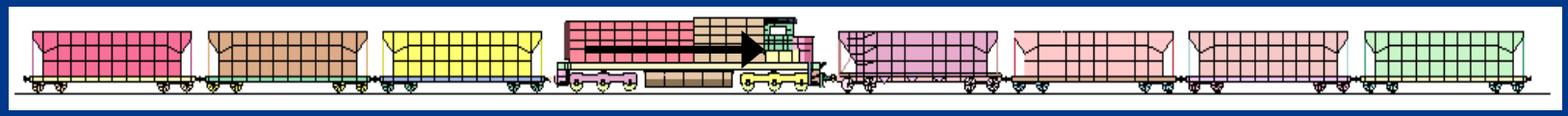
Locomotive Collision Test #10

Feasibility Study of Crew Protection in Locomotive Crash Scenarios Using Airbags – Airbag Design 2

Test #10: Test Setup



3 loaded Hopper cars

Test Locomotive
(SD-45 converted
to SD-70)

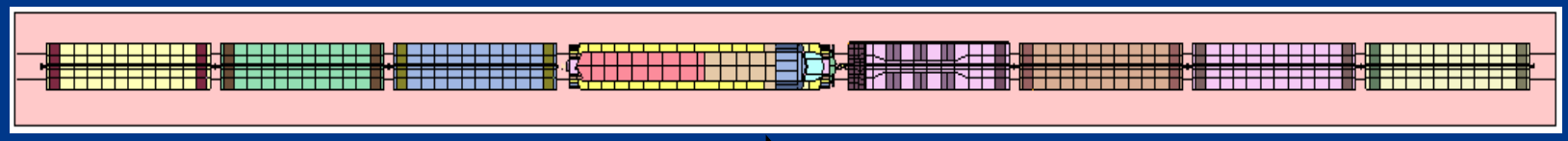
4 Loaded Hopper Cars
(Stationary)

Bullet Mass = 1,159,375 lbs

Target Mass = 943,704 lbs

Bullet Consist

Target Consist
Minimum brakes applied
to last hopper car

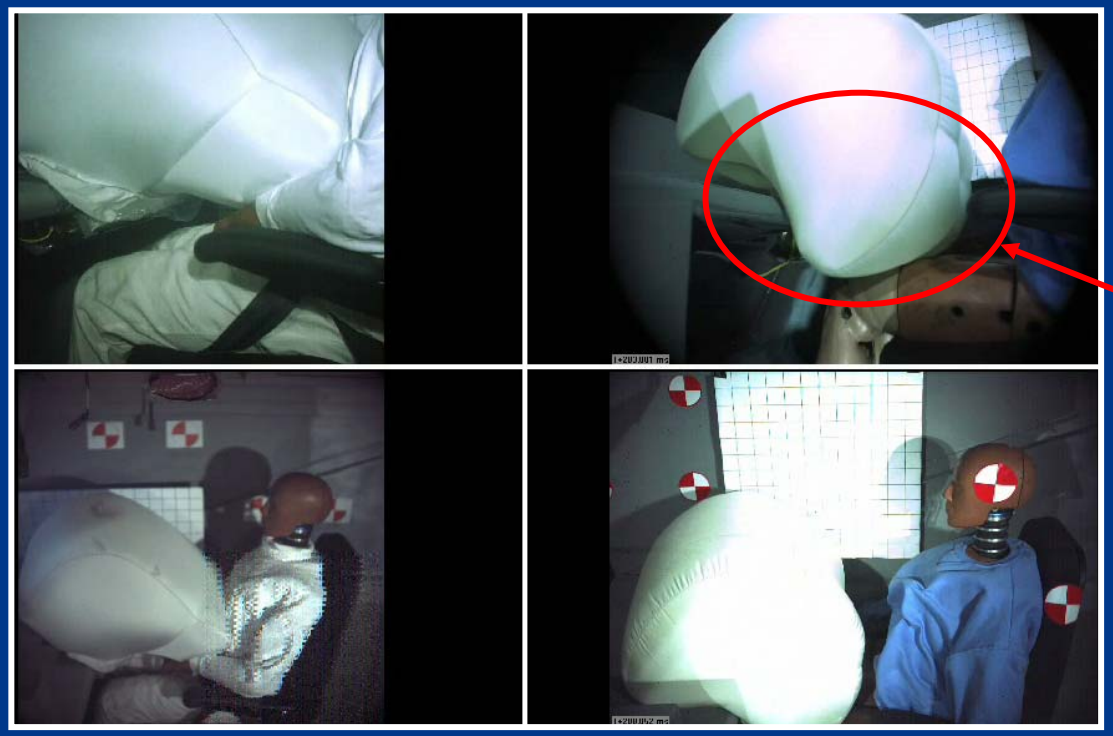


30 mph

Stationary

Test #10: Test Setup – Airbag

- Airbag Design 2
  - Airbag designed and optimized for Unbelted Occupant
  - Airbag optimized for desk type console
    - Added chin to protect abdomen
  - Size, shape, fabric permeability and vent holes optimized for a longer inflation duration



Airbag Design 1 Airbag Design 2

Test #10: Pre-Test Photos

Desktop console without airbag, conductor's side

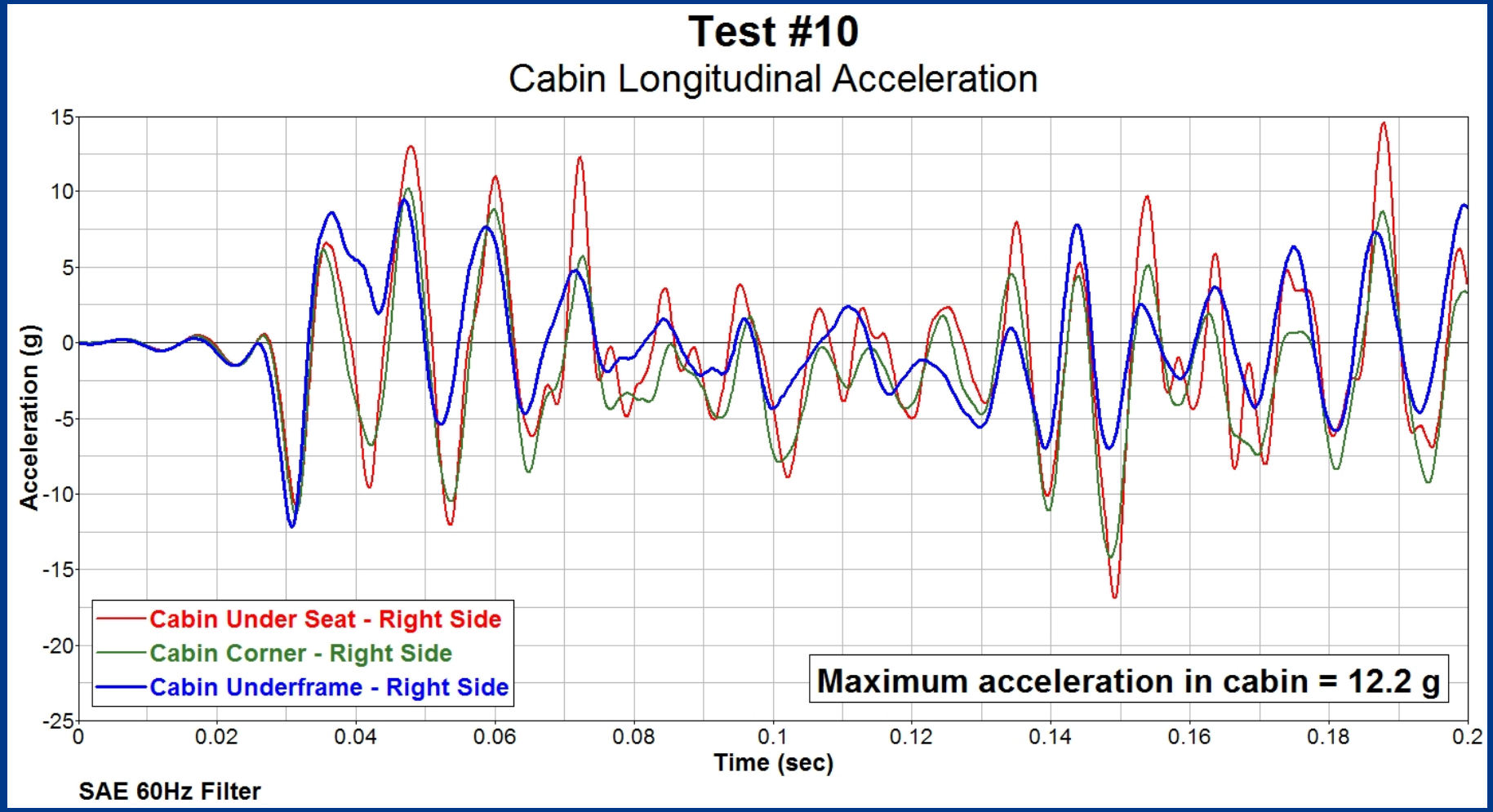
Desktop console with airbag, engineer's side

Test #8: Post Test Photos

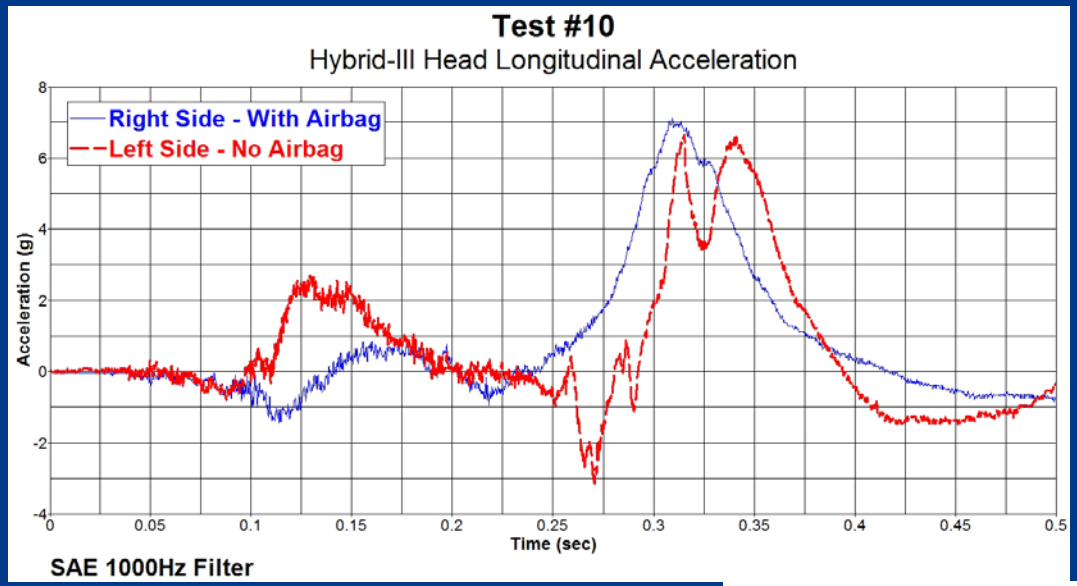
NOTE

On-board camera with view of console with airbag failed during test and therefore there is no high-speed video of the airbag deployment

Test #10: Locomotive Acceleration Data

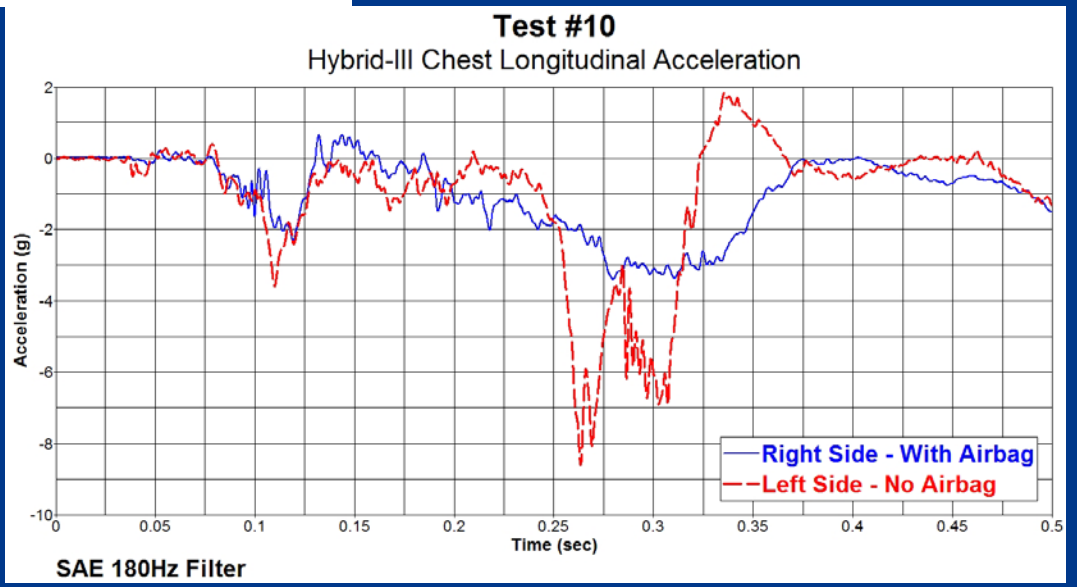


Test #10: ATD Data



Head Acceleration Comparison

Chest Acceleration Comparison



Test #10: Outcome

- What did we learn from this test?
  - New airbag design (added bottom chin) prevents occupant chest and abdomen from contacting the edge of the console
  - Unbelted occupant contacts the edge of desktop in the abdomen region
  - Presence of Airbag had no effect on the head accelerations in this test (due to low deceleration pulse)
  - Presence of airbag decreased the chest deceleration by 65% (from 8.5 g to 3 g)
  - At higher decelerations the ATD would violently contact the console causing sever injuries. At these levels of decelerations, the airbag will greatly help in reducing the injuries
  - *High-speed camera view of occupant and desktop console with airbag failed during the test*