

# NEB 5-alpha Electrocompetent *E. coli*



1-800-632-7799  
info@neb.com  
www.neb.com



## C2989K

6 x 0.1 ml/tube

Lot: 0681411

Store at  $-80^{\circ}\text{C}$

**CAUTION:** This product contains DMSO, a hazardous material. Review the MSDS before handling.

**Description:** NEB 5-alpha Electrocompetent *E. coli* cells are optimized for high transformation efficiency by electroporation. These cells are ideal for DNA library constructions and all cloning purposes.

### Features:

- DH5 $\alpha^{-}$  derivative
- Transformation efficiency:  $1-3 \times 10^{10}$  cfu/ $\mu\text{g}$  pUC19 DNA
- Efficient transformation of unmethylated DNA derived from PCR, cDNA and many other sources (*hsdR*)
- Activity of nonspecific endonuclease I (*endA1*) eliminated for highest quality plasmid preparations
- Suitable for blue/white screening by  $\alpha$ -complementation of the  $\beta$ -galactosidase gene [ $\phi 80\Delta(\text{lacZ})\text{M15}$ ]
- Resistance to phage T1 (*fhuA2*)
- Reduced recombination of cloned DNA (*recA1*)
- K12 Strain
- Free of animal products

### Reagents Supplied:

6 x 0.1 ml/tube of NEB 5-alpha Electrocompetent *E. coli* cells  
(Store at  $-80^{\circ}\text{C}$ )

25 ml of SOC Outgrowth Medium (Store at room temperature)

0.025 ml of 50 pg/ $\mu\text{l}$  pUC19 Control DNA (Store at  $-20^{\circ}\text{C}$ )

### Quality Control Assays

**Transformation Efficiency:** 10 pg of pUC19 plasmid DNA was electroporated into 25  $\mu\text{l}$  NEB 5-alpha Electrocompetent *E. coli* following the protocol described below.  $1-3 \times 10^{10}$  colonies formed/ $\mu\text{g}$  pUC19 after an overnight incubation on LB-ampicillin plates at  $37^{\circ}\text{C}$ .

Untransformed cells were also tested for resistance to phage  $\phi 80$ , a standard test for resistance to phage T1. Cells are sensitive to ampicillin, chloramphenicol, kanamycin, nitrofurantoin, spectinomycin, streptomycin and tetracycline. The cells were shown to be suitable for blue/white screening by  $\alpha$ -complementation of the  $\beta$ -galactosidase gene using pUC19.

### Electroporation Protocol

1. Prepare 17 mm x 100 mm round-bottom culture tubes (e.g. VWR #60818-667) at room temperature. Place SOC recovery medium in a  $37^{\circ}\text{C}$  water bath. Pre-warm selective plates at  $37^{\circ}\text{C}$  for 1 hour.
2. Place electroporation cuvettes (1 mm) and microcentrifuge tubes on ice.
3. As a positive control for transformation, dilute the control pUC19 by 1:5 to a final concentration of 10 pg/ $\mu\text{l}$  using sterile water. Heat-denatured ligation reactions can be used for electroporation directly; however, column purification is recommended.
4. Thaw NEB 5-alpha Electrocompetent cells on ice (about 10 min) and

**STORAGE AND HANDLING:** Competent cells should be stored at  $-80^{\circ}\text{C}$ . Storage at  $-20^{\circ}\text{C}$  will result in a significant decrease in transformation efficiency. Cells lose efficiency whenever they are warmed above  $-80^{\circ}\text{C}$ , even if they do not thaw.

mix cells by flicking gently. Transfer 25  $\mu\text{l}$  of the cells (or the amount specified for the cuvettes) to a chilled microcentrifuge tube. Add 1  $\mu\text{l}$  of the DNA solution.

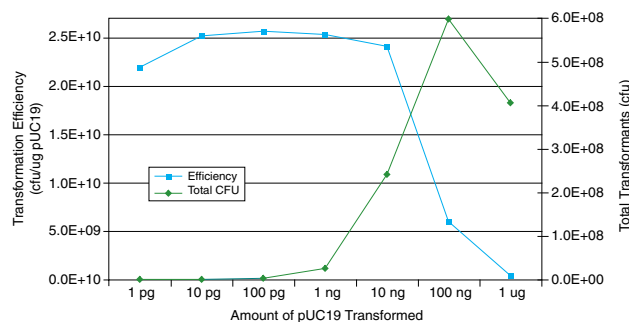
5. Carefully transfer the cell/DNA mix into a chilled cuvette without introducing bubbles and make sure that the cells deposit across the bottom of the cuvette. Electroporate using the following conditions for BTX ECM 630 and Bio-Rad GenePulser electroporators: 1.7 kV, 200  $\Omega$ , and 25  $\mu\text{F}$ . The typical time constant is 4.8 to 5.1 milliseconds.
6. Immediately add 975  $\mu\text{l}$  of  $37^{\circ}\text{C}$  SOC to the cuvette, gently mix up and down twice, then transfer to the 17 mm x 100 mm round-bottom culture tube.
7. Shake vigorously (250 rpm) or rotate at  $37^{\circ}\text{C}$  for 1 hour.
8. Dilute the cells as appropriate then spread 100-200  $\mu\text{l}$  cells onto a pre-warmed selective plate.
9. Incubate plates overnight at  $37^{\circ}\text{C}$ .

### Calculation of Electrotransformation Efficiency

Transformation efficiency is defined as the number of colony forming units (cfu) which would be produced by electrotransforming 1  $\mu\text{g}$  of plasmid into a given volume of electrocompetent cells. For example, if a 10 pg transformation of pUC19 yields 100 colonies when 100  $\mu\text{l}$  of a 1:100 dilution is plated, then the cfu/ $\mu\text{g}$  is  $1.0 \times 10^{10}$  (100 cfu/10 pg x  $10^6$  pg/ $\mu\text{g}$  x 1 ml/0.1 ml plated x 100 dilution).

### Electroporation Tips

- Electroporation cuvettes and microcentrifuge tubes should be pre-chilled on ice.
- Electrocompetent cells should be thawed on ice and suspended well by carefully flicking the tubes.
- Once DNA is added to the cells, electroporation can be carried out immediately. It is not necessary to incubate DNA with cells. The maximum recommended volume of a DNA solution to be added is 2.5  $\mu\text{l}$ . Addition of a large volume of DNA decreases transformation efficiency.
- Contaminants such as salts and proteins can lower electroporation efficiency. Ideally, DNA for transformation should be purified and suspended in water or TE. Transformation efficiency is more than 10-fold lower for ligation mixtures than the control pUC19 plasmid due to the presence of ligase and salts. If used directly, ligation reactions should be heat-inactivated at  $65^{\circ}\text{C}$  for 20 min and then diluted 10-fold. For optimal results, spin columns are recommended for clean up of ligation reactions (Figure 2).
- Electroporation conditions vary with different cuvettes and electroporator. If you are using electroporators not specified in the protocol, you may need to optimize the electroporation conditions. Cuvettes with 1mm gap are recommended (e.g. BTX Model 610/613 and Bio-Rad #165-2089). Higher voltage is required for cuvettes with 2 mm gap.
- Arcing may occur due to high concentration of salts or air bubbles.
- It is essential to add recovery medium to the cells immediately after electroporation. One minute delay can cause a 3-fold reduction in efficiency.
- Cold and dry selection plates lead to lower transformation efficiency. Pre-warm plates at  $37^{\circ}\text{C}$  for 1 hour. Using  $37^{\circ}\text{C}$  pre-warmed recovery medium increases the efficiency by about 20%.
- Refreeze unused cells in a dry ice/ethanol bath for 5 min and then store at  $-80^{\circ}\text{C}$ . Do not use liquid nitrogen. Additional freeze-thaw cycles result in lower transformation efficiency.



**DNA Effects on Transformation Efficiency and Colony Output:** Electrotransformation efficiency remains extremely high up to about 10 ng of input DNA, then decreases precipitously at higher DNA concentrations.

CERTIFICATE OF ANALYSIS

## Solutions/Recipes

SOB:

2%	Vegetable peptone (or Tryptone)
0.5%	Yeast Extract
10 mM	NaCl
2.5 mM	KCl
10 mM	MgCl <sub>2</sub>
10 mM	MgSO <sub>4</sub>

SOC:

SOB + 20 mM Glucose

LB agar:

1%	Tryptone
0.5%	Yeast Extract
0.17 M	NaCl
1.5%	Agar

Blue/White Screening:

X-gal	80 µg/ml
IPTG*	0.3 mM

\*Omit IPTG for potentially toxic genes

## Antibiotics for plasmid selection

Antibiotic	Working Concentration
Ampicillin	100 µg/ml
Carbenicillin	100 µg/ml
Chloramphenicol	33 µg/ml
Kanamycin	30 µg/ml
Streptomycin	25 µg/ml
Tetracycline	15 µg/ml

**Genotype:** *fhuA2Δ(argF-lacZ)U169 phoA glnV44 t80D (lacZ)M15 gyrA96 recA1 relA1 endA1 thi-1 hsdR17*

## Strain Properties

The properties of this strain that contribute to its usefulness as a cloning strain are described below. The genotypes underlying these properties appear in parentheses.

**Blue/White Screening ( $\phi$ 80Δ(*lacZ*)M15):** makes ω-fragment of β-galactosidase (β-gal); (*argF-lacZ*) deletes the β-gal gene on the chromosome) pUC19 and similar plasmids code for the α-peptide of β-galactosidase (*lacZ*). The α-peptide can combine with the ω-fragment of β-galactosidase that is carried on the F' (α-complementation). When β-galactosidase is reconstituted in this manner it can cleave 5-bromo-4-chloro-3-inolyl-β-D-galactosidase (X-gal) and results in blue colonies on an X-gal plate. Inserts cloned into the plasmid polylinker disrupt the α-peptide gene and the colonies are white.

**Recombination Deficient (*recA1*):** *E. coli* has a repair system that will recombine homologous sequences. Genomic clones often have duplicated regions, and RecA mediated rearrangements can be problematic, particularly when regions of homology are longer than 50 bp. Strains that are *recA*<sup>-</sup> tend to grow more slowly than *recA*<sup>+</sup> strains.

**Endonuclease I Deficient (*endA1*):** The periplasmic space of wild type *E. coli* cells contains a nonspecific endonuclease. Extreme care must be taken to avoid degradation of plasmids prepared from these cells. The *endA* mutation deletes this endonuclease and can significantly improve the quality of plasmid preparations.

**Restriction Deficient (*hsdR17*):** Wild type *E. coli* K12 strains carry a restriction endonuclease which cleaves DNA with sites (AAC(N6)GTGC and GCAC(N6)GTT. While *E. coli* DNA is protected from degradation by a cognate methyl-transferase, foreign DNA will be cut at these sites. The *hsdR* mutation eliminates this endonuclease activity. However, this strain has functional methyl restriction systems and may not be suitable for direct cloning of eukaryotic DNA.

**T1 Phage Resistant (*fhuA2*):** T1, an extremely virulent phage requires the *E. coli* ferric hydroxamate uptake receptor for infectivity. Deletion of this gene confers resistance to this type of phage, but does not significantly affect the transformation or growth characteristics of the cell.

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## Companion Products Sold Separately:

SOC Outgrowth Medium

#B9020S 4 x 25 ml medium