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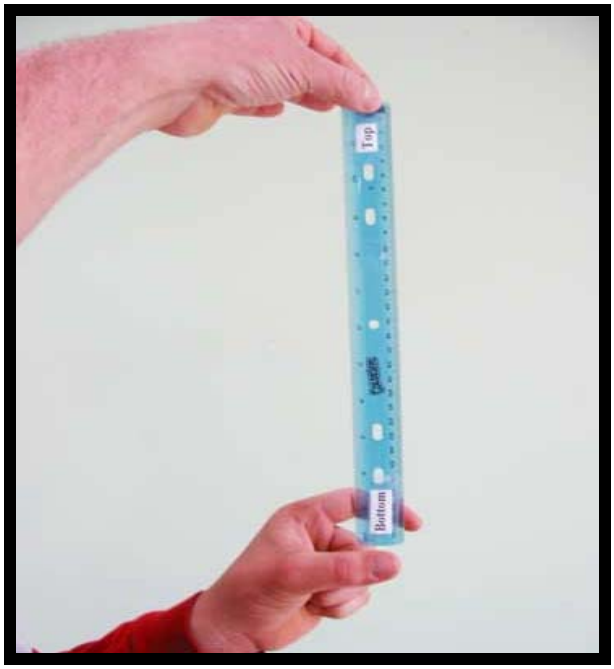
Measuring HRT
Human Reaction Time



Pneumatic systems are fast. Are humans fast enough to avoid injury by ducking out of the path of a fast moving actuator, or pneumatically powered lever system?

To answer this question we need to measure how fast people react to a stimulus. By testing the reaction time of several subjects, it is possible to obtain an average approximation of peoples reaction time.

Here is a simple device that will allow you to compare human reaction times and to obtain an average value that we can use to determine human reaction time or HRT.

Comparing and Measuring Human Reaction Time

This is a great experiment used to calculate and compare human reaction time. Using a 12" plastic ruler, and a little math and physics, it is possible to make a reasonably accurate measurement of the average HRT, (Human Reaction time).

Constructing the Measuring Device

Simple! Use a thin plastic ruler 12 to 18 inches long. Label the 12" end **TOP** and the other end **BOTTOM**. If you do not have a suitable ruler, use a stiff cardboard strip and mark it off in inches.

Using the Device

1.) To use the device, hold the end marked **TOP** so that the **BOTTOM** hangs straight down.
2.) Ask a student to hold one hand out in front of him/her, with the palm vertical and the index finger pointing straight out. Note the picture.
3.) Keep the thumb and index finger separated by at least an inch. Hold the device so that the **BOTTOM** end is between the students' thumb and index finger.

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4.) Instruct the student(s) to catch the ruler by gripping it between their thumb and index finger as soon as they see it start to fall.
5.) If the students anticipate the drop and grip the ruler before it is released, this will corrupt the data. This happens most often when students watch for finger movement of the person dropping the ruler. To avoid this, and to better ensure consistent results, release the ruler by slowly relaxing finger pressure. It is possible to do this without noticeably moving the fingers that grip the ruler.
6.) Wait a few seconds, then release the ruler.
7.) Write down the position, in inches, where the students grasp the ruler.

Collect the Data

Run 5 trials on each subject, and record the average distance the ruler falls before it is caught.

Example:

Student	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	Trial 5
Bill K.	7"	8 1/2"	9 1/2"	7 1/2"	10"
Jean V.	8"	6 1/2"	10"	11"	11"
Rachel B.	9"	7"	5 1/2"	10"	8"

Find the Average Distance the Ruler Dropped

To find the average distance value for each student, add the values for all the trials, and divide by the number of trials.

Example: Average distance value for Bill K.

7" + 8 1/2" + 9 1/2" + 7 1/2" 10" = 42.5

The divide 42.5 by the number of trials.

$$42.5 \div 5 = 8.5"$$

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Convert the Average Distance of a Dropped Ruler to a Reaction Time

Use this equation to calculate a student's average reaction time based on the data obtained from the ruler experiment.

$$t = \sqrt{\frac{2d}{A}}$$

Where:
t = Time in seconds
d =Drop Distance in feet. (Example: 7 inches is written as 7/12' or resolved as a decimal 0.58')
A= Acceleration of gravity in ft/sec/sec. The accepted value for A is 32 ft/sec/sec

Note: We are using Imperial Units (Feet and seconds) You could just as easily substitute metric units (meters and seconds). If you use metric units A = 9.8 m/sec/sec.

Using This Equation
The example experiment (above) the student, Bill K., yielded an average ruler drop distance of 8.5" Let's use this value and the formula below to calculate his reaction time.

$$t = \sqrt{\frac{2d}{A}}$$

substitute the known values: d = 8.5" or 0.708 ft and A = 32 ft/sec/sec

$$t = \sqrt{\frac{2 * 0.708'}{32'\text{sec}/\text{sec}}}$$

$$t = \sqrt{0.044}$$

$$t = 0.210\,\text{sec}$$

Bill K exhibits a reaction time of 0.210 sec. This suggests that it takes Bill K. approximately 0.210 seconds to see a stimulus, and to react to it. It is important to note that students in this experiment are anticipating the stimulus. HRT is greatly increased when the stimulus is unexpected.