# Coefficient of Linear Expansion

**Table 1:**

<table>
<thead>
<tr>
<th>Metal</th>
<th>Original length, (L_0)</th>
<th>Initial thermistor resistance, (R_{rm})</th>
<th>Change in length, (\Delta L)</th>
<th>Hot thermistor resistance, (R_{hot})</th>
<th>Initial tube temp., (T_{rm})</th>
<th>Hot tube temp., (T_{hot})</th>
<th>Change in temp., (\Delta T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td></td>
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</tr>
<tr>
<td>Steel</td>
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<td></td>
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<tr>
<td>Aluminum</td>
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</tbody>
</table>

*** Estimate the temperature to the nearest half degree: Initial and hot temperatures, \(\Delta T\) ***

**Table 2: Comparison of experimental and accepted values of coefficient of linear thermal expansion**

<table>
<thead>
<tr>
<th>Metal</th>
<th>Experimental coefficient of linear thermal expansion, (\alpha_{exp})</th>
<th>Accepted coefficient of linear thermal expansion, (\alpha_{acc}) (x10^{-6} \text{ C}^{-1})</th>
<th>Percent Error in coefficient of linear thermal expansion, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
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</table>

Calculations: Show the following calculations in the space provided below or on an attached sheet of paper. Include units for all your calculations (as appropriate). Ignore any uncertainty. Please be reasonable with your significant digits.

**Copper**

Coefficient of linear expansion

\[
PE = \frac{\alpha_{exp} - \alpha_{acc}}{\alpha_{acc}} \times 100 =
\]
Steel
  Coefficient of linear expansion

Percent error (steel lower end of range)

Percent error (steel upper end of range)

Aluminum
  Coefficient of linear expansion

Percent error

Questions: (Answer on an attached sheet of paper. Adapted from questions in lab manual.)
1. Why must the change in length, $\Delta L$, be measured so carefully, while the length of the rod, $L$, can be measured rather crudely with a meter stick? Be specific about $\Delta L$ and $L$.
2. A flat piece of metal has a hole in it. When heated, metal expands in all directions. When the temperature increases, will the size of the hole increase, decrease, or stay the same? Explain why. Be specific. Feel free to consult your lecture textbook to help answer this question.

Extra credit questions:
EC1. Consider a compound bar consisting of aluminum and iron ($\alpha = 12 \times 10^{-6}$ $1/\text{C}^\circ$) strips fastened together so they will not separate upon heating (see figure for Q2 of the lab manual). What happens when it is heated? Be specific. Draw a sketch of what happens.
EC2. When an ordinary mercury thermometer is placed in hot water, its reading drops at first, but then quickly rises. Explain why. Be specific in your reasoning for the reading first dropping and why it later quickly rises.

Don’t forget to write your summary! (Don’t forget to start your summary with an introductory sentence very briefly describing the lab. Be sure to compare your experimentally determined values for the coefficient of linear expansion to the accepted values for the three metals. What were your values, and what was the percentage error? Do your values agree with the accepted values within reason? (Make sure you mention what percent error you consider to be reasonable.) Also be sure to consider whether your $\alpha$ values are consistently higher than accepted, lower than accepted, or are inconsistent. Why do you think you did not get the accepted values exactly? If your $\alpha$ values are consistently high or consistently low, why do you think that is?)

Lab:  Coefficient of Linear Expansion  Updated 02/23/16