BRAKE FLUID TECH

The two most common brake fluids used in the automotive industry are fluids that contain polyalkylene glycol ether and fluid that contains silicone or silicium-based polymer. Both fluids are common but very different in regards to the manner in which they perform. Fluids containing polyalkylene glycol ether are more widely used and are the only fluids that should be used in racing brake systems. Because brake systems may reach extreme temperatures brake fluid must have the ability to withstand these temperatures and not degrade rapidly.

SILICONE-BASED FLUID

Fluids containing silicone are generally used in military-type vehicles and, because silicone-based fluids will not damage painted surfaces, they are also somewhat common in show cars. Silicone-based fluids are regarded as DOT 5 fluids. They are highly compressible and can give the driver a feeling of a spongy pedal. The higher the brake system temperature the more the compressibility of the fluid. This increases the feeling of a spongy pedal. Silicone based fluids are non-hydroscopic meaning that they will not absorb or mix with water. When water is present in the brake system it will create a water/fluid situation. Because water boils at approximately 212ºF, the ability of the brake system to operate correctly decreases, and the steam created from boiling water adds air to the system. It is important to remember that water may be present in any brake system. Silicone brake fluid lacks the ability to deal with this moisture and will dramatically decrease a brake system's performance.

POLYGLYCOL ETHER-BASED FLUIDS

Fluids containing polyglycol ether are regarded as DOT 3, 4, and DOT 5.1. These types of fluids are hydroscopic, meaning that they have an ability to mix with water and still perform adequately. However, water will drastically reduce the boiling point of the fluid. In a passenger car, this is not an issue. In a race car, it is a major issue, because as the boiling point decreases, the performance of the fluid also decreases. Polyglycol-type fluids are two times less compressible than silicone-type fluids, even when heated. Less compressibility of the brake fluid will increase pedal feel. Changing fluid on a regular basis will greatly increase the performance of the brake system. All brake fluids must meet federal standard #116. Three Department of Transportation (DOT) minimal specifications for brake fluid are defined in this standard. They are DOT 3, DOT 4, and DOT 5.1 (for fluids based with polyalkylene glycol ether) and DOT 5 (for silicone based fluids).

MINIMAL boiling points for these specifications are as follows:

Boilng Type	Wet Boiling Point	Dry Point
DOT 3	284ºF	401ºF
DOT 4	311ºF	446ºF
DOT 5	356ºF	500ºF
DOT 5.1	375ºF	518ºF
HTX 600+	421ºF	618ºF

DOT 3 VS. DOT 4 and 5.1

AFCO's HTX brake fluid dramatically exceeds all DOT 3, 4, and 5.1 standards for wet and dry boiling points, lubrication, corrosion protection, and viscosity specifications.

WET VS. DRY BOILING POINT

The term boiling point, when used regarding brake fluid, means the temperatures at which brake fluid will begin to boil.

WET BOILING POINT

The minimum temperatures at which brake fluids will begin to boil when the brake system contains 3% water by volume of the system.

DRY BOILING POINT

The temperatures at which brake fluid will boil with no water present in the system.

MOISTURE IN THE BRAKE SYSTEM

Water/moisture can be found in nearly all brake systems. Moisture enters the brake system in several ways. One of the more common ways is from using old or pre-opened fluid. Keep in mind that brake fluid draws in moisture from the surrounding air. Tightly sealing brake fluid bottles and not storing them for long periods of time will help keep moisture out. When changing or bleeding brake fluid, always replace master cylinder caps as soon as possible to prevent moisture from entering the system. Condensation (small moisture droplets) can form in lines and calipers. As caliper and line temperatures heat up and cool repeatedly, condensation forms, leaving behind an increase in moisture/water. Over time, the moisture becomes trapped in the internal sections of calipers, lines, master cylinders, etc. When this water reaches 212ºF, the water turns to steam. Many times, air in the brake system is a result of water that has turned to steam. The buildup of steam will create air pressure in the system, sometimes to the point that enough pressure is created to push caliper pistons into the brake pad. This will create brake drag as the rotor and pads make contact and can also create more heat in the system. Another way that moisture may enter the system is through diffusion. Diffusion occurs when moisture enters through rubber brake hoses. Using hoses made from EPDM materials (Ethlene-Propylene-Diene-Materials) OR steel braided brake hoses with a non-rubber sleeve (usually Teflon) will greatly reduce the diffusion process.

THINGS TO REMEMBER

- A brake fluid's dry boiling point is more important than wet boiling point when used in a racing brake system.
- Racing brake system fluid should be changed often. A system with fresh fluid will have a lower moisture content and therefore perform best.
- Never use silicone-based fluids in racing brake systems.
- Never reuse fluid. Never mix types or brands of brake fluid.
- Purge the system (completely drain) and replace the brake fluid often for maximum performance.