

- Accuracy of the driver's perception of the operating environment,
- Dynamic response characteristics of the driver,
- Predictability and reliability of the total brake system,
- Vehicle/road characteristics, and
- Response characteristics of the braking system.

In order to stop a vehicle safely, the brake system should provide repeatable, uniform deceleration for the same brake pedal input and provide braking force in proportion to pedal force. Further, vehicle path direction should be readily controllable by the driver during braking.

The limitation to decelerate a vehicle depends ultimately on road/tire traction, which varies with wheel slip. Maximum braking requires the brake torque to be just enough so that the resulting wheel-slip generates peak traction force available at the tire-road interface. Excessive brake torque causes a progressive increase in wheel slip and decrease in adhesion, resulting in wheel lockup and skidding. Skidding may produce an unsafe condition because directional control of the vehicle is reduced substantially and stopping distances may be increased. Rear-wheel lock-up during braking results in severe vehicle uncontrollability. For this reason, current European braking standards and proposed American braking standards require that in the event of wheel lock-up, the front wheels must lock before the rear wheels. To ensure this condition throughout the life of the friction material, both front and rear brake system performance must not be altered by friction material wear or by other changes in the material friction characteristics. Changes in the friction material properties, either due to replacing the brake shoes with different friction materials, or due to wear, prior operating history, temperature, and load effects, will change the response characteristics of the braking system.

2.3 Influence of Brake Friction Material Characteristics on Brake System Response

There are several scenarios in which an existing hydraulic or pneumatic system would require modification or redesign to accommodate changes in the properties of the brake friction material. These are summarized in Table 2. As indicated in the table, substitution of non-asbestos