part of fuel for gasoline but since greater quantity of oxygen can be drawn into the combustion chamber by simply introducing nitrous oxide. Because nitrous is more oxygen rich than air, the recommended air, fuel ratio becomes 9.5 parts of nitrous to 1 part of fuel (9.5:1). This means when oxygen rich nitrous is introduced additional fuel must also be supplied in order to maintain the optimum ratio. Without the additional fuel the mixture would be too lean and this can cause detonation resulting in damaged engine parts. Making the mixture too rich also can harm performance and destroy engine parts too.

#### IV. NITROUS OXIDE DURING COMBUSTION PROCESS

Nitrous oxide by itself is not flammable but an oxidizer which provides more oxygen to allow the additional fuel to burn and therefore produces more power. The oxygen present in nitrous oxide cause combustion of fuel to take place more rapidly.

Nitrous oxide is in the liquid form while in the cylinder and also held under high pressure. When it is released from the cylinder into the intake track its physical state changes from liquid to a gas. This transformation takes place as the nitrous is released from the area of extreme pressure into the vacuum of the intake manifold (boiling). This boiling effect reduces the temperature of the nitrous to about - 127 degree F. The cooling effect in turn significantly reduces intake charge temp by approximately 60-75 F degree when the additional fuel required for nitrous is introduced in such a way that it is exposed to the full force of the expanding nitrous, it is completely atomized. This assists burning in the combustion chamber and a result power output is increased.

#### System Assembly Drawing



1. Nitrous bottle
2. adapter
3. washer
4. mounting bracket
5. fan spray nozzle
6. nitrous solenoid
7. solenoid TEE
8. Solenoid bracket
9. filter fitting
10. Nipple
11. pressure regulator
12. barb fitting
13. 3AN line male fitting
14. pressure TEE
15. Vacuum hose
16. Ratcheting hose clamp
17. nitrous supply line
18. 4 AN 90o Fitting
19. Flare jet

#### V. PRECAUTIONS IN THE USE OF NITROUS OXIDE

- i. Do not start the engine if the nitrous has been injected while the engine was not running. Disconnect the coil wire and turn the engine over with the throttle wide open for several revolutions before attempting to start the engine otherwise the engine would be damaged. (Crank the engine 10 to 15 sec. before starting)
- ii. Do not allow readily combustible substances e.g. oil, grease etc. to come in contact with cylinders, valves, solenoids, hoses and fittings. They may combine with gases such as oxygen and nitrous oxide to produce a flammable make condition.
- iii. Do not drop or violently strike the bottle to avoid explosion.
- iv. Nitrous bottle should always be closed when the system is not being used.
- v. Do not interchange nitrous and fuel solenoids. It could result to engine damage.
- vi. Do not attempt to remove the siphon tube without completely emptying the bottle of all nitrous and pressure.
- vii. To keep the engine healthy while using Nitrous oxide you must ensure it operates at the proper air /fuel ratio.

## VI. OTHER SIDE EFFECT OF NITROUS OXIDE

It is necessary to be careful while fixing or using nitrous oxide since mistakes could have serious consequences and could lead to damage to equipment and even death.

1. Engine could be damaged if the fuel pressure as flow is not adequate.

2. Nitrous oxide should be used only at wide open throttle at the engine speed of 3000RPM and above and install proper engine to chassis ground otherwise there could be an explosive failure of the main nitrous supply line.

3. Nitrous oxide must not be injected as this could lead to death.

4. Nitrous oxide should not be allowed to come in contact with the skin as this could cause permanent frost bite damage to the skin

## VII. CONCLUSION

Nitrous oxide if properly fitted and managed and all the necessary precautions taken is found to be very economical and so more industries should encourage the use of it in all vehicles by allowing constructors that would make the installations easy and safe.

## REFERENCES

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