

EPA SmartWay Truck Emissions
Test Protocol Workshop

Determining Track-to- Chassis Dynamometer Correlation



Track-to-Dynamometer Correlation – Technical Topics

Correlation methodology

Number of tests required for overall correlation

Test-to-test variability

Lab-to-track variability

Lab-to-lab and track-to-track variability

Efficiency / emissions measurement technique variability –
gravimetric, carbon-balance, other procedure

Test accuracy requirements and additional provisions to
ensure accuracy (e.g., in-cab driver's aid for track)

Selection of probability and confidence intervals for track
and chassis dynamometer tests

Correlation Methodology

- Primary Technical Focus: General methodology necessary to determine equivalency of track and chassis dynamometer testing procedures
 - Protocol: Does make provision for comparing effects of drive trace accuracy from one test sequence to another
 - Comment: Should be comparison of driving style from test to test to ensure consistency, since potential variation far exceeds expected benefit of most new technologies to be evaluated with protocol.

Number of Tests Required for Overall Correlation

- Primary Technical Focus: Quantity of data necessary to provide adequate correlation of track and chassis dynamometer testing procedures
 - No comments received to date

Test-to-Test Variability

- Primary Technical Focus: Aspects of testing that produce variability for replicate testing of same vehicle at same facility, or testing of multiple identical vehicles at same facility
 - Protocol: Tires filled to mfr's recommend max cold inflation pressure and must be free of damage or unusual wear
 - Comment: Should provide tread depth specification of 75% from new to be consistent with road load determination procedure.
 - Comment: Should provide tire break-in specification of 40 - 60% of new tread depth.
 - Protocol: Stand-alone fuel efficiency / emissions test
 - Comment: Drivers may not be able to follow drive cycle trace within tight limits for track testing. Recommend use of comparative-type test as in SAE J1321 so that factors like drive cycle are less critical. Removes other variables such as wind, temperature, weather, and fuel quality.

Lab-to-Track Variability

- Primary Technical Focus: Aspects of testing that produce variability for replicate testing of same vehicle on both track and chassis dynamometer
 - Protocol: Use SAE coastdown test procedures to calculate road load
 - Comment: Coastdown procedures correct road load to constant ambient conditions. Need to factor for air density differences between track and dynamometer testing.
 - Protocol: Max. temperature specification for track / temperature profile specification for dynamometer
 - Comment: Specify consistent fuel temperature requirements for track and dynamometer testing. Dynamometer fuel temperature requirements unachievable if using track method.

Lab-to-Lab & Track-to-Track Variability

- Primary Technical Focus: Aspects of testing that produce variability for replicate testing of same vehicle at different facilities
 - Protocol: Track elevation no higher than 4,000 ft above sea level
 - Comment: Reduce maximum track elevation to less than proposed 4,000 feet to reduce variation due to different air densities.

Efficiency / Emissions Measurement Technique Variability

- Primary Technical Focus: Aspects that produce variability for replicate testing of same vehicle at same facility using different measurement techniques
 - Protocol: Minimum portable tank volume of 16 gallons for gravimetric technique
 - Comment: Minimum volume specification may be unnecessary for short drive cycles due to small quantity of fuel consumed. Large tank would require scale of both high capacity and high resolution.
 - Protocol: Allows use of PEMS in accordance with CFR requirements
 - Comment: Emissions measurement techniques have potential to be more repeatable than other methods. However, PEMS need further testing to validate them against several other benchmark techniques.
 - Comment: PEMS generate significant amount of cab heat, requiring HVAC cooling or open windows. Could impact fuel consumption relative to other measurement techniques.

Test Accuracy Requirements

- Primary Technical Focus: Miscellaneous areas for procedural refinement to improve overall test accuracy
 - Protocol: Instantaneous limits for track / regression analysis for dynamometer
 - Comment: Use the same drive trace accuracy requirements for both track and dynamometer testing
 - Protocol: Use GPS, vehicle ECM data, or speedometer / odometer readings
 - Comment: The resolution of both speedometer and odometer would be inadequate as compared to stringency of other instruments and drive cycle requirements. Fifth wheel device should be used to increase accuracy for track testing.

Test Accuracy Requirements (Cont.)

- Primary Technical Focus: Miscellaneous areas for procedural refinement to improve overall test accuracy
 - Protocol: Ride along observer required to coach driver for drive cycle accuracy
 - Comment: Method isn't consistent with drive cycle accuracy requirements. Recommend use of heads-up video driver's aide or similar instrument.
 - Protocol: Does not specify driving distance measurement tolerance
 - Comment: For purpose of calculating fuel efficiency, tolerance should be specified for driving distance measurements.

Probability & Confidence Intervals Selection

- Primary Technical Focus: Selection of appropriate statistical controls for both track and chassis dynamometer testing procedures
 - No comments received to date

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