2012 Ford Fusion Brake Testing With iPhone Accelerometer - Description of Instruments

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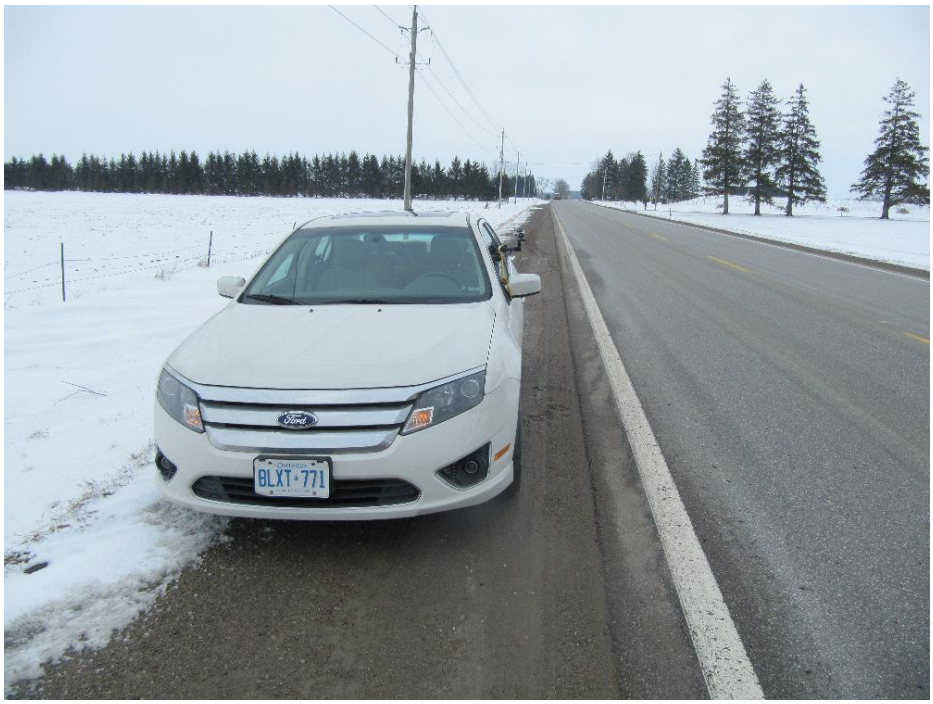
This is the first of four articles that have been prepared to discuss the results of emergency brake testing performed with a 2012 Ford Fusion passenger car on snow-covered and bare roads in the vicinity of London, Ontario, Canada on February 24, 2013. This first article will show the instrumentation that was used in the testing.

The second article will provide details of our Test # 5 that was performed on a dry and bare, tar and chip, northbound, road surface of Clarke Road just north of Medway Road, north-east of London, Ontario.

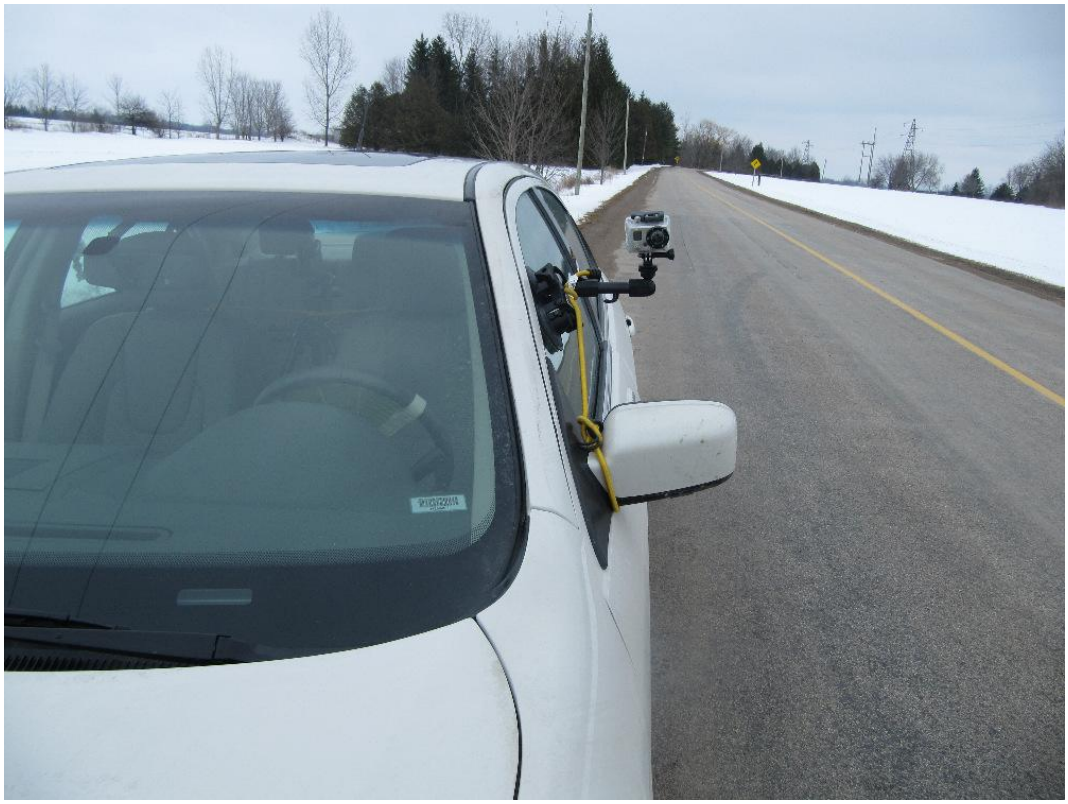
The third article will provided details of our Test #17which was performed by driving the right side wheels of the vehicle onto a gravel shoulder that was partially froze and partially thawed. The left side wheels were on a bare and dry asphalt pavement.

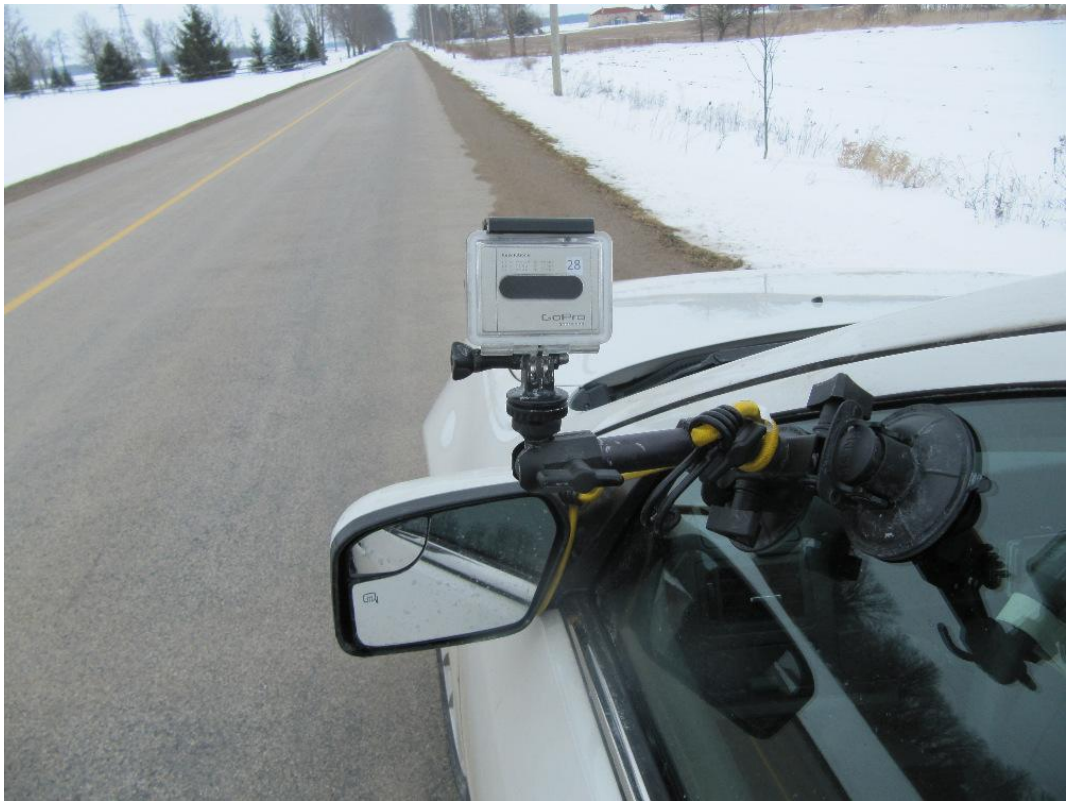
The fourth and final article will continue and analysis and discussion of our Test #17 as well as providing some comparison to Test #5 and other testing and research.

To begin with, here is our description of the instrumentation that was used. The photo below shows a front view of the 2012 Ford Fusion that was used in our testing.

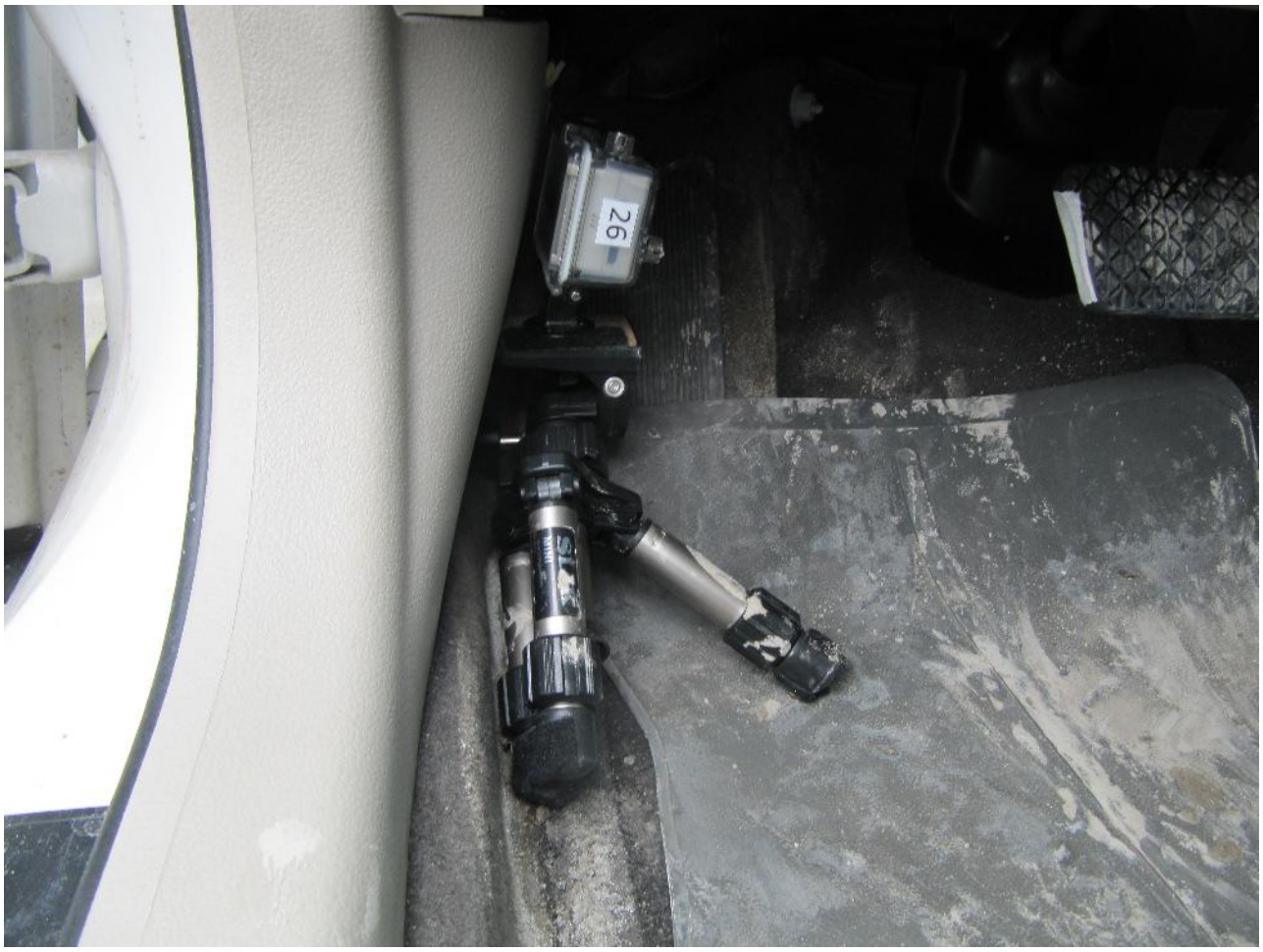


The two photos on this page below show our GoPro28 camera mounted to the exterior of the driver's window and pointing in a forward direction.



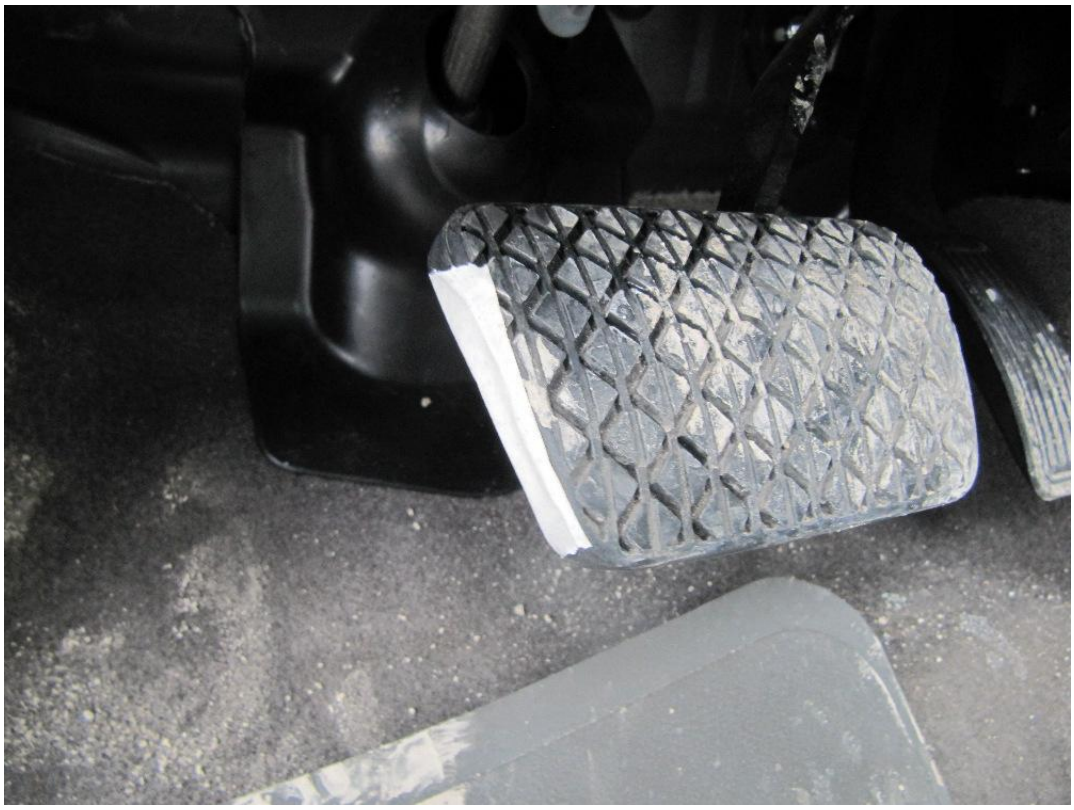


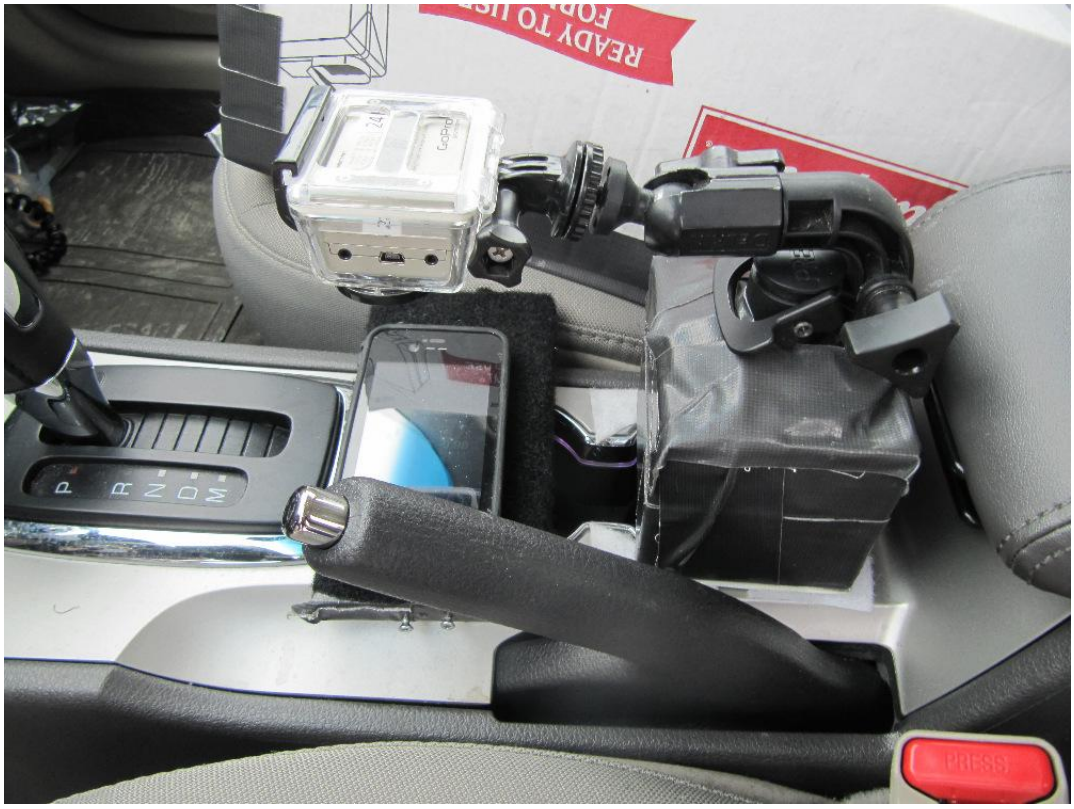
The photo at the top of this page (Page 3) shows our GoPro26 anchored to a small tripod which was placed along he left driver's foot well and pointed at the brake pedal. We found that the small tripod did not need to anchored to the vehicle since arranging its legs to prop it against the vehicle was sufficient even though we were performing high speed braking tests.



If you look closely to the right in the above photo you should be able to see the brake pedal and we attached a small piece of masking tape on the left edge of the pedal so it would be more visible in the darkness below the instrument panel. We have been having some issues with providing sufficient light to this area. We tried anchoring a small, battery operated flashlight to the underside of the instrument panel so that it would shine down on the brake and accelerator pedals but this has provided mixed results. The photo on the top of Page 4 shows a close-up of the tape on the brake pedal.

The photo at the bottom of Page 4 shows how we attached the iPhone 4S to the centre console with GoPro4 pointing down onto its face to capture the accelerometer readings. The infamous "Campbell's" soup box in the background has been shown before as we place it over top of the iPhone and camera to keep reflections out of the recordings.

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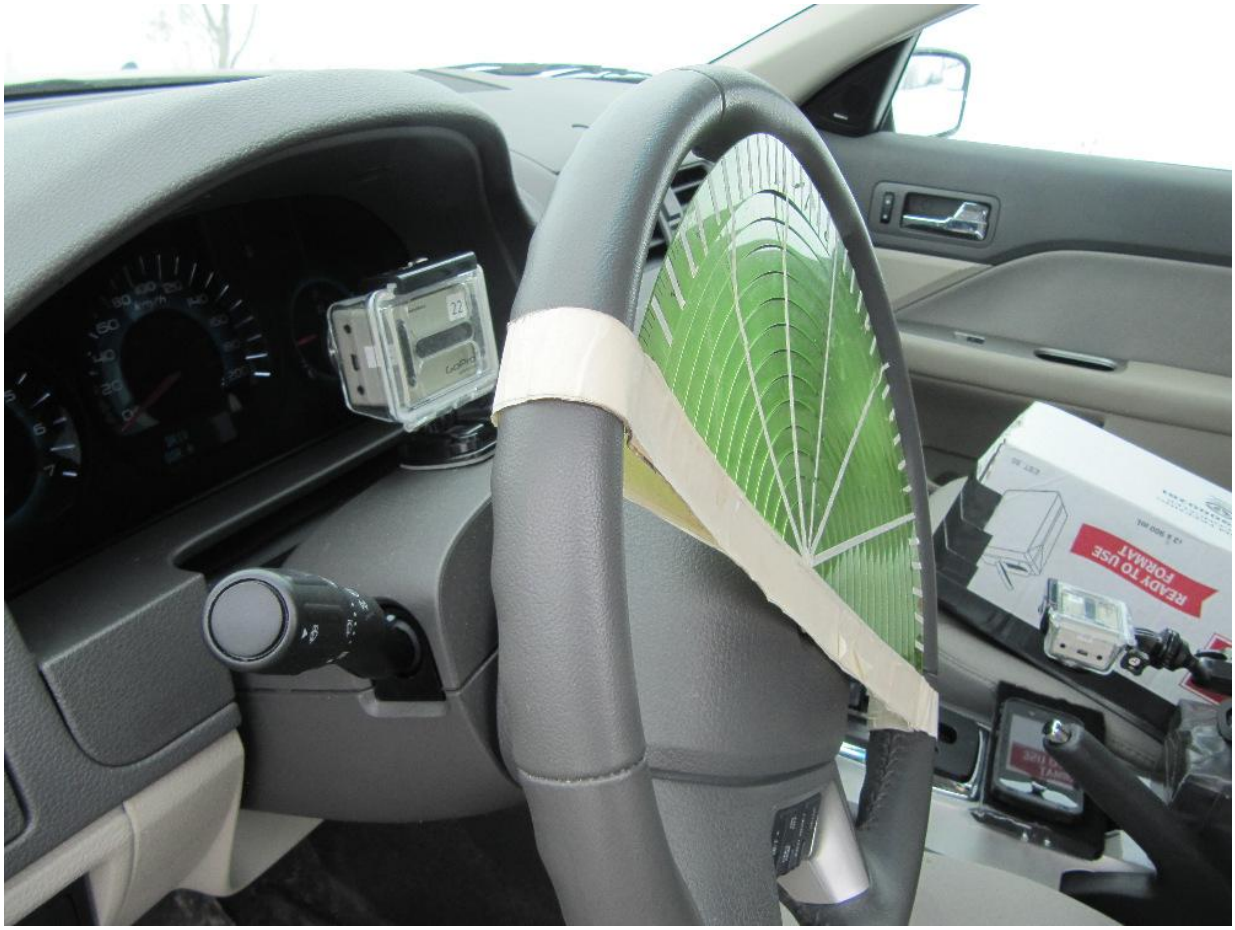
We have found that the interiors of modern passenger cars so designed in such a way that almost nothing will stick to them and this makes it difficult to anchor our cameras and iPhone. For example the suction cup anchors that we normally use to attached our cameras to the exterior of our vehicles will not stick to any part of the Ford Fusion's interior. As you can see we had to attach the suction cup to a block of wood which was then taped over and then some Velcro was attached to the base of the block and then the Velcro on the wood block attached to some Velcro sticking to the centre console. It just demonstrates how each testing session is a challenge from one vehicle to the next.

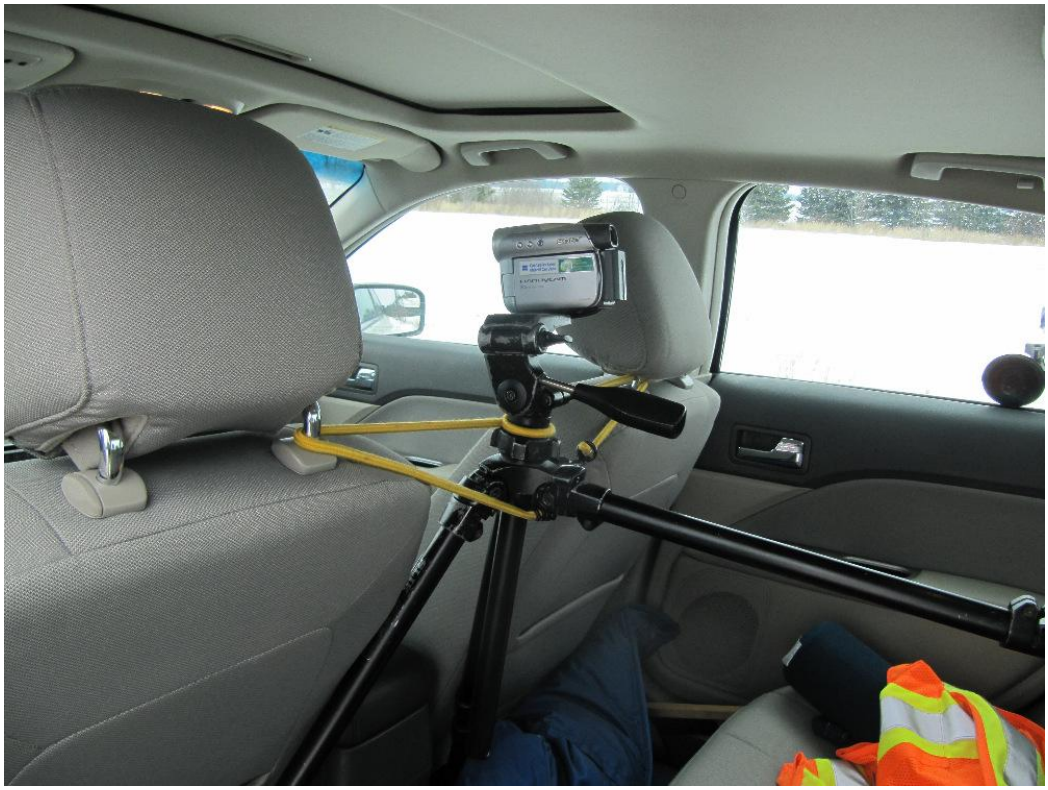
If you have been examining some of our previous articles you will recognize the large plastic protractor shown in the photo below which we attach to the steering wheel of the vehicle and videotape its rotations from a video camera between the two front seats.

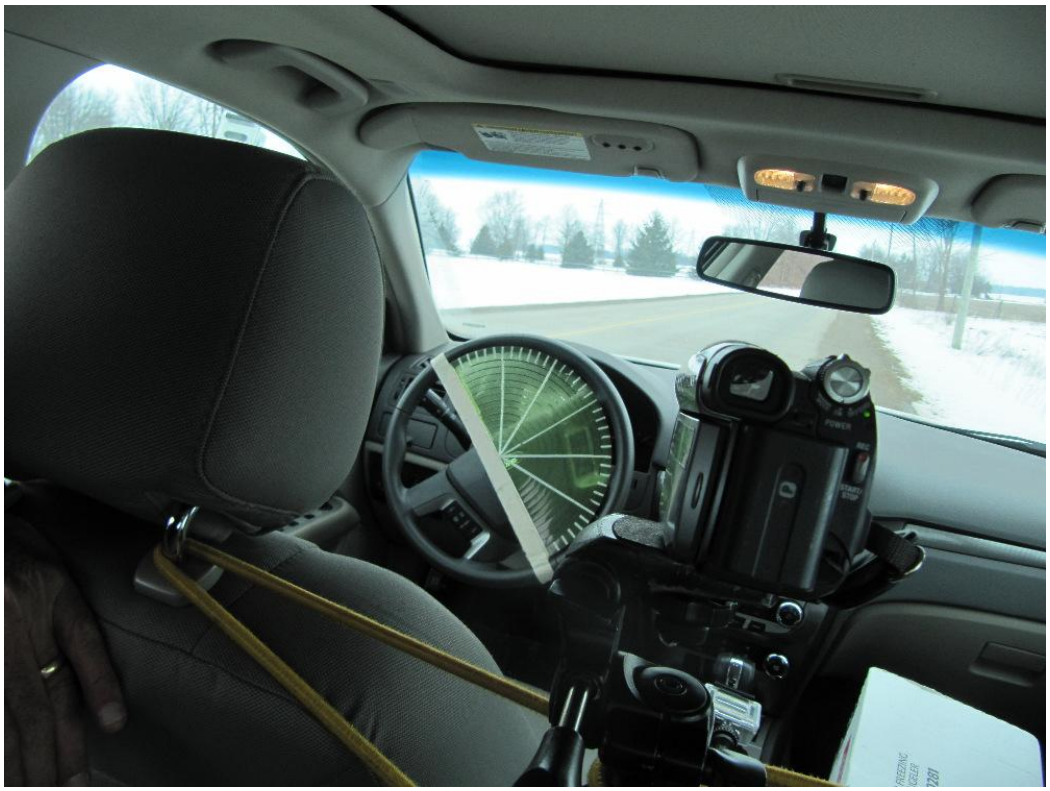


Looking at the above photo you should also be able to see our GoPro22 anchored on top of the steering column in front of the steering rim and pointing at the speedometer, tachometer and other instruments. This arrangement has been used extensively with previous vehicles with great success.

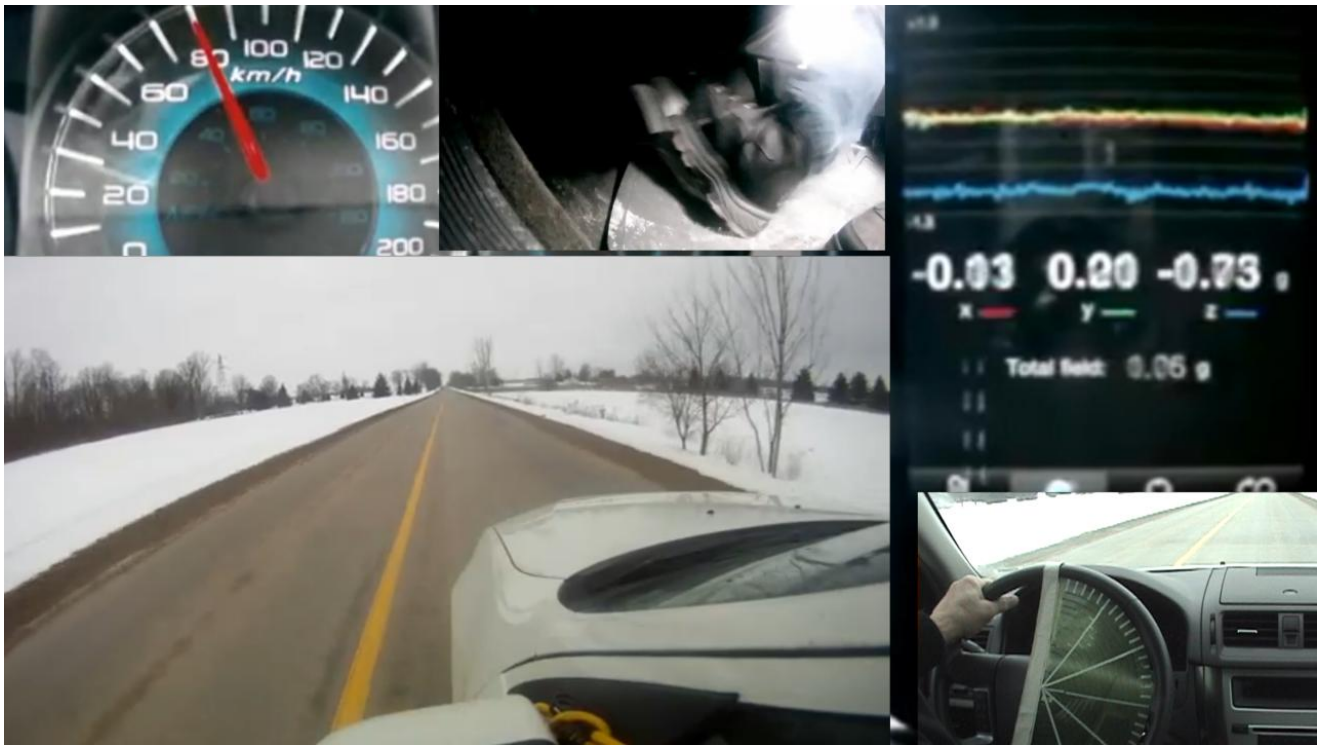
As usual, the photos on Page 6 show the position of Sony #2 miniDV camera which we use to videotape the steering wheel protractor from between the two front seats. We

have found that using a bungie cord wrapped around the anchors of the head restraints and then wrapping around the tripod provides a secure anchorage for the camera.





So this completes our description of the instruments in our test vehicle. When the testing and videotaping are complete we copy our videos into our Adobe Premiere video-editting program and synchronize all the views so that a project shows all the views on our computer screen as shown below. The screen capture shown below is from the beginning of our Test #5 just as the test driver slammed his foot on the brake pedal.



Since this testing involved only a limited set of five video cameras it is possible to insert all the views onto one computer screen without everything becoming too congested. However when we run 10 or more video cameras then we start creating two or three separate projects on individual computers so that we may be looking at the complete complement of views on three computer screens.

In our present testing the view of GoPro22 has been zoomed in so that we only see the speedometer while in fact GoPro22 videotapes all the instrumentation if we needed to see it.

It is not abundantly clear but the view at the middle of the top of the screen is actually the driver's boot pressing down on the brake pedal.

The view at the top right is of the face of the iPhone and it demonstrates the difficulties we sometimes encounter in getting a clear image of the numbers from the face of the iPhone. For example the three sets of large white numbers indicate the longitudinal (forward/backward), the lateral (side to side) and the vertical accelerations of the centre of the test vehicle where the iPhone is anchored. When looking at the numbers one had to question whether the longitudinal acceleration is displaying "-0.13" g or perhaps

something different. We sometimes have to look very closely to be sure. We have found that using our GoPro24 at 60 frames per second (fps) seems to improve the view than if we had it set at 30 fps.

The large view at the bottom left of the screen is from GoPro28 which is anchored to the exterior of the driver's window.

The view on the bottom right is of the steering wheel protractor taken by our Sony #2.

So this summarizes a description of the instrumentation used in the braking testing of the 2012 Ford Fusion. The next three articles will discuss the details of our Test #5 and #17.

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