BRAKE FLUSH ACCELERATOR

RELATED APPLICATIONS

This application is a continuation-in-part of copending U.S. application Ser. No. 10/981,060 entitled "Brake Flush Accelerator" filed Nov. 4, 2004. Additionally, this application claims priority to U.S. provisional Application Ser. No. 60/517,296, filed Nov. 4, 2003, entitled "Brake Flush Accelerator."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to automotive systems and, in particular, to a system and method of flushing a brake system.

2. Description of the Related Art

Anti-lock brake system (ABS) design utilizes multiple hydraulic passage ways and valving that restrict fluid movement. As a result, the brake fluid flow through the system is limited and takes excessive time to properly flush the system. The pressure that can be exerted on the system is limited by the master cylinder reservoir adapter. The adapter connects the pressurized fluid from the brake flush machine to the master cylinder reservoir to the brake system. Most reservoirs are a composite or plastic material and cannot be exposed to pressures above 20 pounds-per-square-inch (PSI) without deforming the shape of the reservoir, causing leakage. Most brake flush machines limit master cylinder reservoir pressure to 12–18 PSI to prevent leakage. The low pressure also makes removing brake fluid contamination more difficult.

In addition, brake fluid does not move through each wheel system equally. Instead, the brake fluid takes the path of least resistance. Some brake flush machines flush all the wheels at the same time, while more advanced machines control flow through the wheels. A machine designed to flush all the wheels at the same time will experience an unequal system flush. This means that one part of the brake system may experience minimal fluid flow, which will not provide a proper flush.

Advanced brake flush machines, hereafter referred to as isolated brake flush machines (IBFMs), isolate different parts of the system to control fluid flow. This allows the machine to force fluid though the more restrictive circuits. The downside is that the flush time is lengthened because the flow is isolated to a part of the system and not all the wheels at the same time. A properly isolated flush could take 2–3 times longer to move the same amount of fluid as an all-wheel flush, keeping in mind that the all-wheel flush also experiences an unequal system flush.

Empirical testing using Strip Dip® brake fluid test strips has shown that it takes approximately ½ gallons of brake fluid flushed through the system at sufficient pressure and flow to attain a proper flush to remove contaminants in the system. Most brake flush machines use ½ gallon fluid containers and operate for 10–12 minutes. The last minute or two of the cycle removes whatever fluid is left in the container and dumps the fluid into a waste container so that the service uses ½ gallons of brake fluid each time. This does not mean the ½ gallons of brake fluid was flushed through the system, but only that ½ gallon of brake fluid was consumed by the machine. The actual flush may have used 1 quart of fresh fluid and the other quart was dumped into the waste. The reason this is done is to complete the flush within the allotted time period and consume ½ gallons of brake fluid per service regardless of the quality of flush obtained.

A low/no pressure area in many master cylinder designs is isolated from the normal fluid pathway during a typical flush. This leaves an area of old fluid that can contaminate the new brake fluid after the flush has been performed. Even if ½ gallons of brake fluid is flushed through the system, the isolated low pressure area can contaminate the brake fluid once the brake pedal is depressed a few times. Depressing the brake pedal exposes the new fluid to the low pressure area, which promotes intermixing. This intermixing result has been demonstrated by the use of FASCAR® Strip Dip brake fluid test strips. For example, a candidate vehicle is tested with Strip Dip®, demonstrating a FASCAR® rating of 100, indicating very dirty fluid. The brake flush is performed using ½ gallons of brake fluid and the brake fluid is immediately tested after the service, which results in a FASCAR® rating of 0. The vehicle is then driven in which the brake pedal is depressed several times. Following the test drive of the candidate vehicle, a Strip Dip® retest is performed, which results in a FASCAR® rating of 25. This is not an indication of a problem with the test strip; rather, it shows that the low/no pressure area was not cleaned during the flush process and the old fluid contaminated the rest of the system.

An isolated brake flush machine could take as long as 30 minutes to properly introduce ½ gallons of brake fluid through the system, while current all-wheel flush machines operate for 10–12 minutes and waste the unused fluid. Each brake flush machine has severe design flaws; for example, the time to perform service or the quality of the service performed. The problem with current brake flush machine technology is that it cannot move fluid through the system with enough force to remove contamination. Removal of this contamination is required to perform a proper flush to meet proposed guidelines for brake fluid replacement and system flush.

BRIEF SUMMARY OF THE INVENTION

To attain a proper brake system flush, approximately ½ gallons of brake fluid must be flushed through the system at sufficient pressure and flow to remove contaminates. In addition, the low/no pressure area of the master cylinder must be exposed to fluid flow to flush that portion of the system to prevent future contamination.

A Brake Flush Accelerator Module can be implemented to accompany the new ISM brake flush machines that have begun to enter the automotive service industry. The Brake Flush Accelerator (BFA) described herein solves the problems current brake flush machines exhibit in attaining a proper brake system flush. The BFA operates by selectively depressing the brake pedal while a vehicle is undergoing a brake flush operation by a brake flush machine. The BFA depresses the brake pedal while the vehicle's master brake cylinder reservoir is operating under pressure from the brake flush machine.

The BFA significantly reduces the flush time for any brake flush machine, increases fluid volume and pressure to remove contaminants, and allows the low/no pressure area of the master cylinder to be flushed. The BFA also solves the problems of traditional foot-type bleeding or flushing by accurately controlling the piston stroke and rate of pedal depression and release. The BFA can be designed as a self-contained module or designed to coexist within the control system in an ISM or similar brake flush machine. The BFA receives its pneumatic power from an air com-