

COLORIMETRIC TEST FOR BRAKE FLUID

BACKGROUND OF THE INVENTION

Description of the Related Art

Brake fluid tests have been in use for years to identify corrosion and to detect other problems with brake fluid. Conventional on-site (e.g., at a service or inspection station) brake fluid tests currently used are copper brake fluid test strips, moisture test strips and boiling point analyzers. The main problem with conventional brake fluid tests are that they can not determine the type of brake fluid in the vehicle brake system.

Another problem with convention brake fluid test are that they can not be used by an automotive service facility that complies with the Motorist Assurance Program (MAP) guidelines for brake fluid replacement. Part of the MAP guidelines require that brake fluid be replaced if it is the incorrect type. For example, a vehicle where the original equipment manufacturer has specified that the brake system must use "DOT 4 brake fluid only." This designation is found in on the master cylinder reservoir lid or cap. If this vehicle is found to contain DOT 3 brake fluid, the brake fluid must be replaced because DOT3 brake fluid has a lower wet and dry boiling point and other lower performance criteria. There is no current available technology that can easily identify this common problem in a short amount of time. Therefore, these current on-site methods are of no value in identifying whether the fluid needs to be replaced to meet the original equipment manufacturer (OEM) specification.

Conventional off-site brake fluid testing methods can be expensive. In addition, the amount of time to test and analyze the results of a conventional off-site brake fluid testing method can be a lengthy process, requiring at least two weeks time before the results can be returned. For example, to accurately determine the type of brake fluid in a vehicle brake system, a sample of brake fluid must be sent to a testing laboratory. This type of laboratory testing is not practical for a service facility to use during regular vehicle inspection procedures. Currently, there is no visual test to identify DOT 3 and DOT 4 or DOT 5.1 brake fluid without having to withdraw a sample of the brake fluid and send it to a laboratory for analysis.

SUMMARY OF THE INVENTION

The invention primarily relates to a method, apparatus and test kit for visually determining a type of brake fluid quickly and in a cost-efficient manner. Another objective of this invention is determining if there is a minority of DOT 4 mixed with a majority of DOT 3 in a brake system.

In its preferred embodiment, the invention comprises a colorimetric reagent that results in a first color when contacted by DOT 3 brake fluid, a second color when contacted by DOT 4 and/or 5.1 brake fluid, and a third color when contacted by a mixture of DOT 3 and DOT 4 and/or 5.1 brake fluid when the DOT 4 and/or DOT 5.1 represent about 50% or less of the DOT 3 and DOT 4/5.1 mixture.

DOT 3 fluid is an aliphatic polyether, whereas DOT 4 and DOT 5.1 are borate ester based. Thus, an embodiment of the invention may be described as a method of distinguishing a borate ester based brake fluid from a brake fluid that lacks borate esters. Another embodiment may be described as method of detecting the presence of a borate ester based brake fluid in a mixture of brake fluids (e.g., detecting whether DOT

4 and/or DOT 5.1 fluid has been mixed with or substituted for DOT 3 fluid in a vehicle requiring same.

In one embodiment, the third color may vary with the concentration of DOT 4/5.1 brake fluid up to about a 50% concentration of such fluid mixed with another. After the DOT 4/5.1 fluid exceeds 50%, the color is substantially the same as for 100% of a DOT 4/5.1 fluid.

In another embodiment, the present invention utilizes a substrate, such as a dipstick, or a kit with a visual color chart that provides an easy color comparison for determining the results of the test. An automated embodiment of the invention includes an electronic color detector to automatically determine the results of the test by inserting the colorimetric reagent into the electronic color tester after making contact with the brake fluid to automatically determine the presence of DOT 3 or DOT 4/5.1 brake fluid and/or a mixture of DOT 3 and DOT 4/5.1 within the brake system.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood from a reading of the following detailed description taken in conjunction with the drawings in which like reference designators are used to designate like elements, and in which:

FIG. 1 is brake fluid color tests for DOT 3 and DOT 4 brake fluids according to the invention.

FIG. 2 is brake fluid color test demonstrating a varying color for certain mixtures of DOT 3 and DOT 4 brake fluid.

FIG. 3 is a schematic illustration of a kit embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention is described in preferred embodiments in the following description with reference to the Figures, in which like numbers represent the same or similar elements.

The described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are recited to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

Applicant's invention comprises a colorimetric reagent that, when contacted with a brake fluid, results in a first color if contacted by DOT 3 brake fluid or a second color if contacted by DOT 4/5.1 brake fluid. The reagent further may become a third color when contacted by a mixture of DOT 3 and DOT 4/5.1 brake fluid. Referring now to FIG. 1, the colorimetric reagent or equivalents thereof must be reactive to a borate ester contained in certain brake fluids (e.g., DOT 4 and 5.1, which are referred to as DOT 4/5.1 for simplicity). Preferably, the colorimetric reagent changes color when contacted by borate ester-containing brake fluid in a pronounced way, such as from yellow to red.

The colorimetric reagent reacts with borate ester containing brake fluids (e.g., DOT 4/5.1), causing a color reaction. The reagent may be substantially non-reactive with brake fluids the do not contain a borate ester (e.g., DOT 3 fluid), thereby remaining a starting color. If a borate ester containing brake fluid is mixed with one or more fluid that do not contain a borate ester, a third color results according to the concen-