

# Q5<sup>®</sup> Hot Start High-Fidelity 2X Master Mix



## M0494S



100 reactions (50 µl vol) Lot: 0061305  
RECOMBINANT Store at -20°C Exp: 5/15

**Description:** The Q5 Hot Start High-Fidelity 2X Master Mix features a high-fidelity, thermostable, hot start DNA polymerase with 3' → 5' exonuclease activity, fused to a processivity-enhancing Sso7d domain to support robust DNA amplification. The addition of an aptamer-based inhibitor allows room temperature reaction setup. With an error rate > 100-fold lower than that of *Taq* DNA Polymerase and 12-fold lower than that of *Pyrococcus furiosus* (*Pfu*) DNA Polymerase, Q5 Hot Start High-Fidelity 2X Master Mix is ideal for cloning and can be used for long or difficult amplicons. The convenient master mix formulation is supplied at a 2X concentration. The mix contains dNTPs, Mg<sup>++</sup> and a proprietary broad-use buffer requiring only the addition of primers and DNA template for robust amplification regardless of GC content. When used at the recommended 1X final concentration, the Q5 Hot Start High-Fidelity Master Mix contains 2 mM MgCl<sub>2</sub>. Q5 Hot Start High-Fidelity DNA Polymerase is unlike typical, lower fidelity PCR enzymes. To determine the optimal annealing temperatures for a given set of primers, use of the **NEB T<sub>m</sub> Calculator** is highly recommended ([www.neb.com/Tmcalculator](http://www.neb.com/Tmcalculator)).

**Please Note:** A precipitate (most noticeable after the first 1–2 freeze/thaw cycles) is not uncommon. To ensure optimal performance, the master mix should be thawed and resuspended prior to use. Stability testing using up to 20 freeze/thaw cycles has shown no negative effect on master mix performance.

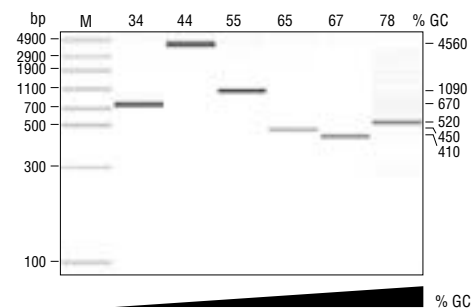
**Source:** An *E. coli* strain that carries the Q5 High-Fidelity DNA Polymerase gene.

### Applications:

- High-specificity PCR
- High-fidelity PCR
- Cloning
- Long or difficult amplification
- High-throughput PCR

**Reaction Conditions:** 1X Q5 Hot Start High-Fidelity Master Mix, DNA template and 0.5 µM primers in a total reaction volume of 50 µl.

### Heat Inactivation: No



Amplification of a variety of human genomic amplicons from low to high GC content using Q5 Hot Start High-Fidelity 2X Master Mix. All reactions were set up at room temperature, conducted using 30 cycles of amplification and visualized by microfluidic LabChip<sup>®</sup> analysis.

### Quality Control Assays

**7 kb Genomic DNA PCR:** 30 cycles of PCR amplification in a 50 µl reaction containing 20 ng genomic DNA with 1X Q5 Hot Start High-Fidelity Master Mix and 0.5 µM of each primer result in the expected 7 kb product.

**20 kb Lambda DNA PCR:** 22 cycles of PCR amplification in a 50 µl reaction containing 10 ng Lambda DNA with 1X Q5 Hot Start High-Fidelity Master Mix and 1.0 µM of each primer result in the expected 20 kb product.

**Hot Start-Specific Genomic DNA PCR:** 25 cycles of PCR amplification in a 25 µl reaction containing 50 ng genomic DNA with 1X Q5 Hot Start High-Fidelity Master Mix in the presence of 0.5 µM of each primer result in the expected 665 bp product, free of non-specific amplification products after pre-incubation at room temperature for 1 hour.

**Note:** Product specifications for individual components in the Q5 Hot Start High-Fidelity 2X Master Mix are available separately.

### PCR

**Please note that protocols with Q5 Hot Start High-Fidelity 2X Master Mix may differ from protocols with other polymerases. Conditions recommended below should be used for optimal performance.**

### Reaction Setup:

*Q5 Hot Start High-Fidelity 2X Master Mix is inhibited at room temperature, allowing flexible reaction setup (RT or ice).*

All components should be mixed prior to use.

COMPONENT	25 µl REACTION	50 µl REACTION	FINAL CONCENTRATION
Q5 Hot Start High-Fidelity 2X Master Mix	12.5 µl	25 µl	1X
10 µM Forward Primer	1.25 µl	2.5 µl	0.5 µM
10 µM Reverse Primer	1.25 µl	2.5 µl	0.5 µM
Template DNA	variable	variable	<1,000 ng
Nuclease-Free Water	to 25 µl	to 50 µl	

Notes: Gently mix the reaction. Collect all liquid to the bottom of the tube by a quick spin if necessary. Overlay the sample with mineral oil if using a PCR machine without a heated lid.

Transfer PCR tubes to a PCR machine and begin thermocycling.

*Q5 Hot Start High-Fidelity 2X Master Mix does not require a separate activation step. Standard Q5 cycling conditions are recommended.*

### Thermocycling Conditions for a Routine PCR:

STEP	TEMP	TIME
Initial Denaturation	98°C	30 seconds
25–35 Cycles	98°C	5–10 seconds
	*50–72°C	10–30 seconds
	72°C	20–30 seconds/kb
Final Extension	72°C	2 minutes
Hold	4–10°C	

\*Use of the NEB T<sub>m</sub> Calculator is highly recommended.

### General Guidelines:

1. **Template:**  
Use of high quality, purified DNA templates greatly enhances the success of PCR. Recommended amounts of DNA template for a 50 µl reaction are as follows:

DNA	AMOUNT
Genomic	1 ng–1 µg
Plasmid or Viral	1 pg–1 ng

2. **Primers:**  
Oligonucleotide primers are generally 20–40 nucleotides in length and ideally have a GC content of 40–60%. Computer programs such as Primer3 (<http://frodo.wi.mit.edu/primer3>) can be used to design or analyze primers. The best results are typically seen when using each primer at a final concentration of 0.5 µM in the reaction.
3. **Mg<sup>++</sup> and additives:**  
The Q5 Hot Start High-Fidelity Master Mix contains 2.0 mM Mg<sup>++</sup> when used at a 1X concentration. This is optimal for most PCR products generated with this master mix.
4. **Deoxynucleotides:**  
The final concentration of dNTPs is 200 µM of each deoxynucleotide in the 1X Q5 Hot Start High-Fidelity Master Mix. Q5 Hot Start High-Fidelity DNA Polymerase cannot incorporate dUTP and is not recommended for use with uracil-containing primers or templates.
5. **Q5 Hot Start High-Fidelity DNA Polymerase concentration:**  
The concentration of Q5 Hot Start High-Fidelity DNA Polymerase in the Q5 Hot Start High-Fidelity 2X Master Mix has been optimized for best results under a wide range of conditions.
6. **Denaturation:**  
*Q5 Hot Start High-Fidelity DNA Polymerase does not require a separate activation step.*  
An initial denaturation of 30 seconds at 98°C is sufficient for most amplicons from pure DNA templates. Longer denaturation times can be used (up to 3 minutes) for templates that require it.  
During thermocycling, the denaturation step should be kept to a minimum. Typically, a 5–10 second denaturation at 98°C is recommended for most templates.
7. **Annealing:**  
Optimal annealing temperatures for Q5 Hot Start High-Fidelity 2X Master Mix tend to be higher than for other PCR polymerases. The **NEB T<sub>m</sub> Calculator** should be used to determine the annealing temperature when using this enzyme. Typically use a 10–30 second annealing step at 3°C above the T<sub>m</sub> of the lower T<sub>m</sub> primer. A temperature gradient can also be used to optimize the annealing temperature for each primer pair.

(see other side)

For high  $T_m$  primer pairs, two-step cycling without a separate annealing step can be used (see note 10).

8. Extension:  
The recommended extension temperature is 72°C. Extension times are generally 20–30 seconds per kb for complex, genomic samples, but can be reduced to 10 seconds per kb for simple templates (plasmid, *E. coli*, etc.) or complex templates < 1 kb. Extension time can be increased to 40 seconds per kb for cDNA or long, complex templates, if necessary.  
A final extension of 2 minutes at 72°C is recommended.

9. Cycle number:  
Generally, 25–35 cycles yield sufficient product. For genomic amplicons, 30–35 cycles are recommended.

10. 2-step PCR:  
When primers with annealing temperatures  $\geq 72^\circ\text{C}$  are used, a 2-step thermocycling protocol (combining annealing and extension into one step) is possible.

11. Amplification of long products:  
When amplifying products > 6 kb, it is often helpful to increase the extension time to 40–50 seconds/kb.

12. PCR product:  
The PCR products generated using Q5 Hot Start High-Fidelity 2X Master Mix have blunt ends. If cloning is the next step, then blunt-end cloning is recommended. If T/A-cloning is preferred, the DNA should be purified prior to A-addition, as Q5 Hot Start High-Fidelity DNA Polymerase will degrade any overhangs generated.

Addition of an untemplated -dA can be done with *Taq* DNA Polymerase (NEB #M0267) or Klenow *exo*<sup>-</sup> (NEB #M0212).

#### Companion Products Sold Separately:

##### Q5 Hot Start High-Fidelity DNA Polymerase

#M0493S 100 units  
#M0493L 500 units

##### Q5 High-Fidelity DNA Polymerase

#M0491S 100 units  
#M0491L 500 units

##### Q5 High-Fidelity 2X Master Mix

#M0492S 100 reactions  
#M0492L 500 reactions

##### Q5 Reaction Buffer Pack

#B9027S 6.0 ml

##### Deoxynucleotide Solution Set

#N0446S 25  $\mu\text{mol}$  of each

##### Deoxynucleotide Solution Mix

#N0447S 8  $\mu\text{mol}$  of each  
#N0447L 40  $\mu\text{mol}$  of each

##### Magnesium Chloride ( $\text{MgCl}_2$ ) Solution

#B9021S 6.0 ml



This product is covered by one or more patents.

Notice to Purchaser: Nucleic acid-based aptamers for use with thermophilic DNA polymerases are licensed exclusively by New England Biolabs, Inc. from SomaLogic, Inc. (See Patent Nos. 5,475,096; 5,670,637; 5,696,249; 5,874,557; and 5,693,502). New England Biolabs, Inc. gives the Buyer/User a non-exclusive license to use the aptamer-based Q5 Hot Start High-Fidelity 2X Master Mix for RESEARCH PURPOSES ONLY. Commercial use of the aptamer-based Q5 Hot Start High-Fidelity 2X Master Mix requires a license from New England Biolabs, Inc. Please contact busdev@neb.com for more information.

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