## F. Using Surrogate Test Vehicles

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The Federal Outdoor Impact Laboratory (FOIL) at the Turner-Fairbanks Research Center of FHWA at McLean, Virginia uses a test bogie in place of a real car for crash tests of breakaway sign and luminaire supports. The test bogie is made up of a steel framework on car wheels with a crushable front end. The crushable front end was designed to simulate the crash of a real car when impacting a breakaway roadside device. During a crash test, the crushable front end is collapsed but the rest of the bogie is generally undamaged. The aluminum honeycomb blocks used in the crushable front end are relatively inexpensive and easily replaced. Thus, crash tests with a bogie can replace real car tests that are much more expensive and time consuming to perform.

Searching back in the ancestry of the bogie used at FOIL, we find there were several generations of surrogate test devices. These were:

- Rigid Nose Pendulum (Prototype Only)
- Crushable Nose Pendulum (Prototype without Slider)
- Crushable Nose Pendulum (with Neoprene Faced Slider)
- Crushable Nose Pendulum (with Aluminum Honeycomb Faced Slider)
- Low Speed Bogie (2250 lbs/20 mph)
- "Breakaway" Bogie (1850 lbs/up to 60 mph)

The "breakaway" bogie currently used at the FOIL has been validated for the testing of breakaway supports. Recently a major test program was completed using the bogie to crash test 44 luminaire supports. Several types of breakaway bases were tested including slip bases, transformer bases, couplings, anchor bases and progressive shear bases.

The workshop planners asked for presentations that would be provocative. Therefore, due to our successful use of the bogie at the FOIL, here is Provocative Statement 1:

1. The "breakaway" bogie should be mandated for certification testing of breakaway sign and luminaire supports.

This mandate would have the benefits of lower cost and greater repeatability of results. Results would be more repeatable because of:

- Precise control of vehicle weight.
- Identical frontal crash characteristics.

Due to the success with bogies at the FOIL, FHWA researchers have proposed plans to design and validate a series of bogies, each custom tailored to test a specific type of roadside hardware. The status of this bogie development program is as follows:

- Breakaway Bogie (Presently Validated and In-Service)
- Base Bending Bogie (Preliminary Design Underway)
- Crash Cushion Bogie (Development on Hold within FHWA R&D)
- Guardrail Bogie (Planning Stage Only)
- Rigid Barrier Bogie (Planning Stage Only)

The above proposals for several new types of bogies at the FOIL lead to Provocative Statement 2:

2. Other surrogate vehicles (bogies) should be mandated for certification testing of roadside safety hardware as they become available. A procedure should be established for the acceptance of new surrogate test devices.

During the series of 44 bogie tests on breakaway supports conducted at FOIL we learned that some test setup parameters greatly affect the test results and the reporting of results. For example, variations in the mounting bolt torque for transformer bases, the clamping bolt torque for slip bases and the mounting circle diameter for transformer bases had a substantial effect on breakaway energy required, and thus the change in velocity of the bogie.

Additionally, the 1985 AASHTO specifications for the testing of breakaway supports require that the stubs of the breakaway devices have no substantial portions extending more than four inches above the ground. In many cases it is difficult to judge what constitutes a "substantial" stub of material, yet this criterion can cause a device to pass or fail. "Substantial" should be defined such that a testing agency can determine a pass or fail condition accurately.

The above observations during our bogie tests of breakaway luminaries lead to Provocative Statement 3:

3. Mounting bolt torques for breakaway devices that are being crash tested should be precisely defined, either by quantifying the torque or specifying acceptable torque ranges. The mounting bolt torques actually used should be reported. Transformer bases should be tested using the maximum bolt circle diameter. The term "substantial" in the AASHTO stub height criterion should be defined or quantified.

Just as the bolt torque and bolt circle requirements for breakaway supports need to be specified in crash test

setup procedures, other roadside safety hardware may need more detailed setup procedures for crash testing. This leads to Provocative Statement 4:

4. A procedure should be defined for specifying new test setup requirements as new knowledge regarding the effect of these setup requirements on test results is determined from other new surrogate test vehicles as they are brought on line.