UNDERSTANDING BRAKE FLUIDS

What do you think is most important when choosing a brake fluid?

Most drivers today are concerned about the boiling temperature of their brake fluid, and not too concerned if it meets DOT specifications or not. This is ok for drivers who only use their cars at the race circuit. Ordinary drivers who frequently drive their cars on ordinary streets should be more concerned if their fluid meets DOT specification. Brake fluid that do not meet DOT specification can speed up the deterioration of brake components over a extended period time. It can also lead to the malfunctioning of ABS during cold weather. Most people do not know much about brake fluid, and it can be hard to find relevant information to learn more about it.

Please read the following section, **'Understanding Brake Fluids'** is an easy to understand guide explaining brake fluid.

What is DOT specification?

DOT is the abbreviation for the 'Department of Transportation', which is an American government transportation department. The DOT set standards such as FMVSS (Federal Motor Vehicle Safety Standard) very similar to the JIS in Japan or DIN in Germany. The following table shows the DOT brake fluid specifications:

Specification	Specification	Dry Boiling Temp.	Wet Boiling Temp.	Viscosity (100°C)	Viscosity (-40°C)	Ph Value
DOT 3	Glycol	Over 205°C	Over 140°C	Over 1.5cst	Under 1500cst	7.0-11.5
DOT 4	Glycol	Over 230°C	Over 155°C	Over 1.5cst	Under 1800cst	7.0-11.5
DOT 5.1	Glycol	Over 260°C	Over 180°C	Over 1.5cst	Under 900cst	7.0-11.5
DOT 5	Silicon	Over 260°C	Over 180°C	Over 1.5cst	Under 900cst	7.0-11.5

Dry Boiling Temp
Boiling point when the fluid is brand new, no moisture absorption.

Wet Boiling Temp
Boiling point with fluid that has 3.7% water by volume. After 1-2 years of fluid use.

Viscosity
A measure to represent the brake fluid flow property. Higher the value, the more difficult for the fluid to flow. If the value is high when the air temperature is low, the fluid can have a negative effect on ABS performance.

pH Value
Value to show acidity / basicity of a solution. If the pH value is lower than 7.0 (strong acidity), the fluid can accelerate corrosion of other brake components

What is boiling point temperature?

The temperature at which the fluid boils. Water boils at 100°C where as brake fluid with high boiling point will boil around 300°C, and low boiling point brake fluid will boil around 140°C.

Why is a low boiling point temperature not acceptable?

When driving aggressively on windy mountain roads or race circuits, brake pad can reach over 300°C. This high heat gets passed onto the brake fluid through the calipers, which can raise the fluid temperature over 200°C. If the brake fluid is repeatedly heated past its boiling point, some of the fluid vaporizes and creates bubbles within the brake lines. This is a very dangerous situation since this can lead what is commonly known as vapour lock, or simply the brakes not working. This occurs since the vapour is compressed instead of the fluid so the brake pads do not move.

What is percent water by volume?

The most common ingredient of brake fluid is glycol-ether. This fluid is hygroscopic which mean it absorbs moisture from the atmosphere. The 'percent by volume' is a measure of the water content in the brake fluid.

The higher the DOT number, the higher the brake fluid performance?

This is not exactly correct. The DOT numbers categorizes the fluids by various uses.

Specification	Application Use	
DOT 3	Cars with small to medium sized engines	
DOT 4	Cars with larger sized engine and / or for use with sports driving	
DOT 5.1	Cars with larger sized engine and /or for use with sports driving (cold climate regions)	
DOT 5	Main ingredients is Silicon, Special Application cars (Hummer, Harley-Davidson)	
Major Difference	DOT 3 vs DOT 4	Boiling point temperature
	DOT 4 vs DOT 5.1	Boiling point temperature and viscosity at low temperatures

DOT 5.1 has strict viscosity standards at lower temperature in addition to having a high boiling point temperature. Therefore, in cold climate areas, the DOT 5.1 brake fluid is very commonly used on most cars. The most widely distributed brake fluid is the DOT 4, which has a dry boiling point temperature around 270°C and a wet boiling point temperature around 170°C. The boiling point temperatures of DOT4 is very similar to those of DOT5.1. The major difference is the viscosity at low temperatures.

Today, cars are commonly equipped with ABS, and DOT5.1 fluid is used since the viscosity of it helps the ABS work consistently even in cold climates.

How frequently should brake fluid be replaced?

For everyday drivers, who use brake fluid that exceed DOT4 specification, fluid replacement once 2 years is acceptable. For people who use DOT3, fluid replacement every year is recommended. For people who drive aggressively on winding roads, fluid replacement every six month to a year is recommended. For people who drive their cars on the race circuit, replacement before each event is recommended.

What could be the volume required for replacement?

For passenger cars, it generally requires 800ml ~ 1L for full volume replacement.