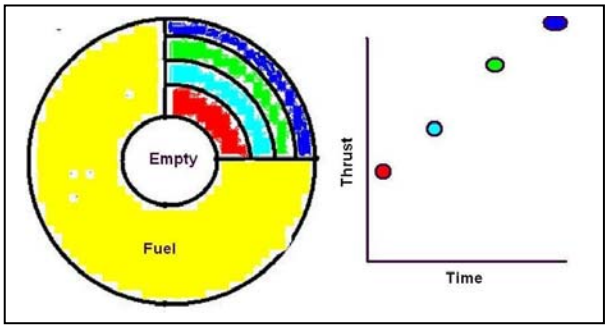
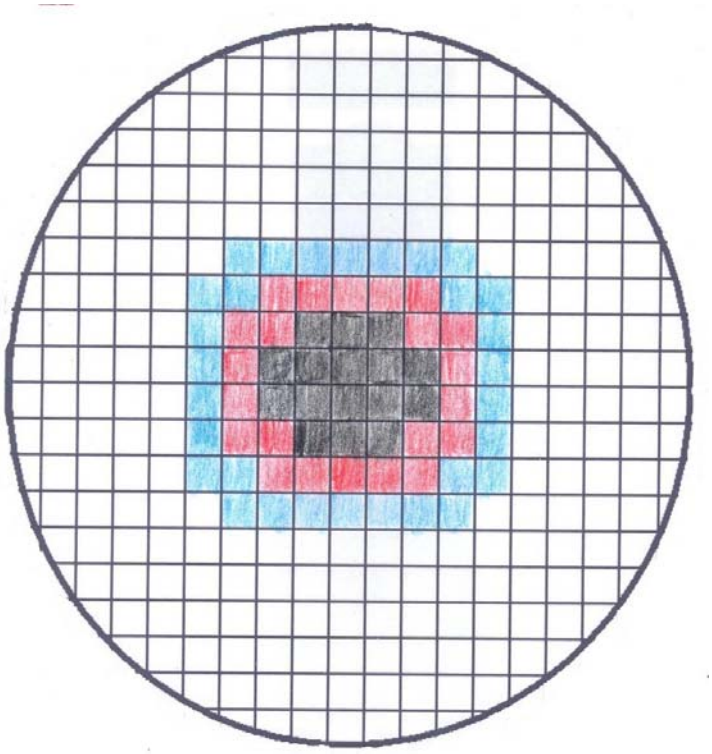
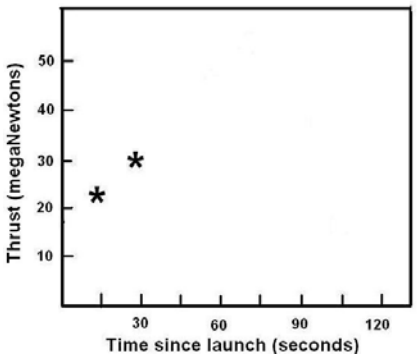
Solid Rocket Boosters - II



The example above shows the thrust curve for fuel burned in shells concentric with a cylindrical empty cavity along the axis of the booster from the inner (red) zone to the outer (blue) zone.

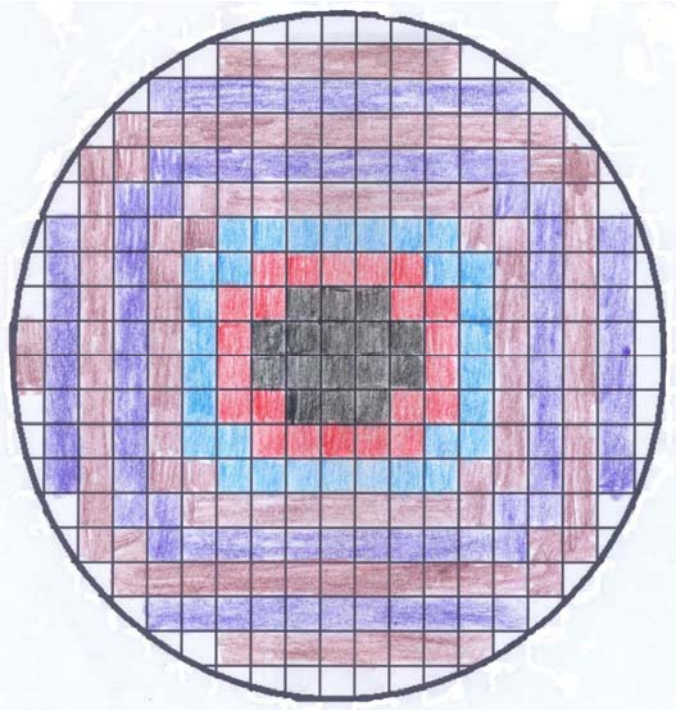
As the fuel in a solid rocket booster burns, it produces gas that exits the nozzle at very high pressure. This produces the thrust needed to launch a rocket. The area under combustion is a hollow core along the long axis of the booster from top to bottom. Depending on the shape of this empty tube, different volumes of gas will be produced from second to second, leading to different patterns of thrust for the rocket during its flight. The curve that describes a rocket engine's 'thrust versus time' is called the **thrust curve**. The more volume of fuel that is burned, the more thrust is produced.

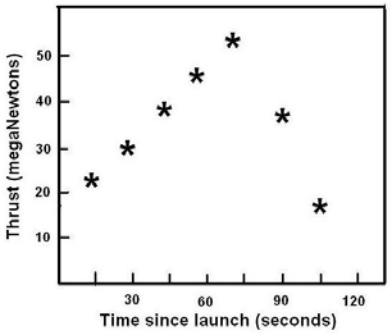




Problem 1 - The grid shows the cross section of a proposed SRB that is a cylinder 80-meters tall. The black squares represent the empty core region. As the fuel burns its way from the core to the outside circle, complete the shading of the rings of combustion at each 15-second time step. Count the number of shaded squares in each ring. The first two rings in red and blue are shown as an example. The graph represents the thrust curve and gives the number of squares shaded (red=22 and blue = 30) at each time step.

Problem 2 - How many seconds after launch does the SRB produce its maximum thrust?





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Answer: see above shaded rings. Note, the rings are only 1-box wide. Students shading may vary. Students may also estimate the areas of the partial boxes near the outer ring as an additional exercise in completing the graph.

Problem 2 - How many seconds after launch does the SRB produce its maximum thrust?

Answer: The thrust curve shows that the booster reaches a maximum thrust of about 54 megaNewtons about 75 seconds after launch.

Note to Teacher: Although the Ares-V rocket boosters are based on a 'star' shaped empty core pattern, it will reach its maximum thrust about 80 seconds after launch. Students may also experiment with other shapes for the empty core region (square, hexagon, triangle) and see what other thrust curves they can produce by the square-counting exercise.