there was no significant change in the results.[10]

Ford and MVMA commented that the test condition in S7.4.3(i), which specifies 20 to 25 snubs from 50 km/h at each of the two loading conditions, is excessive. They state that one or two stops from each loading condition would be sufficient for determining variable proportioning valve (VPV) performance. Alternatively, Ford and MVMA stated that the digital data obtained for each of the torque wheel test stops would provide another source of data for determining variable proportioning valve performance. They requested that if the agency decides to require 20 to 25 snubs, then the snubs be performed at the end of the test sequence to avoid any non-repeatable conditioning of the brake lining.

NHTSA has determined that 20 to 25 snubs to determine the variable proportioning valve performance may be unnecessary, but that the suggested 1 to 2 stops would be inadequate to cover the entire range of brake pressures. The agency has decided to modify S7.4.3(i) to specify 15 snubs. The agency believes that this test procedure will be sufficient to appropriately evaluate variable proportioning valve performance without introducing unnecessary conditioning of brake linings. The agency notes that these extra snubs are only needed when the vehicle is equipped with a variable proportioning valve. With fixed proportioning, the test is a static test, which will have no effect on conditioning of the brake linings.

Ford stated that the linear regression data should only include torque data collected when the vehicle deceleration is within the range of 0.15g to 0.80g rather than when torque output values are > 34 N/minute.

NHTSA agrees with Ford's comment and has modified S7.4.4(b) to reflect this change. The agency believes that it would be inappropriate to use data compiled outside the required performance range of the torque wheel test, since such data may not be relevant to the actual performance requirements.

GRRF, GM, Ford, the MVMA, Suzuki, JAMA, Toyota, Honda, and OICA commented that the upper limit line in Figure 2 in S7.4.4(h) (represented in S7.4.5.1 by the equation $z = 0.1 + 0.7 (k - 0.2)$) is unnecessary and should be eliminated. Ford and GM stated that the line is unnecessary because, even though the wheel lock sequence test has no check for excessive front bias, the cold effectiveness test does. Suzuki, JAMA, Toyota, and OICA stated that the adhesion utilization requirement in S7.4.5.2 for a rear axle is more stringent than the requirement than S7.4.5.1, making S7.4.5.1 redundant.

NHTSA agrees with the commenters that a vehicle that is so front-biased that it would not satisfy the efficiency requirement proposed in Notice 5 would in all probability not be able to meet the cold effectiveness and/or other stopping performance requirements in the standard. Therefore, the efficiency requirement proposed in S7.4.5.1 of Notice 5 is essentially redundant. Accordingly, the agency has decided not to include the upper line in Figure 2. In addition to deleting the area of Figure 2 defined by the equation $z = 0.1 + 0.7 (k - 0.2)$, NHTSA is modifying S7.4.5 by deleting the text of S7.4.5 and S7.4.5.1, and renumbering S7.4.5.2 as S7.4.5.

Chrysler recommended using deep dish wheels and changing tires on the torque wheels, claiming that use of torque wheels will deform normal road wheels by pushing them further out than their normal position. Ford and MVMA requested that the agency modify the requirement to permit use of a separate set of tires in the torque wheel test, based on its concern that lockup situations in other tests under FMVSS No. 135 could flatten or wear spots on tires.

NHTSA has decided to permit manufacturers to use a separate set of tires for the torque wheel test, even though the agency believes that it is unlikely that the tires will be worn down prior to the adhesion utilization test which comes at the beginning of FMVSS No. 135's test sequence. The agency notes that new tires will not alter the adhesion utilization curve for the vehicle. The agency agrees with Chrysler that manufacturers using deep dish rims can avoid tire demounting and thus simplify testing, if they can use such rims with tires already mounted. Based on these considerations, the agency has modified S7.4.2(d) to permit optional use of a separate set of tires for the torque wheel test.

Suzuki commented that for purposes of the torque wheel test, the definition of LLVW should be changed to unloaded weight plus 200 kg, rather than the present 180 kg. It stated that 180 kg may be insufficient to cover the total weight of the driver and required instrumentation.

NHTSA believes that most instrumentation packages fall within the 180 kg specified in the Standard. Moreover, the agency is not aware of any instrumentation packages that exceed the weight allowed for LLVW testing. Based on these considerations, the agency has decided not to change S7.4.2.

Hunter, a manufacturer of a brake balance tester, stated that its device can provide results similar to a road transducer pad. It further stated that its device can be used without the need to modify the vehicle.

NHTSA is aware of Hunter's brake balance tester, which is a simplified version of the road transducer pad. While the Hunter device can provide a rough measure of adhesion utilization, NHTSA believes that the methods of measuring adhesion utilization adopted by the agency are superior to the Hunter device, since the torque wheels evaluate adhesion utilization more precisely. The agency notes that the automotive industry and foreign governments interested in harmonization have stated that the proposed methods of measuring AU are appropriate.

In the 1991 SNPRM, the agency stated that assuming one torque wheel equipment package will service the needs for five years of typical yearly production runs of 30,000 to 100,000 vehicles, the torque wheel would result in a unit cost increase of $0.15 to $0.50 per vehicle.

Kelsey-Hayes stated that NHTSA underestimated the expense of torque wheel equipment. It stated that the agency's discussion of the economic burden associated with the cost of one set of torque wheels over a test run is misleading and incomplete, since numerous sets of torque wheel instrumentation will be required.

NHTSA believes that its estimates in the 1991 SNPRM were reasonably accurate, with the following minor modifications. The agency expects that the cost for a set of four torque wheels (including adapters to accommodate varying wheel mounting bolt patterns) to be approximately $40,000 and $15,000 for the on-board digital data acquisition system that will record the testing results. The equipment should last five production years, which correlates to an annual expense of $11,000 per year. This figure is further reduced when amortized on a per vehicle basis. The agency estimates that direct labor costs for each test to be approximately $50 (including costs for instrumentation technicians, and drivers). The agency estimates that the marginal cost increase per car attributed to the torque wheel test will be between $0.10 and $0.16, depending on the size of the vehicle's production run and the number of vehicles in the run that the manufacturer wants to test, since the manufacturer need not test every vehicle in a vehicle run. The agency

[10] "Harmonization of Braking Regulations, Report Number 7, Testing to Evaluate Wheel Lock Sequence and Torque Transducer Procedures," DOT HS 807611, February 1990.