

# Application Note #10

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## Subject: Efficiency of PCR Reactions

### Rationale

In order to obtain accurate and reproducible results, reactions should have an efficiency as close to 100% as possible. At this efficiency the template doubles after each cycle during exponential amplification. Several design factors can influence efficiency such as the length of the amplicon, the G/C content of the amplicon and secondary structure. The dynamics of the reaction itself can also influence efficiency. Variations in the dynamics can result from such sources as the enzymes used in the reaction and non-optimal reagent concentrations.

### Calculation

The slope of the standard curve can be used to determine the exponential amplification and efficiency of the PCR reaction by the following equations:

$$\text{Exponential Amplification} = 10^{(-1/\text{slope})}$$
$$\text{Efficiency} = [10^{(-1/\text{slope})}] - 1$$

The following table shows the amplification and efficiency for various values of the slope:

Slope	Amplification	Efficiency
-3.60	1.8957	0.8957
-3.55	1.9129	0.9129
-3.50	1.9307	0.9307
-3.45	1.9492	0.9492
-3.40	1.9684	0.9684
-3.35	1.9884	0.9884
<b>-3.30</b>	<b>2.0092</b>	<b>1.0092</b>
-3.25	2.0309	1.0309
-3.20	2.0535	1.0535
-3.15	2.0771	1.0771
-3.10	2.1017	1.1017

As the table illustrates, optimal PCR efficiency is indicated by a slope of -3.3.