TECH TOPIC

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PREVENTING CONTAMINATION IN HYDRAULIC BRAKE SYSTEMS

"An ounce of prevention is worth a pound of cure." In plain English, it's easier to prevent something from happening than it is to repair the damage afterward. A statement so profound could only come from someone with a keen mind, so it should be no surprise that it originated with Benjamin Franklin.

You can apply it to any aspect of life or worldly matters, so it should also be no surprise that it holds true when discussing hydraulic brake system contamination. The heart of a brake system is the fluid, and it's the root of system contamination. Yet it's still one of the most overlooked and neglected fluids on a vehicle. Why? Because most vehicle owners don't realize how quickly it can become contaminated. When it does, it typically doesn't affect brake performance in a manner which would ever be noticed in everyday driving.

In the meantime, it just sits quietly in the brake system, slowly becoming more corrosive and damaging over time, until suddenly, an expensive repair is on the table, such as an ABS modulator or even just a pair of brake calipers or wheel cylinders.

Preventing contamination begins with the knowledge and ends with a simple concept: maintenance. Brake fluid becomes contaminated in many ways. The biggest contributor to the problem is moisture. Brake fluid is hygroscopic, meaning it has the natural tendency to absorb and retain water molecules from the air.

Hygro is not a typo – I thought it strange when I first learned it, because when I think water, I think "hydro." Hydro is a prefix that refers to water or liquids; hygro is defined as relating to moisture – it simply means wet or moist.

You've seen the warnings on brake fluid reservoirs to only use fluid from a sealed container. Brake fluid's hygroscopic properties are the reason why. As a side note, brake fluid comes in multiple different-sized containers. When selling to a DIY customer, it's best to recommend the smallest container necessary for the job they are doing. Even though there's a seal in the bottle cap, it's not the same as the foil seal installed on the bottle when the fluid is new.

Over time, brake fluid sitting on a shelf can absorb moisture due to an imperfect seal, and it may already be "wet" by the time it's used. All brake fluid has a dry boiling point, a specification reflecting its performance when new, and a wet boiling point, a specification reflecting its performance after absorbing 3.7% water from the atmosphere.

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These specifications refer to the point at which the fluid boils under operating conditions. The wet boiling point is much lower than the dry. When brake fluid boils, it creates vapor, just like steam from water. The vapor is compressible, resulting in a severe loss of braking force, identical to a brake system that has ingested air. This is the reason you should always use brake fluid from a sealed container. Many professional shops purchase larger containers of brake fluid because they are filling a brake bleeder, for example, or using large quantities during fluid flush procedures.

Some professionals prefer to keep only small bottles in stock to prevent moisture from ever being a problem. It's a fact that brake fluid begins to absorb moisture immediately when exposed to the air. Published facts for how quickly new brake fluid can become compromised vary anywhere from 15 minutes to two weeks when brake fluid isn't in a sealed container, but the bottom line is it happens quickly.

Many racers prefer to flush their brake fluid right before a race to ensure proper braking performance. So that half-empty bottle of brake fluid that's been sitting on a dusty garage shelf for 13 years? It's time to dispose of it and get fresh fluid.

In addition to the effect moisture has on the boiling point of the fluid, it will cause rust and corrosion on the metal parts inside the brake system. Brake fluid isn't acidic when new, but as the moisture level in the fluid increases, the acidity level increases, causing it to attack the rubber seals and components in the system. Over time, these small rubber particles become additional contaminants in the fluid.

Contamination can also occur from mixing different types of fluid. DOT 3, 4 and 5.1 brake fluids are all compatible because they are glycol-based fluids. DOT 5 silicone is not compatible with any of these. However, never use a lesser-spec'd brake fluid such as DOT 3 in a vehicle that calls for DOT 4 or 5.1. It won't be able to meet the temperature specifications of the fluid.

Some newer vehicles call for a low-viscosity brake fluid formulated specifically for modern braking systems. The best advice is to only use the fluid recommended by the manufacturer. That simple concept of maintenance I mentioned earlier? That's flushing the brake fluid on a regular basis. Most manufacturers recommend every two to three years, but it's never too often.CM