LongAmp® *Taq* 2X Master Mix

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M0287S 019130915031

M0287S

100 reactions (50 µl vol) **Lot: 0191309**

RECOMBINANT **Exp: 3/15** **Store at –20°C**

Description: The LongAmp *Taq* 2X Master Mix combines high quality NEB recombinant *Taq* DNA Polymerase with a trace amount of Deep Vent$_R$™ DNA Polymerase. The 3´→5´ exonuclease activity of Deep Vent DNA Polymerase increases the fidelity and robust amplification of *Taq* DNA Polymerase (1). This ready-to-use mix offers two fold higher fidelity than *Taq* DNA Polymerase alone. A wide range of PCR products can be generated, up to 30 kb from lambda DNA or from genomic DNA (Figure 1).

Source: An *E. coli* strain that carries the *Taq* DNA Polymerase gene from *Thermus aquaticus* YT-1 and an *E. coli* strain that carries the Deep Vent$_R$ DNA Polymerase gene from *Pyrococcus* species GB-D.

Applications:

- Long Range PCR

Reaction Conditions: 1X LongAmp *Taq* Master Mix, DNA template and primers in a total reaction volume of 25–50 µl.

1X LongAmp *Taq* Master Mix:
60 mM Tris-SO_4 (pH 9.0 @ 25°C)
20 mM $(NH_4)_2SO_4$
2 mM $MgSO_4$
125 units/ml LongAmp *Taq* DNA Polymerase
0.3 mM dNTPs
3% glycerol
0.06% IGEPAL® CA-630
0.05% Tween® 20

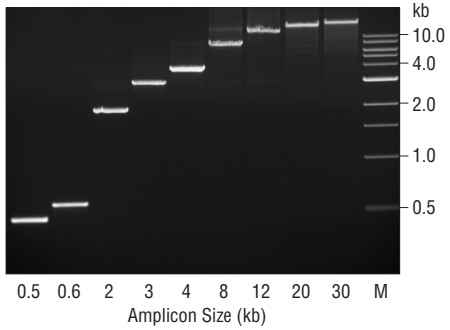
Unit Definition: One unit is defined as the amount of enzyme that will incorporate 10 nmol of dNTP into acid insoluble material in 30 minutes at 75°C.

Unit Assay Conditions: 1X ThermoPol® Reaction Buffer, 200 µM dNTPs including [^{3}H]-dTTP and 200 µg/ml activated Calf Thymus DNA.

Heat Inactivation: No

Quality Controls

Long Amplicon PCR: LongAmp *Taq* DNA Polymerase is tested for the ability to amplify a 30 kb amplicon from lambda DNA and a 30 kb amplicon from human genomic DNA.



Amplification of specific sequences from human genomic DNA using LongAmp Taq DNA Polymerase. Amplicon sizes are indicated below the gel. Marker M is the NEB 1 kb DNA Ladder (NEB #N3232).

PCR

The Polymerase Chain Reaction (PCR) is a powerful and sensitive technique for DNA amplification (2). *Taq* DNA Polymerase is an enzyme widely used in PCR (3). The following guidelines are provided to ensure successful PCR using New England Biolabs' LongAmp *Taq* 2X Master Mix. These guidelines cover routine PCR reactions. Amplification of templates with high GC content, high secondary structure or low template concentrations may require further optimization.

Reaction setup:

We recommend assembling all reaction components on ice and quickly transferring the reactions to a thermocycler preheated to the denaturation temperature (94°C).

COMPONENT	25 µl REACTION	50 µl REACTION	FINAL CONCENTRATION
10 µM Forward Primer	1 µl	2 µl	0.4 µM (0.05–1 µM)
10 µM Reverse Primer	1 µl	2 µl	0.4 µM (0.05–1 µM)
LongAmp *Taq* 2X Master Mix	12.5 µl	25 µl	1X
Template DNA	variable	variable	<1,000 ng
Nuclease-Free Water	to 25 µl	to 50 µl	

Notes: Gently mix the reaction. Avoid pipetting samples containing target DNA when amplicons above 20 kb are desired. 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 from ice to a PCR machine with the block preheated to 94°C and begin thermocycling:

Thermocycling Conditions for a Routine PCR:

STEP	TEMP	TIME
Initial Denaturation	94°C	30 seconds
30 Cycles	94°C	10–30 seconds
	45–65°C	15–60 seconds
	65°C	50 seconds/kb
Final Extension	65°C	10 minutes
Hold	4–10°C	

General Guidelines:

1. Template:
   The quality of the DNA template is essential for long-range PCR amplification. Recommended amounts of DNA template for a 50 µl reaction are as follows:

DNA	UP TO 15 kb	ABOVE 15 kb
Genomic	1 ng–500 ng	10 ng–1 µg
Plasmid or Viral	1 pg–1 ng	10 pg–10 ng

   Successful amplification above 20 kb largely depends on the quality of DNA templates and the primer sequences.

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. For amplicons larger than 20 kb, it is desirable to have primers with GC content above 50%, matched T_m above 60°C and primers at least 24 nucleotides in length. The final concentration of each primer in a PCR reaction may be 0.05–1 µM, typically 0.1–0.5 µM.

3. Mg^{++} and additives:
   Mg^{++} concentration of 1.5–2.0 mM is optimal for most PCR products generated with LongAmp *Taq* DNA Polymerase. The final Mg^{++} concentration in 1X LongAmp *Taq* Master Mix is 2 mM. This supports satisfactory amplification of most amplicons. However, Mg^{++} can be further optimized in 0.5 or 1.0 mM increments using $MgSO_4$.

   Amplification of some difficult targets, like GC-rich sequences, may be improved with additives, such as DMSO (4) or formamide (5).

4. Denaturation:
   An initial denaturation of 30 seconds at 94°C is sufficient for most amplicons from pure DNA templates. For difficult templates such as GC-rich sequences, a longer denaturation of 2–4 minutes at 94°C is recommended prior to PCR cycling to fully denature the template. With colony PCR, an initial 5 minute denaturation at 94°C is recommended.

   During thermocycling a 10–30 second denaturation at 94°C is recommended.

5. Annealing:
   The annealing step is typically 15–60 seconds. Annealing temperature is based on the T_m of the primer pair and is typically 45–65°C. Annealing temperatures can be optimized by doing a temperature gradient PCR starting 5°C below the calculated T_m. We recommend using NEB's T_m Calculator, available at www.neb.com/TmCalculator to determine appropriate annealing temperatures for PCR.

   When primers with annealing temperatures above 60°C are used, a 2-step PCR protocol is possible (see #8).

6. Extension:
   The recommended extension temperature is 65°C. Extension times are generally 50 seconds per kb. A final extension of 10 minutes at 65°C is recommended.

7. Cycle number:
   Generally, 25–35 cycles yields sufficient product. Up to 45 cycles may be required to detect low-copy-number targets.

(see other side)

8. 2-step PCR:
When primers with annealing temperatures above 60°C are used, a 2-step thermocycling protocol is possible.

Thermocycling Conditions for a Routine 2-Step PCR:

STEP	TEMP	TIME
Initial Denaturation	94°C	30 seconds
30 Cycles	94°C	10–30 seconds
	60–65°C	50 seconds/kb
Final Extension	60–65°C	10 minutes
Hold	4–10°C	

9. PCR product:
The majority of the PCR products generated using LongAmp *Taq* DNA Polymerase contain dA overhangs at the 3´–end; therefore the PCR products can be ligated to dT/dU-overhang vectors.

Notes: LongAmp *Taq* 2X Master Mix is stable for fifteen freeze-thaw cycles when stored at –20°C

LongAmp *Taq* 2X Master Mix is also stable for three months at 4°C, so for frequent use, an aliquot may be kept at 4°C.

FAQs:

1. *What is the fidelity of the LongAmp Taq DNA Polymerase compared to Taq DNA Polymerase?*
The LongAmp *Taq* DNA Polymerase offers two fold higher fidelity than *Taq*.

2. *Can the extension step be carried out at 72°C when using LongAmp?*
Yes, LongAmp *Taq* DNA Polymerase can be used at 72°C. However, extension at 65–68°C is a better choice for most amplicons.

3. *What is the extension rate when using LongAmp?*
We recommend 50 seconds per kb for maximum yields. Extension rates such as 30 seconds per kb can be used for targets up to 4 kb using a 3-step PCR protocol. Shorter extension rates such as 15 seconds per kb can be used for targets up to 2 kb using a 3-step PCR protocol on a fast PCR machine.

4. *What type of DNA ends result from a primer extension reaction or a PCR reaction using LongAmp Taq DNA Polymerase?*
The majority of the PCR products generated using LongAmp *Taq* DNA Polymerase contain dA overhangs at the 3´–end; therefore the PCR products can be ligated to dT/dU-overhang vectors.

5. *Why is the product a smear when visualized on an agarose gel?*
When PCR conditions are not optimal, a smear or high level of background is often observed. Try one or more of the following suggestions:
   - use lower amount of enzymes
   - use 65°C for extension
   - raise annealing temperature
   - try 2-step cycling protocols

6. *Can LongAmp 2X Master Mix be used to amplify GC-rich amplicons?*
Yes. The addition of DMSO up to 10% helps amplify GC-rich amplicons.

References:

1. Barnes, W.M. (1994) *Proc. Natl. Acad. Sci. USA,* 91, 2216–2220.
2. Saiki R.K. et al. (1985) *Science,* 230, 1350–1354.
3. Powell, L.M. et al. (1987) *Cell,* 50, 831–840.
4. Sun, Y., Hegamyer, G. and Colburn, N. (1993) *Biotechniques,* 15, 372–374.
5. Sarkar, G., Kapelner, S. and Sommer, S.S. (1990) *Nucleic Acids Res.,* 18, 7465.

Companion Products Sold Separately:

LongAmp *Taq* (Mg-free) Reaction Buffer Pack
#B0322S 6.0 ml

LongAmp *Taq* Reaction Buffer Pack
#B0323S 6.0 ml

Crimson LongAmp *Taq* Reaction Buffer Pack
#B0326S 6.0 ml

Magnesium Sulfate ($MgSO_4$) Solution
#B1003S 6.0 ml

LongAmp *Taq* PCR Kit
#E5200S 100 Reactions

LongAmp *Taq* DNA Polymerase
#M0323S 500 units
#M0323L 2,500 units

Crimson LongAmp *Taq* DNA Polymerase
#M0326S 250 units
#M0326L 1,250 units

Deoxynucleotide Solution Set
#N0446S 25 µmol of each

Deoxynucleotide Solution Mix
#N0447S 8 µmol of each
#N0447L 40 µmol of each