



Lesson 4: How does crush zone length affect vehicle safety?

When engineers design vehicles, they focus on protecting the driver and other people inside the vehicle. The safety cage and surrounding structures are built to limit the injuries to the people. Can you determine the crush zone frame length that best protects a vehicle's occupants? Slam into this challenge head-on and start this simulation.

Here are some definitions to help you in your investigation.

Crush zone -	the front end of a vehicle designed to increase driver safety
Safety cage -	the part of a vehicle that surrounds and protects people
Frame length -	the distance from the front end of the vehicle to the safety cage
Stiffness -	a measure of the firmness or ability to bend or change
Variable -	something that can change
Deformation -	a change in the shape of something
Footwell -	the inside of a car down by the driver's feet
Intrusion -	how much the car frame moved into the driver
Acceleration -	how quickly or slowly the driver changed speed inside the car
Risk -	how likely an injury would happen. 100% means that the injury would occur. 0% means no injury would happen.
Fractures -	broken bones

Doing the Science

1. Start the Car Crash Simulation.
2. Select the blue SUV on the left side of the screen.
3. Select the "Soft" crush zone stiffness.

4. Select the "Short" crush zone length.
5. Select the "Crash Center" button at the bottom of the screen.
6. Select the "40 MPH" speed, and then select the "Crash It" button.
7. Select the "Analysis Center" button at the bottom of the screen.
8. Select the "Measure" button. Select the green round target, then select the next green round target to measure the frame intrusion. Record this information in Table 1.
9. Repeat, measuring the intrusion for the other two targets (yellow and red). Record this information in Table 1.
10. Select the "Medical Report" button. Record this information in Table 2.
11. Select the "Design Center" button at the bottom of the screen.
12. Repeat steps 3-11, except choose the "Medium" crush zone length.
13. Repeat steps 3-11, except choose the "Long" crush zone length.

Table 1. Crush Zone Intrusion

Crush Zone Length	Front End Deformation (green target in meters)	Footwell Intrusion (yellow target in meters)	Dashboard Intrusion (red target in meters)
Short			
Medium			
Long			

Table 2. Possible Injuries

Crush Zone Length	Frame Intrusion	Body Acceleration	Overall
Short			

Medium			
Long			

Do You Understand?

1. How did the length of the crush zone affect the intrusion for various parts of the frame during the crash?
2. How did the length of the crush zone affect the injuries experienced by crash occupants?
3. Based on your overall results, which crush zone length tested provided the vehicle's occupants with the greatest protection during a crash? Provide an explanation for this additional safety.
4. A control variable is something that can change, but that is held constant or the same during an experiment. What is the control variable(s) for this investigation?
5. What was the variable(s) that you changed for this experiment?