PCR Reagents

POLYMERASES, NUCLEOTIDES, & DNA LADDERS

Update 2016

NEW ENGLAND BioLabs® GmbH

Polymerase Overview

New England Biolabs, Inc. offers a wide range of DNA polymerases and through our commitment to research, ensures the development of innovative, high quality tools for PCR. Our product quality, enzyme expertise and outstanding technical support bring unparalleled confidence to your PCR experiments.

When choosing a polymerase for PCR, we recommend starting with One*Taq*® or Q5® DNA Polymerases (shown below in gold). Both offer robust amplification and can be used on a wide range of templates (routine, AT- and GC-rich). Q5 provides the benefit of maximum fidelity, and is also available in a formulation specifically optimized for next generation sequencing.

PCR Polymerase Selection Chart

★ indicates recommended choice for application

	STANDARD PCR		HIGH-FIDELITY PCR			SPECIALTY PCR		
			HIGHEST FIDELITY		MODERATE FIDELITY	LONG AMPLICONS	BISULFITE SEQUENCING	BLOOD DIRECT PCR
	ONE*Taq*®/ ONE*Taq* HOT START	*Taq*/ HOT START *Taq*	Q5®/Q5 HOT START	PHUSION®(1)/ PHUSION(1) FLEX	VENT®/ DEEP VENT™	LONGAMP®/ LONGAMP HOT START *Taq*	EPIMARK® HOT START *Taq*	HEMO KLENTaq®
PROPERTIES								
Fidelity vs. *Taq*	2X	1X	> 100X	> 50X	5–6X	2X	1X	ND
Amplicon Size	< 6 kb	≤ 5 kb	≤ 20 kb	≤ 20 kb	≤ 6 kb	≤ 30 kb	≤ 1 kb	≤ 2 kb
Extension Time	1 kb/min	1 kb/min	6 kb/min	4 kb/min	1 kb/min	1,2 kb/min	1 kb/min	0,5 kb/min
Resulting Ends	3´ A/Blunt	3´ A	Blunt	Blunt	Blunt	3´ A/Blunt	3´ A	3´ A
3´→5´ exo	Yes	No	Yes	Yes	Yes	Yes	No	No
5´→3´ exo	Yes	Yes	No	No	No	Yes	Yes	No
Units/50 µl Reaction	1,25	1,25	1,0	1,0	0,5–1,0	5,0	1,25	N/A
Annealing Temperature	Tm-5	Tm-5	Tm-3	Tm-3	Tm-5	Tm-5	Tm-5	Tm-5
APPLICATIONS								
Routine PCR	★	●	●	●	●	●		
Colony PCR	★	●						
Enhanced Fidelity	●		★	●	●	●		
High Fidelity			★	●				
High Yield	★	●	★	●				
Fast			★	●				
Long Amplicon			★	●		★		
GC-rich Targets	★		★		●	●		
AT-rich Targets	★	●	★	●		●	★	
High Throughput	●	●	●	●			●	
Multiplex PCR	●	★(2)	●	●				
Extraction-free PCR								★
DNA Labeling		★						
Site-directed Mutagenesis			★	●				
Bisulfite Sequencing							★	
NGS APPLICATIONS								
NGS Library Amplification	●		★(3)	●				
FORMATS								
Hot Start Available	●	●	●	●		●	●	
Kit		●	●	●		●		
Master Mix Available	●	●	●	●		●		
Direct Gel Loading	●	●						

(1) Phusion DNA Polymerase was developed by Finnzymes Oy, now a part of Thermo Fisher Scientific. This product is manufactured by New England Biolabs, Inc. under agreement with, and under the performance specifications of Thermo Fisher Scientific.

(2) Use Multiplex PCR 5X Master Mix.

(3) Use NEBNext Hot Start HiFi PCR Master Mix.

Why is Polymerase Fidelity Important?

What is fidelity?

The fidelity of a DNA polymerase refers to its ability to accurately replicate a template. A critical aspect of this is the ability of the DNA polymerase to read a template strand, select the appropriate nucleoside triphosphate and insert the correct nucleotide at the 3′ primer terminus, such that canonical Watson-Crick base pairing is maintained. The rate of misincorporation is known as the polymerase's error rate. In addition to effective discrimination for correct over incorrect nucleotide incorporation, some DNA polymerases possess a 3′→5′ exonuclease activity. This activity, also termed proofreading, is used to excise incorrectly incorporated mononucleotides that are then replaced with the correct nucleotide. High-fidelity PCR utilizes DNA polymerases that couple low misincorporation rates with proofreading activity to give faithful replication of the DNA target of interest.

For what applications is fidelity important?

Fidelity is important for applications in which the DNA sequence must be correct after amplification, including:

- Cloning/subcloning from *in vitro* amplified material (PCR, WGA, etc) for protein expression or gene studies
- SNP analysis by cloning and sequencing
- RNA analysis by RT-PCR
- Applications that involve sequencing of *in vitro* amplified material

Fidelity is less important if the PCR amplified product is directly sequenced by Sanger sequencing (without an intervening cloning step), where the signal is an average of the input amplicons. Fidelity is also less important for diagnostic applications in which sequencing is not required after amplification, and the read-out is the presence or absence of a product. It is more important for next generation and single molecule sequencing techniques.

How does a high-fidelity polymerase ensure that the correct base is inserted?

High-fidelity DNA polymerases have several checkpoints to protect against making and propagating mistakes while copying DNA.

- High-fidelity polymerases have a significant binding preference for the correct versus the incorrect nucleotide triphosphate during polymerization.
- If an incorrect nucleotide does bind in the polymerase active site, incorporation is slowed due to the sub-optimal architecture of the active site complex. This time increases the opportunity for the incorrect nucleotide to dissociate before incorporation, thereby allowing the process to start again (and for a correct nucleotide triphosphate to bind) (1,2).
- If an incorrect nucleotide is inserted, proofreading DNA polymerases have an extra line of defense. They can "sense" the perturbation caused by the mispaired bases and move the 3′ end of the growing DNA chain into a proofreading 3′→5′ exonuclease domain. There, the incorrect nucleotide is removed by the 3′→5′ exonuclease activity before the chain is moved back into the polymerase domain, where polymerization can continue with the correct nucleotide.

TOOLS & RESOURCES

Visit **www.neb.com/tools-and-resources/tutorials** to find the latest PCR videos from NEB Scientists, including:

- Choosing the right polymerase for your PCR
- How to amplify GC-rich DNA
- Why choose Q5 High-Fidelity DNA Polymerase
- Important tips for Q5 High-Fidelity DNA Polymerase
- Tips for amplifying large amplicons
- Amplification of GC-rich regions
- Tips for setting up PCR
- Types of PCR
- Why is Tm important?

References:

1. Johnson, K. A. (2010) *Biochim. et. Biophys. Acta*, 1804, 1041–1048.
2. Joyce, C. M. and Bencovic, S. (2004) *Biochemistry*, 43, 14317–14324.

Q5® High-Fidelity DNA Polymerase

Q5 Hot Start High-Fidelity DNA Polymerase

Q5 High-Fidelity DNA Polymerase sets a new standard for both fidelity and performance. With the highest fidelity amplification available (> 100X higher than *Taq* and 2X higher than Thermo Scientific® Phusion®), Q5 DNA Polymerase results in ultra-low error rates. Q5 DNA Polymerase is composed of a novel polymerase that is fused to the processivity-enhancing Sso7d DNA binding domain, improving speed, fidelity and reliability of performance.

The Q5 buffer system is designed to provide superior performance with minimal optimization across a broad range of amplicons, regardless of GC content. For routine or complex amplicons up to ~65% GC content, Q5 Reaction Buffer provides reliable and robust amplification. For amplicons with high GC content (> 65% GC), addition of the Q5 High GC Enhancer ensures continued maximum performance. Q5 DNA Polymerase is available as a standalone enzyme, in hot start, master mix or kit format. Master mix formulations include dNTPs, Mg^{++} and all necessary buffer components. The kit contains Q5 High-Fidelity 2X Master Mix, nuclease-free water, gel loading dye and the Quick-Load® 2-log DNA Ladder.

Also available: Q5 High-Fidelity DNA Polymerase optimized for NGS applications. Visit **NEBNext.com** for details.

Q5 High-Fidelity DNA Polymerase	M0491S/L
Q5 High-Fidelity 2X Master Mix	M0492S/L
Q5 Hot Start High-Fidelity DNA Polymerase	M0493S/L
Q5 Hot Start High-Fidelity 2X Master Mix	M0494S/L
Q5 High-Fidelity PCR Kit	E0555S/L
NEBNext® Q5 Hot Start HiFi PCR Master Mix	M0543S/L
NEBNext High-Fidelity 2X PCR Master Mix	M0541S/L
NEBNext Ultra™ II Q5 Master Mix	M0544S/L

POLYMERASE DETAILS

Extension Rate	6 kb/min
Amplicon Size	≤ 20 kb
Fidelity	> 100X *Taq*
Units/50 µl rxn	1 unit
Resulting Ends	Blunt
3´→5´ Exonuclease Activity	Yes
5´→3´ Exonuclease Activity	No
Supplied Buffer	Q5 Rxn Buffer
Supplied Enhancer	Q5 High GC Enhancer
Compatible w/Other Buffers	with Reduced Activity Profile

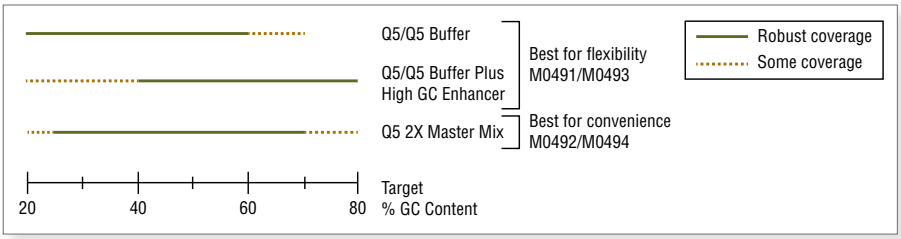
Product Formats

Hot Start Available	Yes
- Activation Required	No
Master Mix Available	Yes
PCR Kit Available	Yes
NGS Version Available	Yes

Applications

High-Fidelity PCR	Yes
Difficult PCR	Yes
High GC PCR	Yes
T/A, U/A Cloning	No
Colony PCR	No
Blunt Cloning	Yes

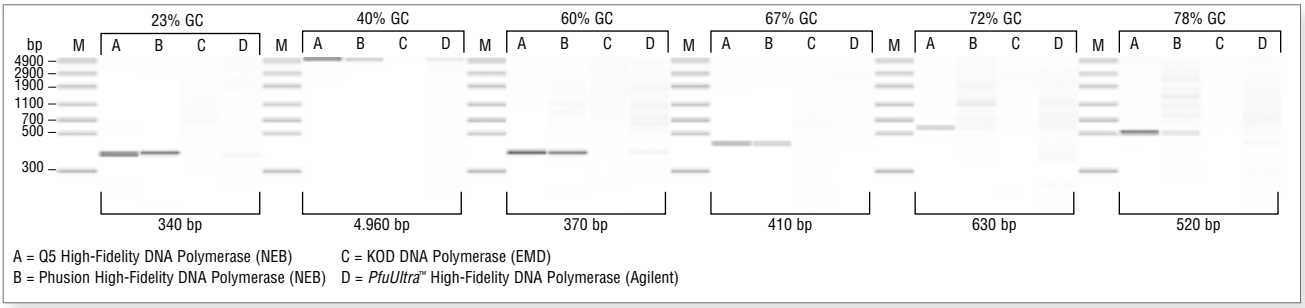
Q5 DNA Polymerases offer exceptional coverage over the entire range of GC composition



The stand-alone enzyme comes with a reaction buffer that supports robust amplification of high AT to routine targets. Addition of the High GC Enhancer allows amplification of GC rich and difficult targets. For added convenience, the master mix formats allow robust amplification of a broad range of targets with a single formulation.

Learn how Q5 can be used in multiplex PCR in our application note at Q5PCR.com

Q5 DNA Polymerase offers superior amplification for a wide range of templates, even with high GC content



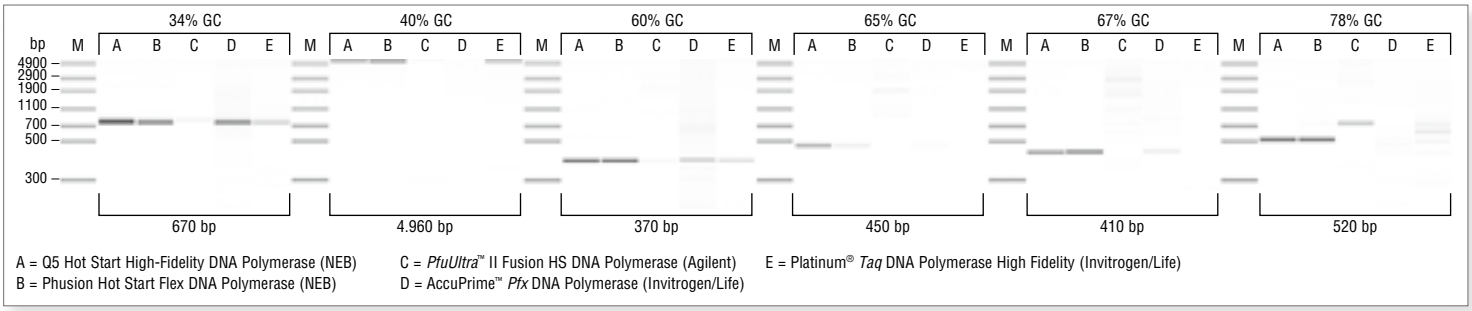
Amplification of a variety of human genomic amplicons from low to high GC content demonstrates the broad performance of Q5 High-Fidelity DNA Polymerase. All reactions were conducted using 20 ng of input template and included 30 cycles of amplification. Results were visualized by microfluidic LabChip® analysis. Competitor polymerases were cycled according to manufacturer's recommendations. For the final three amplicons, GC Buffers or enhancers were used when supplied with the polymerase.

Q5 Hot Start High-Fidelity DNA Polymerase

In contrast to chemically-modified or antibody-based hot start polymerases, NEB's Q5 Hot Start utilizes a unique synthetic aptamer. This structure binds to the polymerase through non-covalent interactions, blocking activity during the reaction setup. The polymerase is activated during normal cycling conditions, allowing reactions to be set up at room temperature. Q5 Hot Start does not require a separate high temperature activation step, shortening reaction times and increasing ease-of-use. Q5 Hot Start is an ideal choice for high specificity amplification and provides robust amplification of a wide variety of amplicons, regardless of GC content.

High-fidelity polymerases benefit from a $Tm^{+}3$ annealing temperature. Use the NEB Tm Calculator to ensure successful PCR at TmCalculator.neb.com.

Q5 Hot Start DNA Polymerase offers superior amplification for a wide range of templates, even with high GC content



Amplification of a variety of human genomic amplicons from low to high GC content demonstrates the broad performance of Q5 Hot Start High-Fidelity DNA Polymerase. All reactions were set up at room temperature using 20 ng of input template and included 30 amplification cycles. Results were visualized by microfluidic LabChip analysis. Competitor polymerases were cycled according to manufacturer's recommendations. For the final three amplicons, GC Buffers or enhancers were used when provided with the polymerase.

Comparison of high-fidelity polymerases

PRODUCT NAME (SUPPLIER)	POLYMERASE FIDELITY (Reported by supplier)	MAXIMUM AMPLICON LENGTH[6]	EXTENSION TIME[6] (For simple templates[5])	EXTENSION TIME[6] (For complex templates[5])
Q5 High-Fidelity DNA Polymerase (NEB)	> 100X *Taq*[1,2]	20 kb simple; 10 kb complex	10 s/kb	10 s/kb (< 1 kb) 20–30 s/kb (> 1 kb)
Phusion High-Fidelity DNA Polymerase* (NEB)	> 50X *Taq*[1,2]	20 kb simple; 10 kb complex	15 s/kb	30 s/kb
AccuPrime™ *Pfx* (Life)	26X *Taq*[1]	12 kb[4]	60 s/kb[4]	
PfuUltra™ II Fusion HS (Agilent)	20X *Taq*[1]	19 kb[4]	15 s/kb (< 10 kb[4]) 30 s/kb (> 10 kb[4])	
PfuUltra High-Fidelity DNA Polymerase (Agilent)	19X *Taq*[1]	17 kb simple; 6 kb complex	60 s/kb (< 10 kb) 120 s/kb (> 10 kb)	60 s/kb (< 6 kb) 120 s/kb (> 6 kb)
Platinum *Taq* HiFi (Life)	6X *Taq*[1]	20 kb[4]	60 s/kb[4]	
KOD DNA Polymerase (EMD)	4X *Taq*[3]	6 kb simple; 2 kb complex	10–20 s/kb	30–60 s/kb

[1] PCR-based mutation screening in lacZ (NEB), lacI (Agilent) or rpsL (Life)

[2] Due to the very low frequency of misincorporation events being measured, the error rate of high-fidelity enzymes like Q5 is difficult to measure in a statistically significant manner. Although measurements from assays done side-by-side with *Taq* yield Q5 fidelity values from 100–200X *Taq*, we report ">100X *Taq*" as a conservative value.

[3] Takagi et. al. (1997) *Appl. Env. Microbiol.* 63, 4504–4510.

[4] Template not specified.

[5] Simple templates include plasmid, viral and *E. coli* genomic DNA. Complex templates include plant, human and other mammalian genomic DNA.

[6] Values provided by individual manufacturers.

* Phusion DNA Polymerase was developed by Finnzymes Oy, now a part of Thermo Fisher Scientific.

One*Taq*® DNA Polymerase

One*Taq* Hot Start DNA Polymerase

An optimized blend of *Taq* and Deep Vent$_R$ DNA polymerases, One*Taq* and One*Taq* Hot Start DNA Polymerases offer robust amplification across a wide range of templates. The 3´→5´ exonuclease activity of Deep Vent DNA Polymerase increases the fidelity and robustness of *Taq*. Additionally, One*Taq* Reaction Buffers and High GC Enhancer have been formulated for robust yields with minimal optimization, regardless of a template's GC content.

One*Taq* DNA Polymerase is supplied with two 5X buffers (Standard and GC), as well as a High GC Enhancer solution. For most routine, AT- rich or complex amplicons with up to ~65% GC content, One*Taq* Standard Reaction Buffer provides robust amplification. For GC-rich amplicons, the One*Taq* GC Reaction Buffer can improve both performance and yield. For particularly high GC (> 65%) or difficult amplicons, the One*Taq* High GC Enhancer can be added to reactions containing One*Taq* GC Buffer. These formulations ensure maximum performance for routine, AT- or GC-rich amplicons.

For direct and fast agarose gel-loading after routine-PCRs such as genotyping or colony-PCR etc., One*Taq* DNA Polymerase is also available in a Quick-Load format. It is supplied with a densitiy and tracking dye containing 5x One*Taq* Quick-Load Reaction Buffer for direct gel loading in addtion to the regular "color-less" 5x One*Taq* Reaction Buffer.

Master Mix Formulations

In addition to standalone enzymes, both One*Taq* and One*Taq* Hot Start DNA Polymerases are available in master mix and Quick-Load master mix formats. Master mix formulations include dNTPs, $MgCl_2$ and other buffers and stabilizers. The Quick-Load master mix formulations also include two tracking dyes for use with downstream visualization (i.e., agarose gels). With these convenient formats, the addition of primers and template are all that is required for robust amplification.

One*Taq* DNA Polymerase	M0480S/L/X
One*Taq* Quick-Load DNA Polymerase	M0509S/L/X
One*Taq* 2X Master Mix with Standard Buffer	M0482S/L
One*Taq* 2X Master Mix with GC Buffer	M0483S/L
One*Taq* Quick-Load 2X Master Mix with Standard Buffer	M0486S/L
One*Taq* Quick-Load 2X Master Mix with GC Buffer	M0487S/L

One*Taq* Buffer Recommendations

AMPLICON % GC BUFFER	RECOMMENDED DEFAULT BUFFER	OPTIMIZATION NOTES
< 50% GC	One*Taq* Standard Reaction Buffer	Adjust annealing temperature, primer/ template concentration, etc. if needed.
50–65% GC	One*Taq* Standard Reaction Buffer	One*Taq* GC Reaction Buffer can be used to enhance performance of difficult amplicons.
> 65% GC	One*Taq* GC Reaction Buffer	One*Taq* GC Reaction Buffer with 10–20% One*Taq* High GC Enhancer can be used to enhance performance of difficult amplicons.

POLYMERASE DETAILS

Extension Rate	1 kb/min
Amplicon Size	≤ 6 kb
Fidelity	2X *Taq*
Units/50 µl rxn	1,25 units
Resulting Ends	3´ A/Blunt
3´→5´ Exonuclease Activity	Yes
5´→3´ Exonuclease Activity	Yes
Supplied Buffer	One*Taq* Std Rxn Buffer, One*Taq* GC Rxn Buffer*
Supplied Enhancer	One*Taq* High GC Enhancer*
Compatible w/Other Buffers	with Reduced Activity Profile

Product Formats

Hot Start Available	Yes
- Activation Required	No
Master Mix Available	Yes
Direct Gel-loading Available	Yes
PCR Kit Available	No

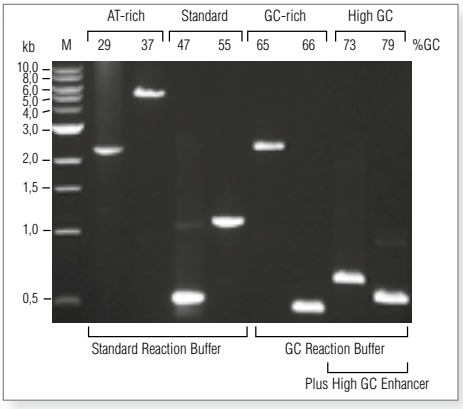
Applications

Routine PCR	Yes
SNP Detection	Yes
T/A, U/A Cloning	Yes
Colony PCR	Yes

**not supplied with OneTaq Quick-Load DNA Polymerase*

Visit **www.neb-online.de/onetaq** for more information.

Achieve robust amplification for routine, AT- and GC-rich templates with One*Taq*



Amplification of a selection of sequences with varying AT and GC content from human and C. elegans genomic DNA using OneTaq DNA Polymerase. GC content is indicated above gel. Marker M is the 1 kb DNA Ladder (NEB #N3232).

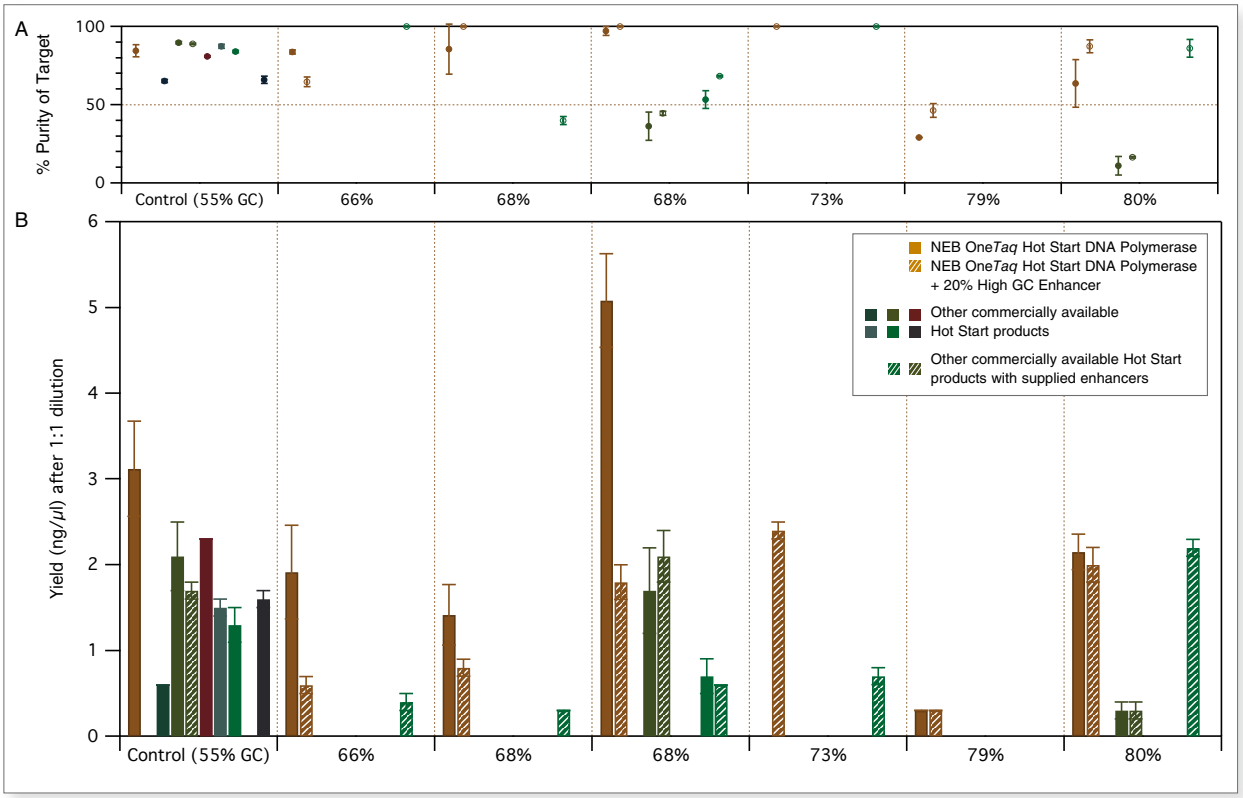
One*Taq* Hot Start DNA Polymerase allows room temperature reaction setup with no separate activation step

In contrast to chemically-modified or antibody-based hot start polymerases, NEB's One*Taq* Hot Start utilizes aptamer technology. This aptamer/inhibitor binds to the polymerase through non-covalent interactions, blocking polymerase activity at temperatures below 45°C. The polymerase is activated during normal cycling conditions, allowing reactions to be set up at room temperature. One*Taq* Hot Start DNA Polymerase does not require a separate high temperature incubation step to activate the enzyme and can be used in typical *Taq*-based cycling protocols. This ultimately shortens reaction times and increases ease of use.

To learn how One*Taq* can be used in colony PCR, download the application note at **www.neb-online.de/onetaq**

One*Taq* Hot Start DNA Polymerase	M0481S/L/X
One*Taq* Hot Start 2X Master Mix with Standard Buffer	M0484S/L
One*Taq* Hot Start 2X Master Mix with GC Buffer	M0485S/L
One*Taq* Hot Start Quick-Load 2X Master Mix with Standard Buffer	M0488S/L
One*Taq* Hot Start Quick-Load 2X Master Mix with GC Buffer	M0489S/L

Comparison of One*Taq* Hot Start DNA Polymerase to other commercially available hot start polymerases.



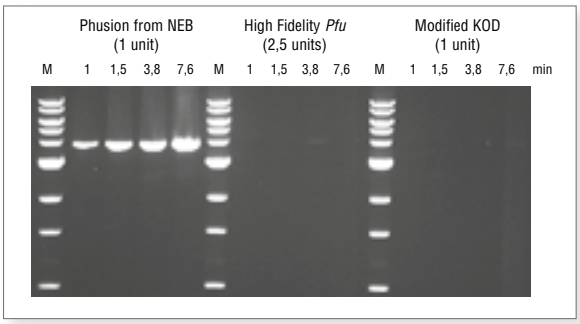
Reactions containing high GC human genomic DNA templates were set up at room temperature. PCR experiments included 30 cycles. Purity (A) and Yield (B) were calculated via microfluidic analysis from triplicate reactions. OneTaq polymerases were used with GC Buffer. Some OneTaq reactions also contained High GC Enhancer (striped bars). Competitor polymerases were cycled according to manufacturer's recommendations and included GC enhancers when supplied (striped bars).

Phusion® High-Fidelity DNA Polymerase

DNA polymerases with high fidelity are important for applications in which the DNA sequence needs to be correct after amplification. Manufactured and quality controlled at New England Biolabs, Thermo Scientific® Phusion High-Fidelity DNA Polymerase offers both high fidelity and robust performance, and thus can be used for all PCR applications. Its unique structure, a novel *Pyrococcus*-like enzyme fused with a processivity-enhancing domain, increases fidelity and speed. Product selection includes a standalone enzyme, master mix and kit format, as well as a choice of reaction buffers for amplification of difficult templates. Phusion Hot Start Flex DNA Polymerase is available as standalone enzyme or in a master mix format and enables high specificity amplification of a broad range of templates with the flexibility of room temperature setup.

Phusion High-Fidelity DNA Polymerase	M0530S/L
Phusion High-Fidelity PCR Kit	E0553S/L
Phusion High-Fidelity PCR Master Mix with HF Buffer	M0531S/L
Phusion High-Fidelity PCR Master Mix with GC Buffer	M0532S/L
Phusion Hot Start Flex	M0535S/L
Phusion Hot Start Flex 2X Master Mix	M0536S/L

Phusion DNA Polymerase generates amplicons with high yield and much shorter extension times



A 3,8 kb fragment was amplified from 50 ng of Jurkat gDNA using different polymerases. Reactions were carried out according to the manufacturer's recommended conditions. Extension times are indicated (in minutes). Ladder M is a 1 kb DNA Ladder (NEB #N3232).

Phusion Buffer Selection Chart

CHOICE OF BUFFER	APPLICATION	NEB #
Phusion HF Buffer Pack	Default buffer for high-fidelity amplification	B0518S
Phusion GC Buffer Pack	For long, difficult or GC-rich templates (when HF buffer fails)	B0519S

Phusion DNA Polymerase was developed by Finnzymes Oy, now a part of Thermo Fisher Scientific.

POLYMERASE DETAILS

Extension Rate	4 kb/min
Amplicon Size	≤ 20 kb
Fidelity	> 50X *Taq*
Units/50 µl rxn	1 units
Resulting Ends	Blunt
3´→5´ Exonuclease Activity	Yes
5´→3´ Exonuclease Activity	No
Supplied Buffer	5X Phusion HF Buffer, 5X Phusion GC Buffer
Supplied Enhancer	100% DMSO
Compatible w/Other Buffers	No

Product Formats

Hot Start Available	Yes
- Activation Required	No
Master Mix Available	Yes
PCR Kit Available	Yes

Applications

High-Fidelity PCR	Yes
T/A, U/A Cloning	No
Colony PCR	No
Blunt Cloning	Yes

High-fidelity polymerases benefit from a $Tm^{+}3$ annealing temperature. Use the NEB Tm Calculator to ensure successful PCR at TmCalculator.neb.com.

Vent$_R$® DNA Polymerase

Vent$_R$ DNA Polymerase is a recombinant, high-fidelity thermophilic DNA polymerase with the lowest cost per reaction of any moderate-fidelity PCR polymerase. It has an error rate 5-fold lower than *Taq* DNA Polymerase, a characteristic derived in part from an intrinsic 3′→5′ proofreading exonuclease. In addition, greater than 90% of the polymerase activity remains following a 1 hour incubation at 95°C, ensuring maximal activity over the course of the PCR reaction. For enhanced-fidelity amplification of routine targets, Vent$_R$ DNA Polymerase offers exceptional value.

Vent$_R$ (exo$^-$) DNA Polymerase has been genetically engineered to eliminate the 3′→5′ proofreading exonuclease activity resulting in higher yield PCR.

Vent$_R$ DNA Polymerase M0254S/L
Vent$_R$ (exo$^-$) DNA Polymerase M0257S/L

POLYMERASE DETAILS

Extension Rate	1 kb/min
Amplicon Size	≤ 6 kb
Fidelity	5X *Taq*
Resulting Ends	Blunt
3′→5′ Exonuclease Activity	Yes (M0254)
5′→3′ Exonuclease Activity	No
Supplied Buffer	ThermoPol® Rxn Buffer
Compatible w/Other Buffers	No

Applications

Blunt Cloning	Yes
Enhanced Thermostability	Yes

Deep Vent$_R$™ DNA Polymerase

Deep Vent$_R$ DNA Polymerase is a recombinant, moderate-fidelity DNA polymerase with unsurpassed thermostability. This feature makes Deep Vent$_R$ an ideal choice for PCR amplification of DNA targets with a high degree of secondary structure, even in the absence of additives. It has an error rate 6-fold lower than *Taq* DNA Polymerase, a characteristic derived in part from an integral 3′→5′ proofreading exonuclease. Deep Vent$_R$'s combination of extreme thermostability and moderate-fidelity make it an excellent choice for accurate PCR amplification of GC-rich sequences or templates with secondary structures.

Deep Vent$_R$ (exo$^-$) DNA Polymerase has been genetically engineered to eliminate the 3′→5′ proofreading exonuclease activity resulting in higher yield PCR.

Deep Vent$_R$ DNA Polymerase M0258S/L
Deep Vent$_R$ (exo$^-$) DNA Polymerase M0259S/L

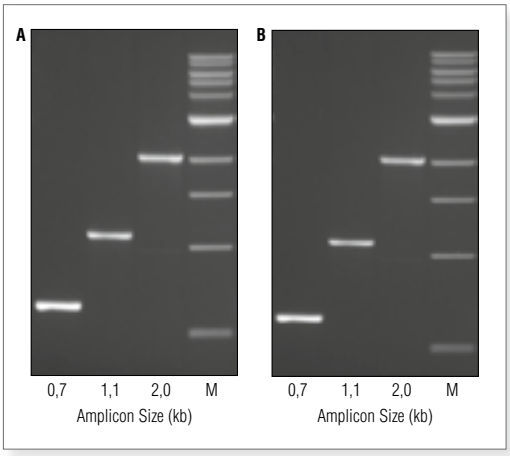
POLYMERASE DETAILS

Extension Rate	1 kb/min
Amplicon Size	≤ 6 kb
Fidelity	6X *Taq*
Resulting Ends	Blunt
3′→5′ Exonuclease Activity	Yes (M0258)
5′→3′ Exonuclease Activity	No
Supplied Buffer	ThermoPol Rxn Buffer
Compatible w/Other Buffers	No

Applications

Blunt Cloning	Yes
Enhanced Thermostability	Yes

Amplification with Vent and Deep Vent DNA Polymerases



Amplification of Jurkat Genomic DNA with Vent$_R$ (A) and Deep Vent$_R$ (B) DNA Polymerases. Amplicon sizes are indicated below gel. Marker M is the 1 kb DNA Ladder (NEB #N3232).

Taq DNA Polymerase

For routine amplification, where cost per reaction and yield are the priorities, *Taq* DNA Polymerase is the industry standard. NEB provides high quality recombinant *Taq* at an exceptional value. To accommodate a variety of PCR applications, *Taq* is available with different reaction buffers. Standard *Taq* Buffer is designed to support existing PCR platforms and is an ideal choice for DHPLC and high-throughput applications. ThermoPol Buffer is formulated to promote high product yields, even under demanding conditions.

Taq DNA Polymerase with Standard *Taq* Buffer	M0273S/L/X
Taq DNA Polymerase with Standard *Taq* (Mg-free) Buffer	M0320S/L
Taq DNA Polymerase with ThermoPol Buffer	M0267S/L/X/E
Taq PCR Kit	E5000S
Taq PCR Kit with Controls	E5100S
Taq 5X Master Mix	M0285L
Taq 2X Master Mix	M0270L
Quick-Load *Taq* 2X Master Mix	M0271L
Hot Start *Taq* DNA Polymerase	M0495S/L
Hot Start *Taq* 2X Master Mix	M0496S/L

Taq Buffer Selection Chart

CHOICE OF BUFFER	MG-CONTROL	NEB #
Standard *Taq* Reaction Buffer: Detergent-free and designed to be compatible with existing assay systems	*Taq* with Standard *Taq* Buffer	M0273S/L/X
	Taq with Standard *Taq* (Mg-free) Buffer	M0320S/L
ThermoPol Buffer: Designed to optimize yields and specificity	*Taq* with ThermoPol Buffer	M0267S/L/X/E

POLYMERASE DETAILS

Extension Rate	1 kb/min
Amplicon Size	≤ 5 kb
Units/50 µl rxn	1,25 units
Resulting Ends	3´ A
3´→5´ Exonuclease Activity	No
5´→3´ Exonuclease Activity	Yes
Supplied Buffer	Standard *Taq* Rxn Buffer, or ThermoPol Rxn Buffer
Compatible w/Other *Taq* Buffers	Yes

Product Formats

Hot Start Available	Yes
- Activation Required	No
Master Mix Available	Yes
Direct Gel-loading Available	Yes
PCR Kit Available	Yes

Applications

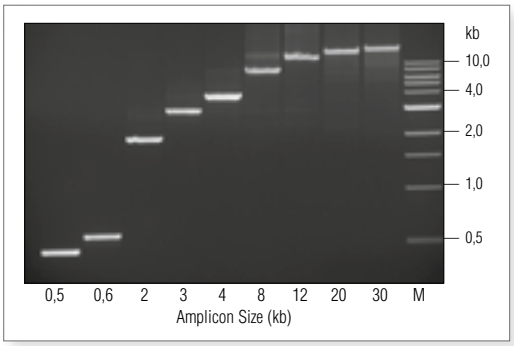
Routine PCR	Yes
SNP Detection	Yes
T/A, U/A Cloning	Yes
Colony PCR	Yes

LongAmp® *Taq* enables extension of longer amplicons

An optimized blend of *Taq* and Deep Vent$_R$ DNA Polymerases, LongAmp *Taq* DNA Polymerase enables amplification of up to 30 kb PCR products with a fidelity higher than *Taq* DNA Polymerase alone.

LongAmp *Taq* DNA Polymerase M0323S/L
LongAmp *Taq* PCR Kit E5200S
LongAmp *Taq* 2X Master Mix M0287S/L
LongAmp Hot Start *Taq* DNA Polymerase M0534S/L
LongAmp Hot Start *Taq* 2X Master Mix M0533S/L

Amplification of longer templates with LongAmp *Taq*



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

POLYMERASE DETAILS

Extension Rate	1,2 kb/min
Amplicon Size	≤ 30 kb
Fidelity	2X *Taq*
Units/50 µl rxn	5 units
Resulting Ends	3´ A/Blunt
3´→5´ Exonuclease Activity	Yes
5´→3´ Exonuclease Activity	Yes
Supplied Buffer	LongAmp or *Taq* Rxn Buffer
Compatible w/Other *Taq* Buffers	with Reduced Activity Profile

Product Formats

Hot Start Available	Yes
- Activation Required	No
Master Mix Available	Yes
Direct Gel-loading Available	Yes
PCR Kit Available	Yes

Applications

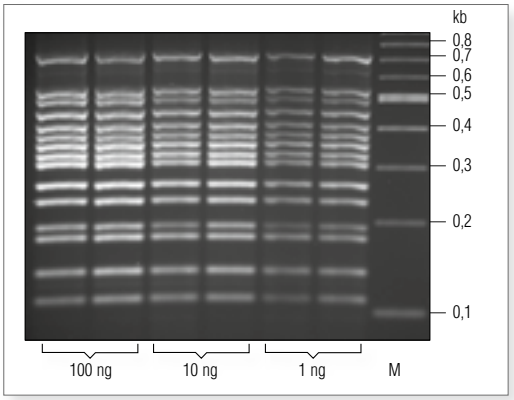
Long Amplicons	Yes
Routine PCR	Yes
T/A, U/A Cloning	Yes
Colony PCR	Yes

Multiplex PCR 5X Master Mix for multiple templates

Multiplex PCR can simultaneously detect two or more products in a single reaction. Multiplex PCR can also be used for semi-quantitative gene expression analysis using cDNA templates. The NEB Multiplex PCR 5X Master Mix is an easy-to-use solution featuring high quality recombinant *Taq* DNA Polymerase. The mix is optimized for high yield and performance. Its performance is illustrated below in a 15-plex PCR reaction using human genomic DNA. The 5X formulation allows maximal flexibility for input of custom primers and template DNAs.

Multiplex PCR 5X Master Mix M0284S

15-plex PCR reaction



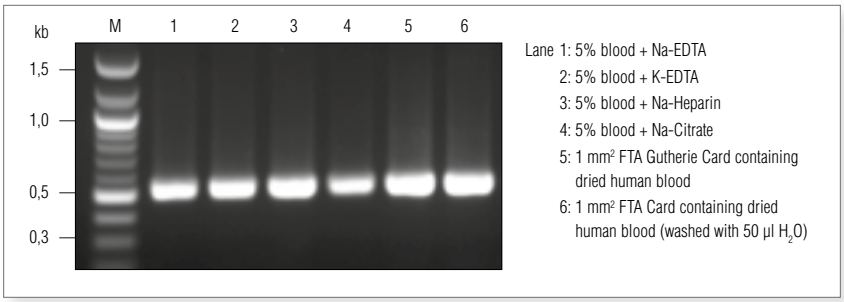
15-plex PCR using varying amounts of human genomic DNA. 1X Multiplex PCR 5X Master Mix was used with 0,15 µM of each primer. The cycling conditions were 95°C for 1 minute, 35 cycles of 95°C for 20 seconds, 60°C for 1 minute and 68°C for 2 minutes. Marker M is the 2-Log DNA Ladder (NEB #N3200).

Hemo KlenTaq® for PCR from blood

Hemo KlenTaq is a truncated version of *Taq* DNA Polymerase that contains mutations, making it resistant to inhibitors present in whole blood. Hemo KlenTaq offers the versatility of *Taq* and can successfully amplify samples containing up to 20% whole blood from human and mouse sources in a 50 µl reaction volume.

Hemo KlenTaq M0332S/L

Amplification from human whole blood with Hemo Klen*Taq*



Percent blood present in sample and anticoagulant used are indicated in the legend. Ladder M is the 2-Log DNA Ladder (NEB #N3200).

POLYMERASE DETAILS

Extension Rate	0,5 kb/min
Amplicon Size	≤ 2 kb
Units/50 µl rxn	4 units
Resulting Ends	3´A
3´→5´ Exonuclease Activity	No
5´→3´ Exonuclease Activity	No
Supplied Buffer	Hemo Klen *Taq* Rxn Buffer
Compatible w/Other Buffers	Yes

Applications

Extraction-free PCR	Yes
T/A, U/A Cloning	Yes
Cloning PCR	Yes

EpiMark® Hot Start *Taq* DNA Polymerase for bisulfite sequencing

EpiMark Hot Start *Taq* DNA Polymerase is a mixture of *Taq* DNA Polymerase and a temperature sensitive, aptamer-based inhibitor. This inhibitor binds reversibly to the enzyme, inhibiting polymerase activity below 45°C, but releases the enzyme during normal PCR cycling conditions. With a reaction buffer that has been optimized for AT-rich templates, EpiMark Hot Start *Taq* is an excellent choice for bisulfite-treated DNA.

EpiMark Hot Start *Taq* DNA Polymerase M0490S/L

POLYMERASE DETAILS

Extension Rate	1 kb/min
Amplicon Size	≤ 1 kb
Units/50 µl rxn	1,25 units
Resulting Ends	3´A
3´→5´ Exonuclease Activity	No
5´→3´ Exonuclease Activity	Yes
Supplied Buffer	Epimark Hot Start *Taq* Rxn Buffer
Compatible w/Other *Taq* Buffers	with Reduced Activity Profile

Product Formats

Hot Start Available	Yes
- Activation Required	No

Applications

A/T Rich Targets	Yes
Bisulfite-converted DNA	Yes
Routine PCR	Yes
T/A, U/A Cloning	Yes

PreCR® Repair Mix

The PreCR Repair Mix is a cocktail of enzymes formulated to repair damaged DNA *in vitro* prior to PCR. The repair pre-treatment can be applied to techniques such as whole genome amplification, DNA sequencing and microarray analysis.

The PreCR Repair Mix can repair a wide range of damaged DNA, resulting from exposure to heat, low pH, oxygen, and/or UV light. The lesions repaired by the PreCR Repair Mix do not include all possible types of damage. For example, it cannot repair DNA crosslinks, such as those that occur during exposure to formalin, nor can the mix effectively repair highly fragmented DNA.

PreCR Repair Mix M0309S/L

ADVANTAGES

- **Specific** - Treats damaged DNA without harming template
- **Versatile** - Can be used in conjunction with any thermophilic polymerase
- **Convenient** - PCR can be done directly on repair reaction
- **Flexible** - Suitable for PCR, microarrays and other DNA technologies

Nucleotide Solutions

Deoxynucleotide (dNTP) Solution Set

The Deoxynucleotide Solution Set contains four separate 100 mM solutions of ultrapure nucleotides (dATP, dCTP, dGTP, and dTTP).

Deoxynucleotide Solution Set N0446S

Deoxynucleotide (dNTP) Solution Mix

The Deoxynucleotide Solution Mix is an equimolar mixture of ultrapure dATP, dCTP, dGTP, and dTTP. Each nucleotide is present at a concentration of 10 mM in the mixture for a total dNTP concentration of 40 mM.

Deoxynucleotide Solution Mix N0447S/L

7-deaza-dGTP*

A useful additive for PCR of GC-rich templates; contains a 5 mM solution of 7-deaza-GTP as a dilithium salt.

* *licensed from Roche Diagnostics GmbH*

7-deaza-dGTP* N0445S/L

Acyclonucleotide Set

Acyclonucleotide Set contains four separate tubes of acyNTPs (acyATP, acyCTP, acyGTP and acyTTP).

Acyclonucleotide Set N0460S

dATP Solution

Contains 0,25 ml of 100 mM ultrapure dATP.

dATP Solution N0440S

Ribonucleotide Solution Set

Ribonucleotide Solution Set consists of four separate 100 mM solutions of ATP, GTP, CTP and UTP.

Ribonucleotide Solution Set N0450S/L

Ribonucleotide Solution Mix

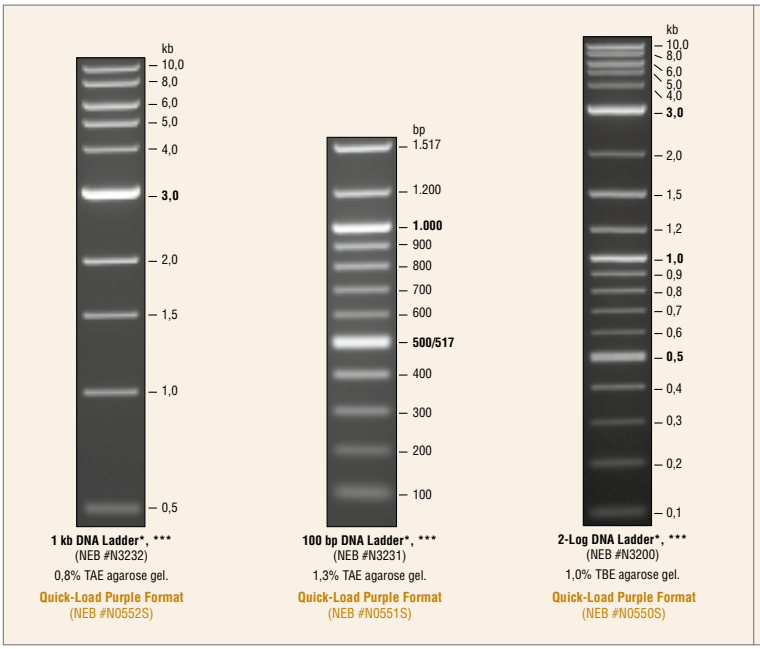
The Ribonucleotide Solution Mix is an equimolar mixture of ribonucleotide triphosphates (rATP, rCTP, rGTP and rUTP). Each is supplied at a concentration of 80 mM for a total concentration of 320 mM.

Ribonucleotide Solution Mix N0466S/L

DNA Analysis

Agarose- or polyacrylamide-gel electrophoresis is the standard method used for separation, identification and purification of DNA fragments. DNA is visualized on a gel after soaking or pre-impregnating the gel with ethidium bromide, a DNA intercalating agent that fluoresces under UV illumination. Using the marker or ladder as a reference, it is possible to determine the size and relative quantity of the DNA of interest. The original DNA markers were made of genomic DNAs digested with a restriction enzyme to exhibit a banding pattern of known fragment sizes. Later, markers were made of fragments with evenly-spaced sizes and the resulting banding pattern resembles a ladder. The bands are visible under UV illumination; since the bands of the marker/ladder are not visible under normal lighting conditions. To track the progress of the gel as it runs, the marker contains a dye or combination of dyes that identify the leading edge of well contents, also called the dye front.

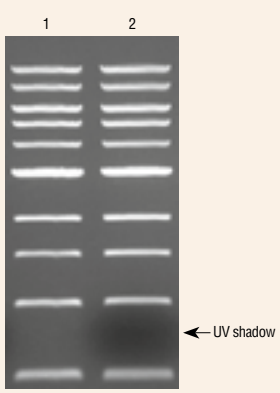
The following DNA Ladders are Now Available in Quick-Load Purple Format



1 kb DNA Ladder*, ***
(NEB #N3232)
0,8% TAE agarose gel.
Quick-Load Purple Format
(NEB #N0552S)

100 bp DNA Ladder*, ***
(NEB #N3231)
1,3% TAE agarose gel.
Quick-Load Purple Format
(NEB #N0551S)

2-Log DNA Ladder*, ***
(NEB #N3200)
1,0% TBE agarose gel.
Quick-Load Purple Format
(NEB #N0550S)

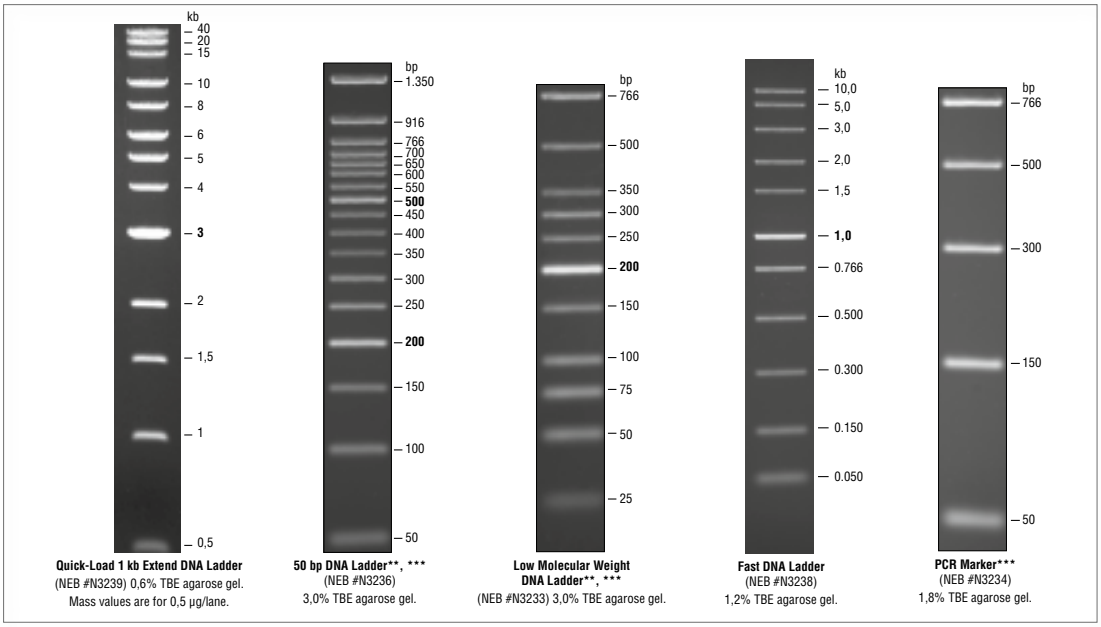


Gel Loading Dye, Purple (6X)
(NEB #B7024S)
Gel Loading Dye, Purple (6X) no SDS
(NEB #B7025S)

The new Gel Loading Dye, Purple (6X) (Lane 1) included in the Quick-Load Purple DNA Ladder, does not cast a UV shadow over the underlying bands, unlike the Gel Loading Dye, Blue (6X) (Lane 2).

** Available in Quick-Load and TriDye™ formats*
**** Free Loading Dye included*

Additional DNA Ladders from New England Biolabs



Quick-Load 1 kb Extend DNA Ladder
(NEB #N3239) 0,6% TBE agarose gel.
Mass values are for 0,5 µg/lane.

50 bp DNA Ladder, *****
(NEB #N3236)
3,0% TBE agarose gel.

Low Molecular Weight DNA Ladder, *****
(NEB #N3233) 3,0% TBE agarose gel.

Fast DNA Ladder
(NEB #N3238)
1,2% TBE agarose gel.

PCR Marker***
(NEB #N3234)
1,8% TBE agarose gel.

*** Available in Quick-Load format*
**** Free Loading Dye included*

PCR Troubleshooting Guide

The following guide can be used to troubleshoot PCR reactions. Additional tips for optimizing reactions can be found in the technical reference section of our website, **international.neb.com**.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Sequence errors	Low fidelity polymerase	• Choose a higher fidelity polymerase such as Q5 High-Fidelity (NEB #M0491) or Phusion (NEB #M0530)* DNA Polymerases
	Suboptimal reaction conditions	• Reduce number of cycles • Decrease extension time
	Unbalanced nucleotide concentrations	• Prepare fresh deoxynucleotide mixes
	Template DNA has been damaged	• Start with a fresh template • Try repairing DNA template with the PreCR® Repair Mix (NEB #M0309) • Limit UV exposure time when analyzing or excising PCR product from the gel
	Desired sequence may be toxic to host	• Clone into a non-expression vector • Use a low-copy number cloning vector
Incorrect product size	Incorrect annealing temperature	• Recalculate primer Tm values using the NEB Tm calculator (TmCalculator.neb.com)
	Mispriming	• Verify that primers have no additional complementary regions within the template DNA
	Improper Mg^{2+} concentration	• Adjust Mg^{2+} concentration in 0,2–1 mM increments
	Nuclease contamination	• Repeat reactions using fresh solutions
No product	Incorrect annealing temperature	• Recalculate primer Tm values using the NEB Tm calculator (www.neb.com/TmCalculator) • Test an annealing temperature gradient, starting at 5°C below the lower Tm of the primer pair
	Poor primer design	• Check specific product literature for recommended primer design • Verify that primers are non-complementary, both internally and to each other • Increase length of primer
	Poor primer specificity	• Verify that oligos are complementary to proper target sequence
	Insufficient primer concentration	• Primer concentration can range from 0,05–1 µM in the reaction. Please see specific product literature for ideal conditions
	Missing reaction component	• Repeat reaction setup
	Suboptimal reaction conditions	• Optimize Mg^{2+} concentration by testing 0,2–1 mM increments • Thoroughly mix Mg^{2+} solution and buffer prior to adding to the reaction • Optimize annealing temperature by testing an annealing temperature gradient, starting at 5°C below the lower Tm of the primer pair
	Poor template quality	• Analyze DNA via gel electrophoresis before and after incubation with Mg^{2+} • Check 260/280 ratio of DNA template
	Presence of inhibitor in reaction	• Further purify starting template by alcohol precipitation, drop dialysis or commercial clean up kit • Decrease sample volume
	Insufficient number of cycles	• Rerun the reaction with more cycles
	Incorrect thermocycler programming	• Check program, verify times and temperatures
	Inconsistent thermocycler block temperature	• Test calibration of heating block
	Contamination of reaction tubes or solutions	• Autoclave empty reaction tubes prior to use to eliminate biological inhibitors • Prepare fresh solutions or use new reagents
	Complex template	• Use One*Taq* DNA Polymerases • For GC-rich templates, use One*Taq* DNA Polymerase (NEB #M0480) with One*Taq* GC Reaction Buffer (plus One*Taq* High GC Enhancer, if necessary) or Q5 High-Fidelity DNA Polymerase (NEB #M0491) with the High GC Enhancer • For longer templates, we recommend LongAmp *Taq* DNA Polymerase
Multiple or non-specific products	Premature replication	• Use a hot start polymerase, such as Q5 Hot Start High-Fidelity (NEB #M0493) or One*Taq* Hot Start (NEB #M0481) DNA Polymerases • Set up reactions on ice using chilled components and add samples to thermocycler preheated to the denaturation temperature
	Primer annealing temperature too low	• Recalculate primer Tm values using the NEB Tm Calculator (TmCalculator.neb.com) • Increase annealing temperature
	Incorrect Mg^{2+} concentration	• Adjust Mg^{2+} in 0,2–1 mM increments
	Poor primer design	• Check specific product literature for recommended primer design • Verify that primers are non-complementary, both internally and to each other • Increase length of primer • Avoid GC-rich 3´ ends
	Excess primer	• Primer concentration can range from 0,05–1 µM in the reaction. Please see specific product literature for ideal conditions.
	Contamination with exogenous DNA	• Use positive displacement pipettes or non-aerosol tips • Set-up dedicated work area and pipettor for reaction setup • Wear gloves during reaction setup
	Incorrect template concentration	• For low complexity templates (e.g., plasmid, lambda, BAC DNA), use 1 pg–10 ng of DNA per 50 µl reaction • For higher complexity templates (e.g., genomic DNA), use 1 ng–1 µg of DNA per 50 µl reaction

* Phusion DNA Polymerase was developed by Finnzymes Oy, now a part of Thermo Fisher Scientific. This product is manufactured by New England Biolabs, Inc. under agreement with, and under the performance specifications of Thermo Fisher Scientific. Phusion® is a registered trademark and property of Thermo Fisher Scientific.

General Guidelines for PCR Optimization

New England Biolabs offers a diverse group of DNA Polymerases for PCR-based applications. Specific recommendations for PCR optimization can be found in the product literature or on the individual product webpages. However, these general guidelines will help to ensure success using New England Biolabs' PCR enzymes.

Setup Guidelines

DNA Template

- Use high quality, purified DNA templates whenever possible. Please refer to specific product information for amplification from unpurified DNA (e.g., colony PCR or direct PCR).
- For low complexity templates (e.g., plasmid, lambda, BAC DNA), use 1 pg–10 ng of DNA per 50 µl reaction
- For higher complexity templates (e.g., genomic DNA), use 1 ng–1 µg of DNA per 50 µl reaction
- Higher DNA concentrations tend to decrease amplicon specificity, particularly when a high number of cycles are run

Primers

- Primers should typically be 20–40 nucleotides in length
- Ideal primer content is 40–60% GC
- Primer Tm calculation should be determined with NEB's Tm Calculator (www.neb.com/TmCalculator)
- Annealing temperatures should be determined according to specific enzyme recommendations. *Please note that Q5 and Phusion annealing temperature recommendations are unique.*
- Primer pairs should have Tm values that are within 5°C
- Avoid secondary structure (e.g., hairpins) within each primer and potential dimerization between the primers
- Final concentration of each primer should be 0,05–1 µM in the reaction. Please refer to the more detailed recommendations for each specific enzyme.
- Higher primer concentrations may increase secondary priming and create spurious amplification products
- When amplifying products > 20 kb in size, primers should be ≥ 24 nucleotides in length with a GC content above 50% and matched Tm values above 60°C
- When engineering restriction sites onto the end of primers, 6 nucleotides should be added 5´ to the site
- To help eliminate primer degradation and subsequent non-specific product formation, use a hot-start enzyme (e.g., One*Taq* Hot Start DNA Polymerase or Q5 Hot Start High-Fidelity DNA Polymerase)

Magnesium Concentration

- Optimal Mg^{++} concentration is usually 1,5–2,0 mM for most PCR polymerases
- Most PCR buffers provided by NEB already contain sufficient levels of Mg^{++} at 1X concentrations. Please refer to the specific product information for Mg^{++} content.
- NEB offers a variety of Mg-free reaction buffers to which supplemental Mg^{++} can be added for applications that require complete control over Mg^{++} concentration
- Further optimization of Mg^{++} concentration can be done in 0,2–1 µM increments, if necessary. For some specific applications, the enzyme may require as much as 6 mM Mg^{++} in the reaction
- Insufficient Mg^{++} concentrations may cause reaction failure

Deoxynucleotides

- Ideal dNTP concentration is typically 200 µM of each, however, some enzymes may require as much as 400 µM each. Please refer to specific product literature for more detailed recommendations.
- Excess dNTPs can chelate Mg^{++} and inhibit the polymerase
- Lower dNTP concentration can increase fidelity, however, yield is often reduced
- The presence of uracil in the primer, template, or deoxynucleotide mix will cause reaction failure when using archaeal-based PCR polymerases. Use One*Taq* or *Taq* DNA Polymerases for these applications.

Enzyme Concentration

- Optimal enzyme concentration in the reaction is specific to each polymerase. Please see the product literature for specific recommendations.
- In general, excess enzyme can lead to amplification failure, particularly when amplifying longer fragments

Starting Reactions

- Unless using a hot start enzyme (e.g., One*Taq* Hot Start DNA Polymerase or Q5 Hot Start High-Fidelity DNA Polymerase), assemble all reaction components on ice
- Add the polymerase last, whenever possible
- Transfer reactions to a thermocycler that has been pre-heated to the denaturation temperature. Please note that pre-heating the thermocycler is not necessary when using a hot start enzyme(e.g., One*Taq* Hot Start DNA Polymerase or Q5 Hot Start High-Fidelity DNA Polymerase).

Cycling Guidelines

Denaturation

- Optimal denaturation temperature ranges from 94°–98°C and is specific to the polymerase in the reaction. Please refer to product information for recommended conditions.
- Avoid longer or higher temperature incubations unless required due to high GC content of the template
- For most PCR polymerases, denaturation of 5–30 seconds is recommended during cycling
- NEB's aptamer-based hot start enzymes do not require additional denaturation steps to activate the enzymes

Annealing

- Primer Tm values should be determined using the NEB Tm Calculator (**TmCalculator.neb.com**)
- For PCR polymerases other than Q5 High-Fidelity DNA Polymerase or Phusion High-Fidelity DNA Polymerase*, annealing temperatures are usually set at 2°–5°C below the lowest Tm of the primer pair
- When using Q5 High-Fidelity DNA Polymerase or Phusion High-Fidelity DNA Polymerase*, annealing temperatures should be set at 0°–3°C above the lowest Tm of the primer pair. Please refer to the product literature for detailed recommendations.
- Non-specific product formation can often be avoided by optimizing the annealing temperature or by switching to a hot start enzyme (e.g., One*Taq* Hot Start DNA Polymerase or Q5 Hot Start High-Fidelity DNA Polymerase)
- Annealing temperatures can be optimized by doing a temperature gradient PCR, starting at 5°C below the lowest Tm of the primer pair
- Ideally, primer Tm values should be less than the extension temperature. However, if Tm values are calculated to be greater than the extension temperature, a two-step PCR program (combining annealing and extension into one step) can be employed.

Extension

- Extension temperature recommendations range from 65°–72°C and are specific to each PCR polymerase. Please refer to the product literature for specific recommendations.
- Extension rates are specific to each PCR polymerase. In general, extension rates range from 15–60 seconds per kb. Please refer to the recommendations for each specific product.
- Longer than recommended extension times can result in higher error rates, spurious banding patterns and/or reduction of amplicon yields

* Phusion DNA Polymerase was developed by Finnzymes Oy, now a part of Thermo Fisher Scientific. This product is manufactured by New England Biolabs, Inc. under agreement with, and under the performance specifications of Thermo Fisher Scientific. Phusion® is a registered trademark and property of Thermo Fisher Scientific.

For more information on polymerase properties and usage, visit http://international.neb.com.

PCR Polymerases

PRODUCT	NEB #	SIZE
Deep Vent$_R$ DNA Polymerase	M0258S/L	200/1.000 units
Deep Vent$_R$ (exo$^-$) DNA Polymerase	M0259S/L	200/1.000 units
EpiMark Hot Start *Taq* DNA Polymerase	M0490S/L	100/500 reactions
Hemo KlenTaq DNA Polymerase	M0332S/L	200/1.000 reactions (25 µl reaction vol)
Hot Start *Taq* 2X Master Mix	M0496S/L	100/500 reactions (50 µl reaction vol)
Hot Start *Taq* DNA Polymerase	M0495S/L	200/1.000 units
LongAmp *Taq* 2X Master Mix	M0287S/L	100/500 reactions (50 µl reaction vol)
LongAmp *Taq* DNA Polymerase	M0323S/L	500/2.500 units
LongAmp *Taq* PCR Kit	E5200S	100 reactions (50 µl reaction vol)
LongAmp Hot Start *Taq* DNA Polymerase	M0534S/L	500/2.500 units
LongAmp Hot Start *Taq* 2X Master Mix	M0533S/L	100/500 reactions (50 µl reaction vol)
Multiplex PCR 5X Master Mix	M0284S	100 reactions (50 µl reaction vol)
NEBNext Q5 Hot Start HiFi PCR Master Mix	M0543S/L	50/250 reactions
NEBNext High-Fidelity 2X PCR Master Mix	M0541S/L	50/250 reactions
NEBNext Ultra II Q5 Master Mix	M0544S/L	50/250 reactions
One*Taq* DNA Polymerase	M0480S/L/X	200/1.000/5.000 units
One*Taq* Quick-Load DNA Polymerase	M0509S/L/X	100/500/2.500 units
One*Taq* 2X Master Mix with Standard Buffer	M0482S/L	100/500 reactions (50 µl reaction vol)
One*Taq* 2X Master Mix with GC Buffer	M0483S/L	100/500 reactions (50 µl reaction vol)
One*Taq* Quick-Load 2X Master Mix with Standard Buffer	M0486S/L	100/500 reactions (50 µl reaction vol)
One*Taq* Quick-Load 2X Master Mix with GC Buffer	M0487S/L	100/500 reactions (50 µl reaction vol)
One*Taq* Hot Start DNA Polymerase	M0481S/L/X	200/1.000/5.000 units
One*Taq* Hot Start 2X Master Mix with Standard Buffer	M0484S/L	100/500 reactions (50 µl reaction vol)
One*Taq* Hot Start 2X Master Mix with GC Buffer	M0485S/L	100/500 reactions (50 µl reaction vol)
One*Taq* Hot Start Quick-Load 2X Master Mix with Standard Buffer	M0488S/L	100/500 reactions (50 µl reaction vol)
One*Taq* Hot Start Quick-Load 2X Master Mix with GC Buffer	M0489S/L	100/500 reactions (50 µl reaction vol)
Phusion High-Fidelity DNA Polymerase	M0530S/L	100/500 units
Phusion High-Fidelity PCR Kit	E0553S/L	50/200 reactions (50 µl reaction vol)
Phusion High-Fidelity PCR Master Mix with HF Buffer	M0531S/L	100/500 reactions (50 µl reaction vol)
Phusion High-Fidelity PCR Master Mix with GC Buffer	M0532S/L	100/500 reactions (50 µl reaction vol)
Phusion Hot Start Flex DNA Polymerase	M0535S/L	100/500 units
Phusion Hot Start Flex 2X Master Mix	M0536S/L	100/500 reactions (50 µl reaction vol)
Q5 High-Fidelity DNA Polymerase	M0491S/L	100/500 units
Q5 Hot Start High-Fidelity DNA Polymerase	M0493S/L	100/500 units
Q5 High-Fidelity 2X Master Mix	M0492S/L	100/500 reactions (50 µl reaction vol)
Q5 Hot Start High-Fidelity 2X Master Mix	M0494S/L	100/500 reactions (50 µl reaction vol)
Quick-Load *Taq* 2X Master Mix	M0271L	500 reactions (50 µl reaction vol)
Taq 2X Master Mix	M0270L	500 reactions (50 µl reaction vol)
Taq 5X Master Mix	M0285L	500 reactions (50 µl reaction vol)
Taq DNA Polymerase with Standard *Taq* Buffer	M0273S/L/X	400/2.000/4.000 units
Taq DNA Polymerase with Standard *Taq* (Mg-free) Buffer	M0320S/L	400/2.000 units
Taq DNA Polymerase with ThermoPol Buffer	M0267S/L/X/E	400/2.000/4.000/20.000 units
Taq PCR Kit	E5000S	200 reactions (50 µl reaction vol)
Vent$_R$ DNA Polymerase	M0254S/L	200/1.000 units
Vent$_R$ (exo$^-$) DNA Polymerase	M0257S/L	200/1.000 units

Repair

PRODUCT	NEB #	SIZE
PreCR Repair Mix	M0309S/L	30/150 reactions

Companion Products

1 kb DNA Ladder	N3232S/L	200/1.000 gel lanes
Quick-Load 1 kb Extend DNA Ladder	N3239S	125 gel lanes
100 bp DNA Ladder	N3231S/L	100/500 gel lanes
2-Log DNA Ladder (0,1–10,0 kb)	N3200S/L	100–200/500–1.000 gel lanes
50 bp DNA Ladder	N3236S/L	100–200/500–1.000 gel lanes
Low Molecular Weight DNA Ladder	N3233S/L	100/500 gel lanes
Fast DNA Ladder	N3238S	50 gel lanes
PCR Marker	N3234S	100/500 gel lanes
Quick-Load Purple 1 kb DNA Ladder	N0552S	125 gel lanes
Quick-Load Purple 100 bp DNA Ladder	N0551S	125 gel lanes
Quick-Load Purple 2-Log DNA Ladder (0,1–10,0 kb)	N0550S	125–250 gel lanes
Deoxynucleotide Solution Set	N0446S	25 µmol of each
Deoxynucleotide Solution Mix	N0447S/L	8 µmol of each/40 µmol of each
dATP Solution	N0440S	25 µmol
Acyclonucleotide Set	N0460S	0,5 µmol of each
7-deaza-dGTP	N0445S/L	0,15 µmol of each/0,3 µmol of each
Ribonucleotide Solution Set	N0450S/L	10 µmol of each/50 µmol of each
Ribonucleotide Solution Mix	N0466S/L	8 µmol of each/40 µmol of each

For full licensing information, please visit www.neb.com.

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