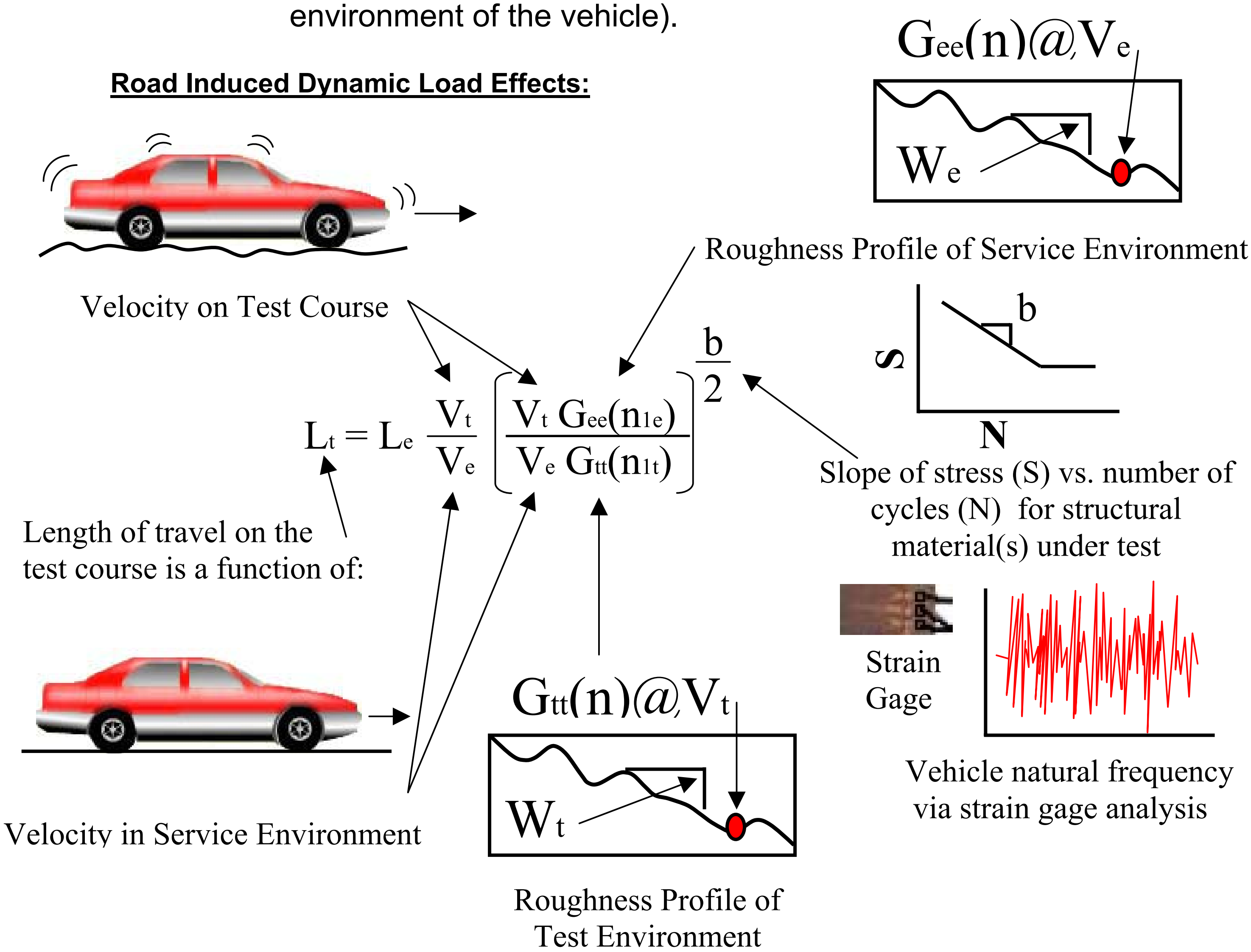
ACCELERATED LIFE CYCLE TESTING

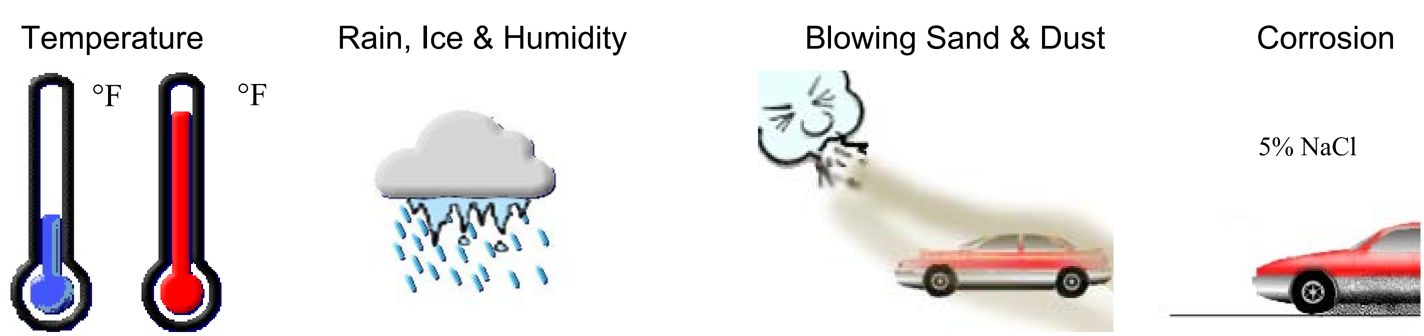
The following diagram illustrates how NATC uses an accelerated life cycle test to simulate 15 years or 250,000 miles in 16 weeks and 30:1 acceleration factor (depending on the service environment of the vehicle).

Road Induced Dynamic Load Effects:



$$L_t = L_e \frac{V_t}{V_e}\left[\frac{V_t\, G_{ee}(n_{1e})}{V_e\, G_{tt}(n_{1t})}\right]^{\frac{b}{2}}$$

Environmental Load Effects:



Publication List and Technical Description on Reverse Side →

NATC offers Accelerated Life Cycle Testing

For more information on NATC's validated accelerated life cycle testing methodology, contact Colin Ashmore or Henry C. Hodges Jr. at 775-629-2000. Additionally, the three publications below, detailing NATC's accelerated testing methodologies are available upon request (NATC, P.O. Box 234, Carson City, Nevada 89702-0234).

1. S.C. Ashmore and H.C. Hodges Jr., *Dynamic Force Measurement Vehicle (DFMV) and its Application to Measuring and Monitoring Road Roughness*. Vehicle, Tire, Pavement Interface, ASTM STP I 164, J.J. Henry and J.C. Wambold, Eds., American Society for Testing and Materials, Philadelphia, 1992, pp. 69-96.

2. S.C. Ashmore, A.G. Piersol and J.J. Witte, *Accelerated Service Life Testing of Automotive Vehicles on a Test Course*, Vehicle System Dynamics, Volume 21, Number 2, 1992, pp. 89-108.

3. S.C. Ashmore and J.J. Witte, *Accelerated Service Life Testing Conducted with an Automotive Vehicle on a Test Course*, Proceedings, Institute of Environmental Sciences, 1993, pp. 134-146.

The first paper discusses how NATC acquires and analyzes road roughness data in terms of a vehicle-independent physical roughness profile and a statistical wave-number spectra [spatial Power Spectral Density (PSD)]. The paper primarily discusses vertical inputs to vehicles; however, NATC also realizes that the longitudinal and lateral inputs are equally important. For example, NATC also defines relative powertrain demands (grades, traction, soft soils and sinkage, washboard, etc.) between environments through longitudinal force measurements with the DFMV. The DFMV is a research tool that has other applications, as briefly discussed in the paper. For example, NATC has been performing off-road anti-lock brake studies utilizing triaxial for measurements with the DFMV.

The second and third papers were written as a result of testing for the nuclear transport industry and for prototype vehicles within the commercial market, both domestic and foreign service environments. These papers detail the development of a definitive methodology for scaling energetics between the test and service environments. Whereas the automotive industry design approach is largely evolutionary, NATC developed the approach to design and test a vehicle from the "ground up".

On the reverse side is a figure that provides an overview of NATC's accelerated life test methodology. As shown, if the wave-number spectra for the service and test environments are defined in terms of a vehicle-independent measurement, then direct comparisons can be made in engineering terms. As derived in the second paper, mileage equivalencies between service and test environments can be calculated through scaling the wave-number spectra, vehicle speeds, and a fatigue parameter for the vehicle (and a road-component transfer function). This scaling equation has been validated through several accelerated durability tests and strain gage fatigue analysis tests at NATC.

NATC's approach also includes the anticipated level of discrete inputs such as washboard, mud, sand, grades, and impacts (potholes, curbs, etc.). These discrete inputs are run one-for-one, and no attempt is made to accelerate their inputs.

Additionally, NATC typically integrates accelerated environmental cycles (high and low temperature, humidity and corrosion) at the beginning, middle and end of the durability testing. The reason for combining the environmental tests is that the service environment has a high probability of interactions or synergistic effects between road induced dynamic loads and environmentally induced loads. This test scenario is designed to account for those interactions.

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