INF GR/DL/5/2

BMW Presentation, “Proposed Door Test Procedures Hinged Side Doors”

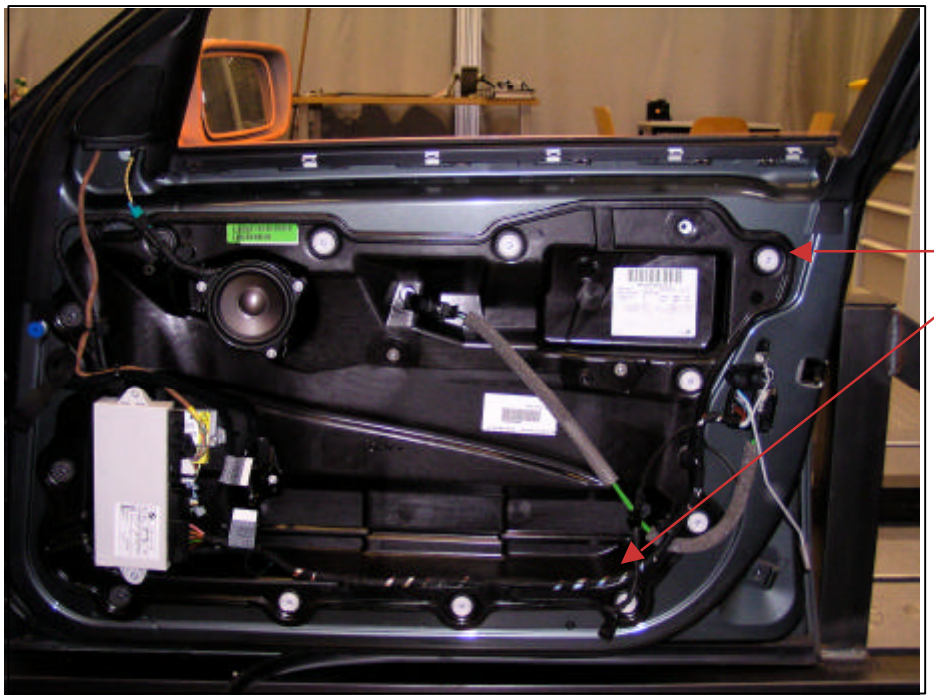
Proposed Door Test Procedures

Hinged Side Doors

BMW Group

BMW Side Door (interior view)

Reinforcement has to remain in place



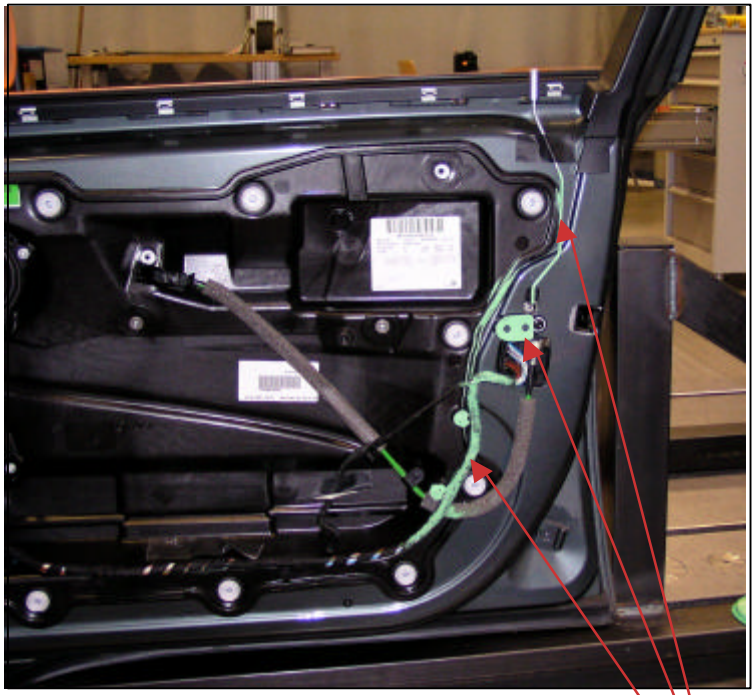
Reinforcing structure, essential for side door strength located under contoured interior door trim panel.

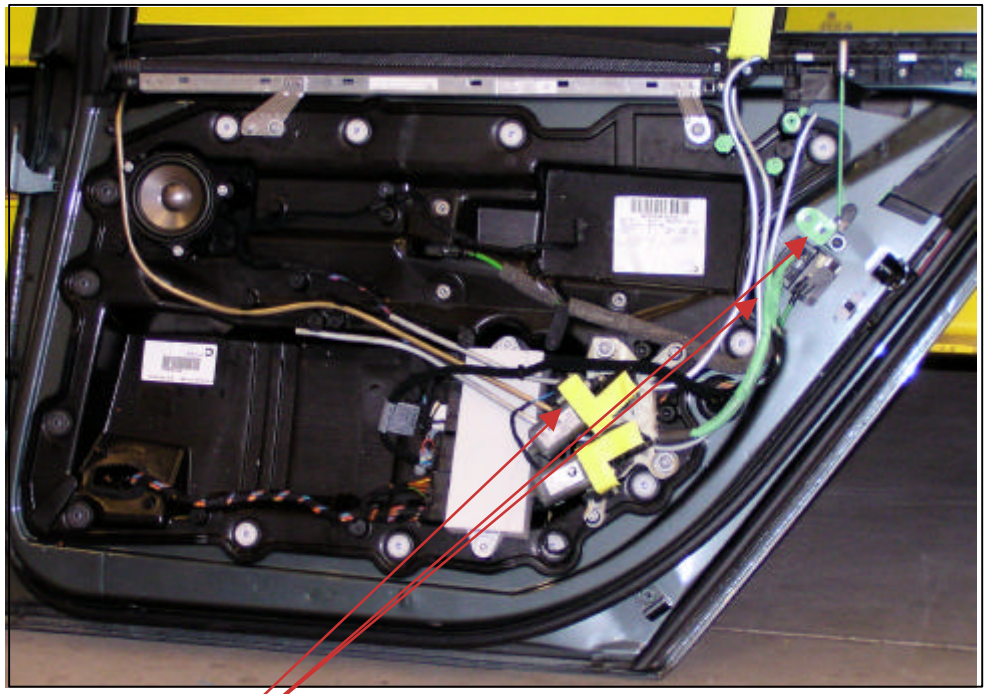
This part has to remain in place to as not to compromise the strength of the door structure and to ensure correct test results.

However it can become necessary to remove the interior door trim panel to find a supporting structure for force application.

BMW Side Doors (interior view under trim panel)

Projections of Parts



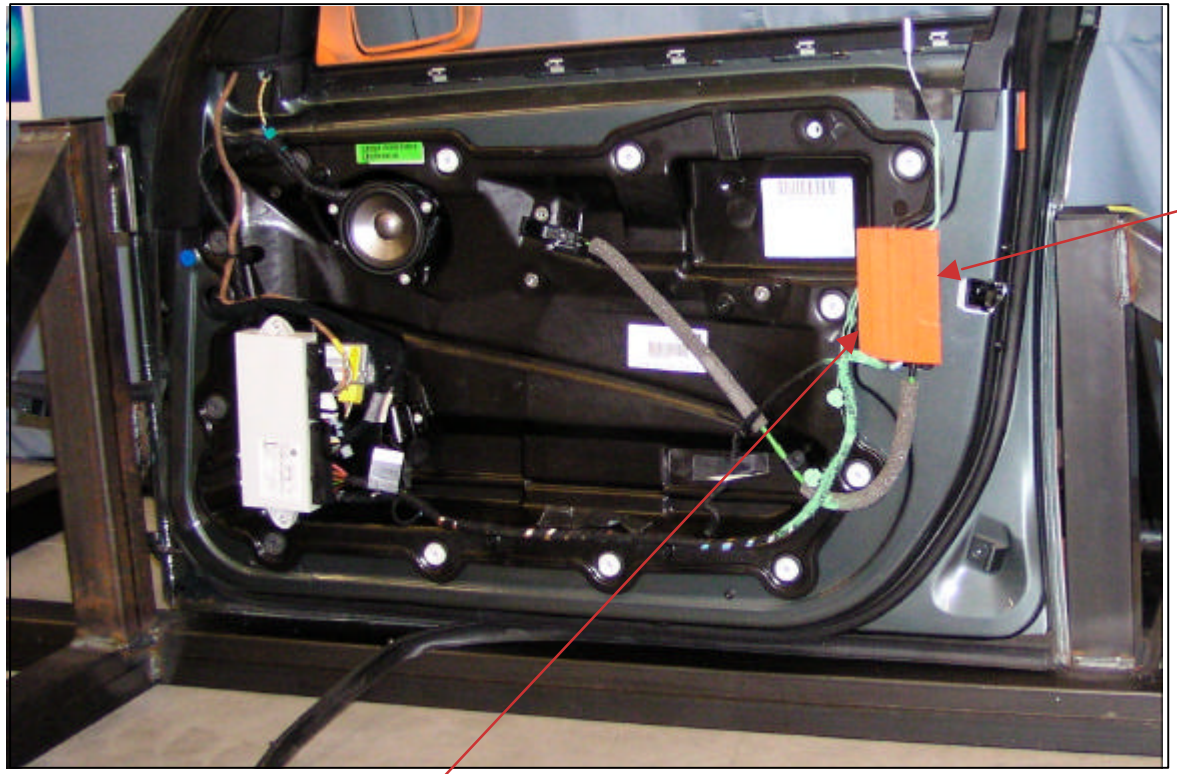


Projections against door structure (highlighted in green and yellow)

Should those parts remain in place or do they need to be removed?

BMW Longitudinal Force Test

Transversal Force application (Pre-Load)



Application of Transversal Force (1000 N)

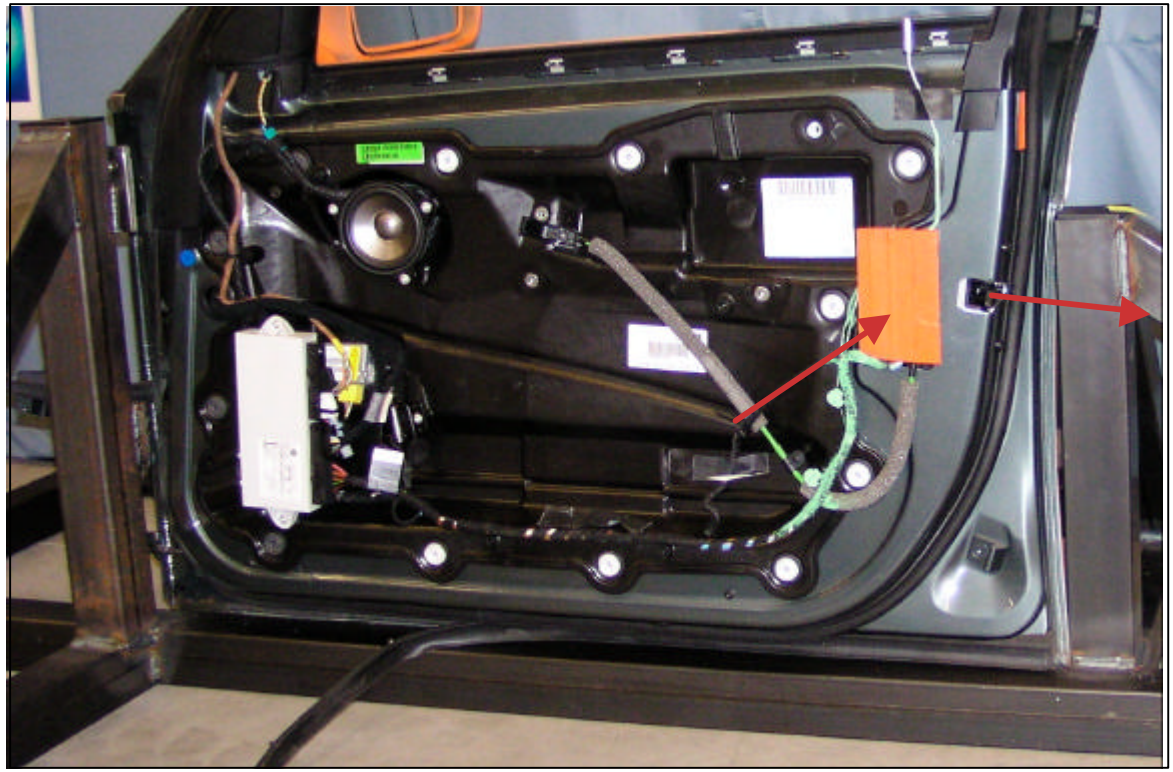
If this Force is applied before the longitudinal Force it will be increased by the reaction Forces of the pulling cylinders.

Would a static Force of 1000 N applied by e.g. a compressed coil spring be able to do the same/better job?

The requirements of the force application plate need to be defined with regard to radius on outer edges (otherwise it might cut the door)

BMW Longitudinal Force Test

Transversal Force application (Pre-Load)



Suggested sequence of loads:

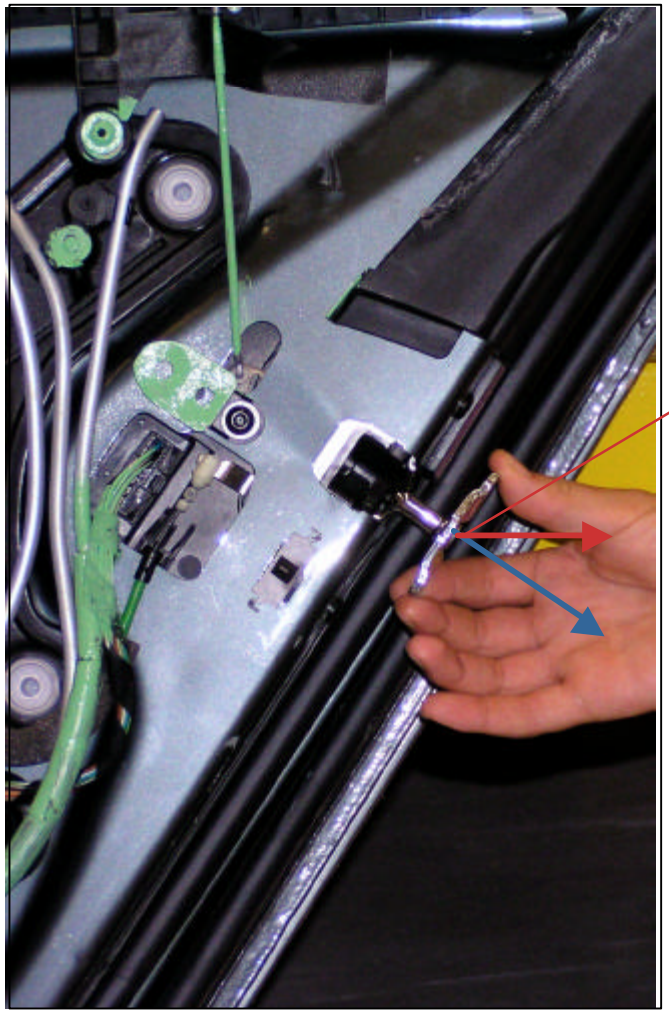
1. Apply a longitudinal force of 1000 N to get the cylinders under tension.

2. Apply the transversal force of 1000 N

3. Increase the test load of 17000 N until the requred time is up.

Longitudinal Test

Direction of Force Application



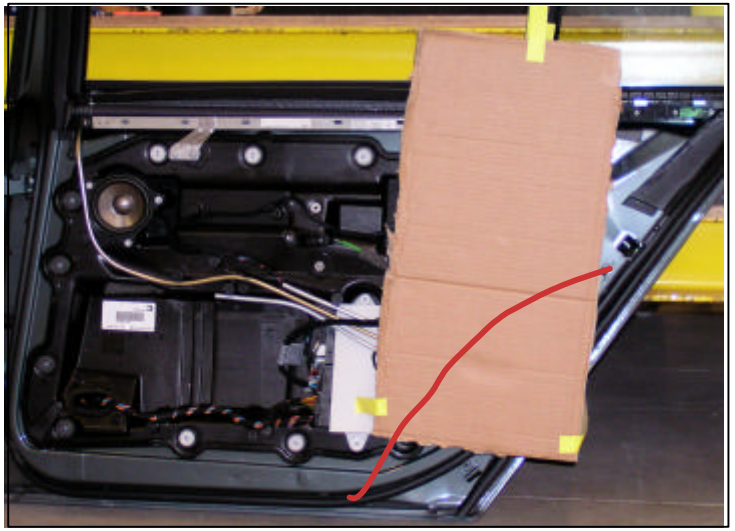
What Force direction is considered longitudinal with regard to door latch/striker assembly?

Longitudinal in vehicle coordinates (red) or longitudinal to latch/striker (blue)?

NHTSA picked the red (x-) direction, that requires a guided hydraulic cylinder.

Transversal Test

Direction of Force Application

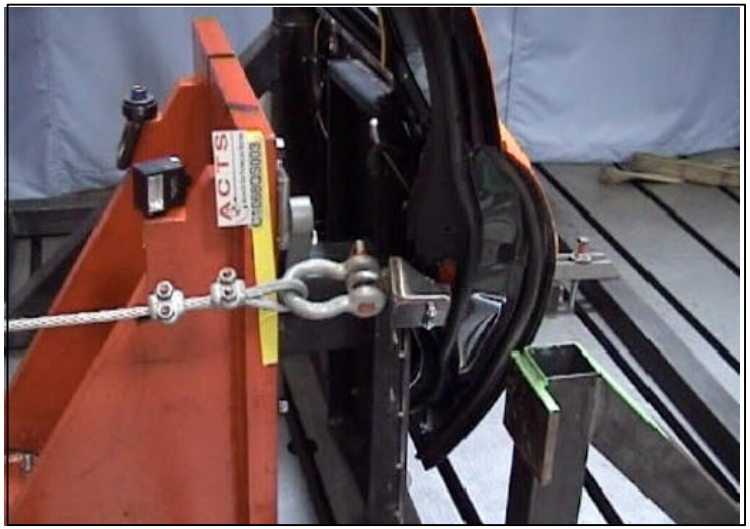


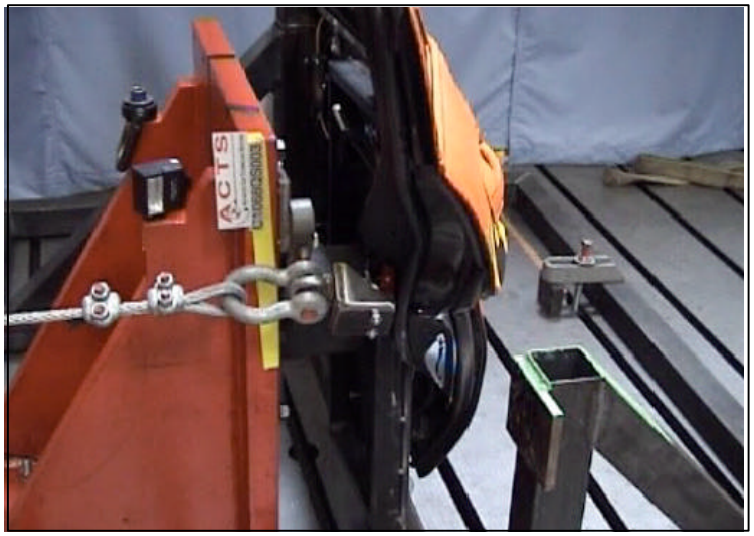
Actual size of rigid plate for lateral testing. For very high side doors (SUVs, special passenger cars, trucks) this size might not be sufficient as it may not be able to engage the structural parts on top and bottom of the door but instead only push against the soft outer door sheetmetal.

On contoured doors (rear doors) there is only a small overlap near the latch, are there any experiences if that is sufficient?

Transversal Test

Unrealistic Results/Deformations





During the lateral testing deformation occured that does not match the patterns seen in real world accidents. The proposed test setup raises several questions that should be answered :

-Is this test suitable to assess the strength of the latch system or the strength of the door structure (sheetmetal)?

-May the unrealistic deformations cause failure modes that will not occur in real world (due to a better support of complete body)? Might a better support (e.g. by horizontal beams in X-direction improve this situation?

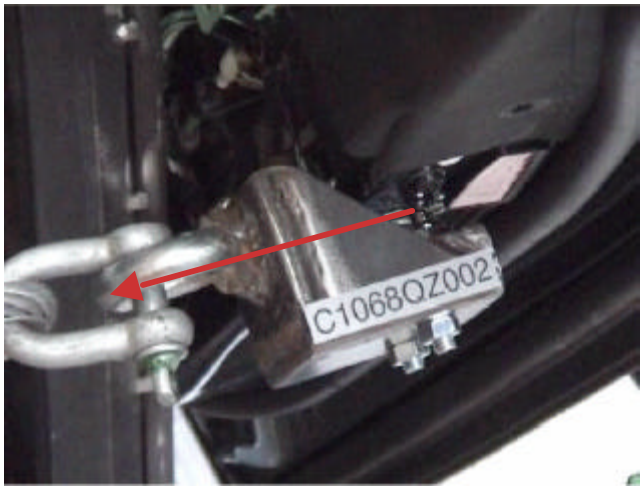
-What is the effect of the location of the rigid plate relative to the latch?

-What is the effect of the radius of the rigid plate with regard to deformation/Force direction?

(Note: this door passed the test requirements)

Transversal Test

Variation of Force Direction



2 Pictures (before and end of test) taken from exactly the same camera position

Due to deformation (bending) of the sheetmetal structure around the edge of the rigid plate the effective force direction varies during the test and/or moments are applied to the latch/striker/door structure assembly that do not occur in real world crashes.

-The moments created during the test will vary with the distance between the latch and the rigid plate. Was that intented? Won´t that cause differences between test labs using different equpment and therefore varying the distance between latch and rigid support plate?

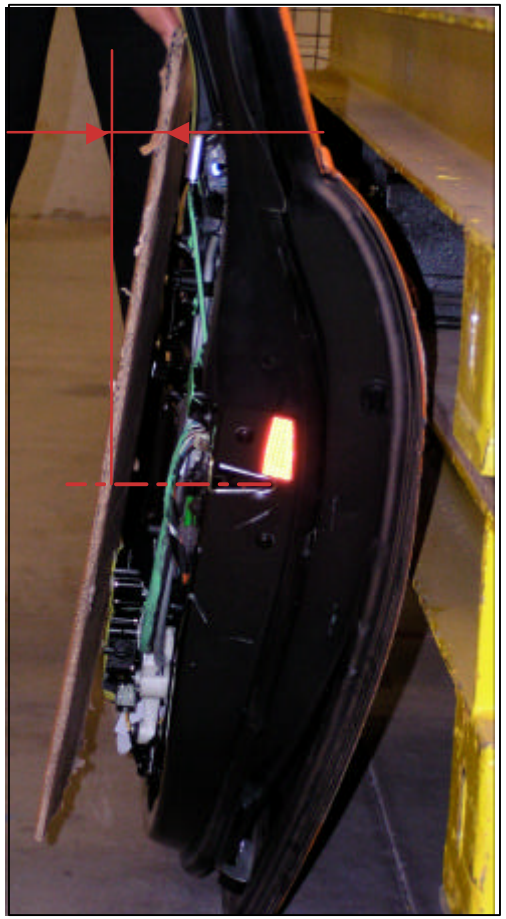
-The deformation and thereby the variance of the forces/moments during the test will vary over the shape/contour of the door due to resistance against bending (contoured design of rear doors, projections).

-The edge of the rigid plate needs a well defined large radius to avoid damages of the door structure

-We are still afraid that the proposed test setups will be design restrictive

Transversal Test

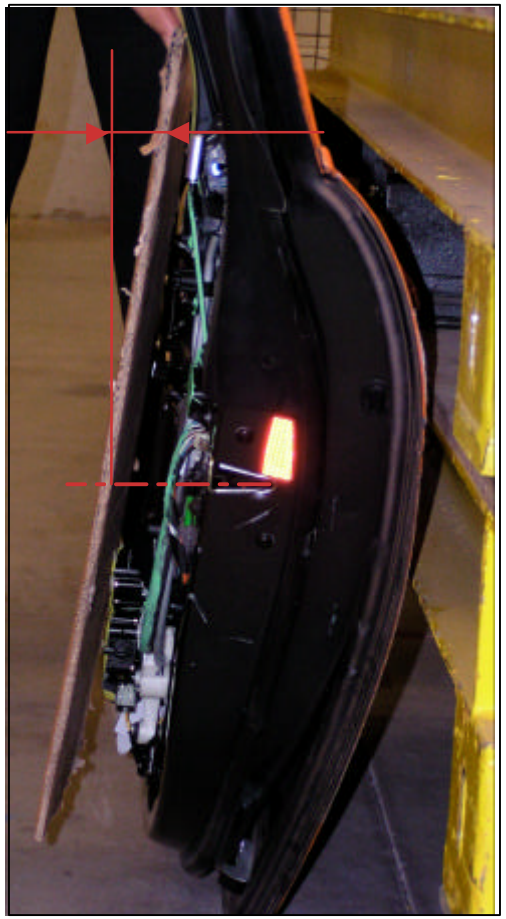
Direction of Force Application



Due to projecting parts and contour of the door firstly only two small areas of the door will get in contact with the rigid plate, one consisting of the window frame and the other of the projecting parts.

Was that intented?
Should the projecting parts be removed for testing?

Transversal Test
Door Orientation



In our opinion the door orientation has to match the configuration in the vehicle (to apply the loads in the same direction as it happens in the vehicle, also with regard to the hinges). But that might cause difficulties with the vertical rigid plate.

However attaching the door vertically in the frame to align it with a vertical rigid plate influences the direction of the force application. What test setup is correct and representative? (These points are relevant for both, the longidudinal and the lateral test)

How should latches be tested in cases where the door orientation is not vertical or if they are installed on the lower side of the door (e.g. gullwing doors)?

We are afraid that the proposed tests are indeed design restrictive and force the vehicle manufacturers to design doors for testing.