

**Lesson 3: How does the front end of a vehicle affect safety?**

Many crashes happen in the front end of vehicles. Vehicle makers call this part of the vehicle the crumple or crush zone. What do you think is best at protecting driver safety: a stiff front end or a softer frame that easily collapses? Stiffen up your investigative skills and start this simulation.

Here are some definitions to help you in your investigation.

Stiffness -	a measure of the firmness or ability to bend or change
Crush zone -	the front end of a vehicle designed to increase driver safety
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 red car on the right 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 crush zone deformation. 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" frame stiffness.
13. Repeat steps 3-11, except choose the "Stiff" frame stiffness.

Table 1. Crush Zone Intrusion

Crush Zone Stiffness	Front End Deformation (green target in meters)	Footwell Intrusion (yellow target in meters)	Dashboard Intrusion (red target in meters)
Soft			
Medium			
Stiff			

Table 2. Possible Injuries

Crush Zone Stiffness	Frame Intrusion	Body Acceleration	Overall
Soft			

Medium			
Stiff			

Do You Understand?

1. How did the stiffness of the crush zone affect the intrusion for various parts of the frame during the crash?
2. How did the stiffness of the crush zone affect the injuries experienced by the driver during the crash?
3. Based on your overall results, which crush zone stiffness tested provided the driver 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?