

# **OverExpress<sup>TM</sup> Electrocompetent Cells**

**IMPORTANT!  
-80°C Storage Required  
Immediately Upon Receipt**

**Lucigen<sup>®</sup> Corporation**  
Advanced Products for Molecular Biology

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# OverExpress™ Electrocompetent Cells

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# OverExpress™ Electrocompetent Cells

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## Components & Storage Conditions

Four strains of Lucigen's OverExpress Electrocompetent Cells are available: C41(DE3), C43(DE3), C41(DE3)pLysS, and C43(DE3)pLysS.

The cells are shipped on dry ice in one container, along with supercoiled control pUC19 DNA at 1 ng/μl, supercoiled control plasmid pAVD10 at 5 ng/μl, and Expression Recovery Medium. C41(DE3), C43(DE3), C41(DE3)pLysS, and C43(DE3)pLysS are packaged in 25-μl aliquots ("SOLO"), sufficient for one transformation per tube. Please refer to the table below for materials and catalog numbers

**All OverExpress Electrocompetent Cells require storage at -80° C.**

### OverExpress Electrocompetent Cells

STRAIN	Efficiency (cfu/μg pUC19)	Transformations	Catalog #	Storage
OverExpress C41(DE3) (Green tube)	$\geq 1 \times 10^{10}$	12 ( 12 x 25 μl) 24 ( 24 x 25 μl)	60341-1 60341-2	<b>-80°C</b>
OverExpress C41(DE3)pLysS (Brown tube)	$\geq 1 \times 10^9$	12 ( 12 x 25 μl) 24 ( 24 x 25 μl)	60343-1 60343-2	<b>-80°C</b>
OverExpress C43(DE3) (Blue tube)	$\geq 1 \times 10^{10}$	12 ( 12 x 25 μl) 24 ( 24 x 25 μl)	60345-1 60345-2	<b>-80°C</b>
OverExpress C43(DE3)pLysS (White tube)	$\geq 1 \times 10^9$	12 ( 12 x 25 μl) 24 ( 24 x 25 μl)	60347-1 60347-2	<b>-80°C</b>
OverExpress ComboPack (3 reactions of each of the above)		12 ( 12 x 25 μl)	60350-1	<b>-80°C</b>
Expression Recovery Medium* (lactose-free)		12 ( 1 x 12 ml) 24 ( 2 x 12 ml) 96 ( 8 x 12 ml)	---- ---- 80030-1	<b>-20 to -80°C</b>
Supercoiled pAVD10 DNA (5 ng/ μl)		10 ( 1 x 10 μl)	----	<b>-20 to -80°C</b>
Supercoiled pUC19 DNA (1 ng/ μl)		( 1 x 5 μl)	----	<b>-20 to -80°C</b>

# OverExpress™ Electrocompetent Cells

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## OverExpress Electroporation Competent Cells

OverExpress C41(DE3), C41(DE3)pLysS, C43(DE3), and C43(DE3)pLysS Electrocompetent Cells are *E. coli* strains that are effective in expressing toxic proteins from all classes of organisms, including bacteria, yeast, plant, viruses, and mammals.

These new OverExpress strains contain genetic mutations phenotypically selected for conferring tolerance to toxic proteins (1-5). The strain C41(DE3) was derived from BL21(DE3). This strain has at least one uncharacterized mutation, which prevents cell death associated with expression of many recombinant toxic proteins. The strain C43(DE3) was derived from C41(DE3) by selecting for resistance to a different toxic protein. It can express a different set of toxic proteins than C41(DE3).

As in standard BL21(DE 3) strains, OverExpress C41(DE3), C41(DE3)pLysS, C43(DE3), and C43 (DE3)pLysS are lysogens of  $\lambda$ DE3. These strains carry a chromosomal copy of the T7 RNA polymerase gene under the control of the *lacUV5* promoter. These strains are suitable for production of protein from target genes cloned into T7-driven expression vectors. OverExpress C41(DE3), C41(DE3) pLysS, C43(DE3), and C43(DE3)pLysS are also deficient in the *lon* and *ompT* proteases.

OverExpress C41(DE3)pLysS and C43(DE3)pLysS carry a chloramphenicol resistant plasmid that expresses a small amount of T7 lysozyme, which is a natural inhibitor of T7 RNA polymerase. These strains are used to suppress basal expression of T7 RNA polymerase prior to induction, thus stabilizing recombinants encoding particularly toxic proteins. Chloramphenicol (34  $\mu$ g/ml) should be added to the media to maintain the pLysS plasmid.

### Genotypes

#### OverExpress C41(DE3) (Green tube)

$F^- ompT hsdS_B (r_B^- m_B^-) gal dcm$  (DE3)

#### OverExpress C41(DE3)pLysS (Brown tube)

$F^- ompT hsdS_B (r_B^- m_B^-) gal dcm$  (DE3) pLysS (Cm<sup>R</sup>)

#### OverExpress C43(DE3) (Blue tube)

$F^- ompT hsdS_B (r_B^- m_B^-) gal dcm$  (DE3)

#### OverExpress C43(DE3)pLysS (White tube)

$F^- ompT hsdS_B (r_B^- m_B^-) gal dcm$  (DE3) pLysS (Cm<sup>R</sup>)

As a control for transformation, OverExpress Electrocompetent Cells are provided with supercoiled pUC19 DNA at a concentration of 1 ng/ $\mu$ l. Dilute the plasmid 1:100 in dH<sub>2</sub>O, and use 1  $\mu$ l for transformation.

As a control for differentiating C41(DE3) and C43(DE3) strains from each other and from BL21 (DE3), OverExpress Electrocompetent cells are provided with the plasmid vector pAVD10 at a concentration of 5 ng/ $\mu$ l. Dilute 1:50 and use 1  $\mu$ l for transformation.

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## Preparation for Transformation

OverExpress Electrocompetent Cells are provided in 25 µl aliquots (SOLOs), sufficient for one transformation reaction. Transformation is carried out in a 0.1 cm gap cuvette. Optimal settings for electroporation are listed in the table below. Typical time constants are 3.5 to 4.5 msec.

Optimal Setting	Alternate Settings (~ 20-50% lower efficiencies)
1.0 mm cuvette	1.0 mm cuvette
10 µF	25 µF
600 Ohms	200 Ohms
1800 Volts	1400 – 2000 Volts

### Suggested Electroporation Systems:

Eppendorf Model 2510; Bio-Rad Micro Pulser #165-2100; Bio-Rad E. coli Pulser #165-2102; Bio-Rad Gene Pulser II #165-2105; BTX ECM630 Electroporation System.

### Suggested Electroporation Cuvettes (1.0 mm gap):

BTX (Model 610), BioRad (Cat. #165-2089), or Eppendorf (Cat. #4307-000-569). Users have reported much lower transformation efficiencies using Invitrogen cuvettes (Cat. # 65-0030).

Optional transformation control reactions include electroporation with 10 pg of supercoiled pUC19 DNA (1 µl of a 1:100 dilution of the provided stock solution of pUC19).

To ensure successful transformation results, the following precautions must be taken:

- For best results, the ligation reaction must be purified or heat killed at 70°C for 15 minutes before transformation.
- The DNA sample to be used for electroporation must be dissolved in water or a buffer with low ionic strength, such as TE. The presence of salt in the electroporation sample leads to arcing at high voltage, resulting in the loss of the cells and DNA. *NOTE: Ligation reactions performed with Lucigen's CloneDirect™ Ligation Buffer (included with Lucigen's Cloning or Ligation Kits) can be used immediately after heat inactivation, without purification of the ligation products.*
- Microcentrifuge tubes and electroporation cuvettes must be thoroughly pre-chilled on ice before use.
- The cells must be completely thawed **on ice** before use.
- For highest transformation efficiency, use the provided Expression Recovery Medium to resuspend the cells after electroporation. Use of TB or other media may result in lower transformation efficiencies and induction of protein expression.

## Transformation Protocol

1. Have Expression Recovery Medium and 17 mm x 100 mm sterile culture tubes readily available at room temperature (one tube for each transformation reaction). Transformation efficiency may decrease with the use of SOC or other media.
2. Place electroporation cuvettes (1.0 mm gap) on ice
3. Remove OverExpress cells from the -80°C freezer and place on wet ice until they thaw **completely** (10-15 minutes).
4. When cells are thawed, mix them by tapping gently.

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5. Add 1 µl of the heat-denatured CloneSmart® or CloneDirect™ Ligation reaction, or purified ligation product, to the 25 µl of cells on ice. (Failure to heat-inactivate the ligation reaction will prevent transformation.) Stir briefly with pipet tip; **do not** pipet up and down to mix, which can introduce air bubbles and warm the cells. Note: Use of more than 2 µl of ligation mix may cause electrical arcing during electroporation.
6. Carefully pipet 25 µl of the cell/DNA mixture into a chilled electroporation cuvette without introducing bubbles. Quickly flick the cuvette downward with your wrist to deposit the cells across the bottom of the well. Electroporate according to the conditions recommended above.
7. Within 10 seconds of the pulse, add 975 µl of Expression Recovery Medium to the cuvette and pipet up and down three times to resuspend the cells. Transfer the mixture to a culture tube.
8. Place the tube in a shaking incubator at 250 rpm for 1 hour at 37°C.
9. Spread up to 100 µl of transformed cells on YT agar plates containing the appropriate antibiotic.
10. Incubate the plates overnight at 37°C.
11. Transformed clones can be further grown in YT or in lactose-free medium.

Note: YT agar plates are essential for efficient transformation. Colonies may be slow-growing, small, or variable on LB plates. However, liquid LB medium can be used for growth of cultures in tubes.

For OverExpress pLysS strains, add chloramphenicol to 34 µg/ml, in addition to the antibiotic used for selection of the expression vector.

## Strain Verification Protocol

The vector pAVD10 is provided with OverExpress Electrocompetent Cells to verify the identity of the cells. This vector encodes a protein that is toxic to BL21(DE3) cells, even at a very low level of expression. C41 (DE3) cells tolerate basal expression of the protein, but not induced expression. C43(DE) cells are viable even at high levels of expression.

1. Dilute the pAVD10 test vector 1:50 in diH<sub>2</sub>O to 100 pg/ µl
2. Transform the competent cell sample with 1 µl of the diluted pAVD10, using the protocol described above.
3. Plate 100 µl of the transformation reaction onto a YT+ ampicillin plate and 100 µl onto a YT+amp+IPTG plate.
4. Incubate the plates overnight at 37°C.
5. Observe the growth of colonies on each plate.

Expected Results:

	<b>BL 21(DE3)</b>	<b>C41(DE3)</b>	<b>C43(DE3)</b>
YT+Amp	No Colonies	Colonies	Colonies
YT+Amp+IPTG	No Colonies	No Colonies	Colonies

## Sample Induction Protocol

1. Inoculate a single colony from a freshly streaked plate into 5 ml of YT medium containing the appropriate antibiotic for the plasmid and host strain. For OverExpress pLysS strains, add chloramphenicol to 34 µg/ml, in addition to the antibiotic used for selection of the expression vector.

# OverExpress™ Electrocompetent Cells

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2. Incubate with shaking at 37°C overnight. To minimize the amount of expression of the target protein prior to induction, add glucose to the growth medium at a concentration of 0.2% (w/v).
3. Inoculate 50 ml of YT medium containing the appropriate antibiotic with 0.5 ml of the overnight culture prepared in step 2.
4. Incubate with shaking at 37°C until the OD<sub>600</sub> reaches 0.8 -1.
5. Add IPTG to a final concentration of 1 mM. (Prepare a 1 M solution of IPTG by dissolving 2.38 g of IPTG in water and adjust the final volume to 10 ml. Filter sterilize before use). To determine the optimal concentration of IPTG for maximum expression of the target protein, a range of IPTG concentrations from 0.25 - 2 mM should be tested.
6. Incubate at 37°C for 3-4 hours. Optimal time for induction of the target protein may vary from 2-16 hours, depending on the protein.
7. Place the culture on ice for 10 minutes. Harvest cells by centrifugation at 5,000 x g for 10 minutes at 4°C.
8. Remove the supernatant and store the cell pellet at -20°C (storage at lower temperature is also acceptable).

Note: LB medium may be used in place of YT medium for liquid cultures grown in tubes.

## Media Recipes

### YT Agar Plates

Per liter:           5 g yeast extract  
                          8 g tryptone  
                          5 g NaCl  
                          15 g agar

Add deionized water to 1 liter. Adjust pH to 7.0 with NaOH. Autoclave. Cool to 55°C and add the appropriate filter-sterilized antibiotic (e.g., 30-50 mg kanamycin for kanamycin-resistant transformants; 50-100 mg ampicillin or carbenicillin for ampicillin-resistant transformants).

For OverExpress pLysS strains, add chloramphenicol to 34 µg/ml, in addition to the antibiotic used for selection of the expression vector.

For blue/white screening, add 3 ml 100mM IPTG and 10 ml 2% X-gal to the molten agar at 55°C before pouring. Pour approximately 25 ml per petri plate.

Note: YT agar plates are essential for efficient transformation. Colonies may be slow-growing, small, or variable on LB plates.

### IPTG

Prepare a 1 M solution of IPTG (Isopropyl-β-D-thiogalactoside; Isopropyl-β-D-thiogalactopyranoside) by dissolving 2.38 g of IPTG in water and adjust the final volume to 10 ml. Filter sterilize before use.

### YT Culture Medium for Growth of Transformants

Per liter:           5 g yeast extract  
                          8 g tryptone  
                          5 g NaCl

Add all components to deionized water. Adjust pH to 7.0 with NaOH. Autoclave and cool to 55°C.

Note: LB medium may be used in place of YT medium for liquid cultures grown in tubes.

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## Related Lucigen Products

- *E. coli*® EXPRESS BL21(DE3) Electrocompetent Cells
- CloneSmart® Blunt Cloning Kit
- DNATerminator® End Repair Kit
- PCRTerminator® End Repair Kit
- UltraClone™ DNA Ligation & Transformation Kit
- CloneDirect™ Rapid Ligation Kit
- PCR-SMART™ Cloning Kit
- ClonePlex® Library Construction Kit
- pEZSeq™ Blunt Cloning Kit
- cSMART™ cDNA Cloning Kit
- *E. coli*® 10G Electrocompetent Cells

## References

1. B. Miroux and J.E. Walker (1996). Over-production of proteins in *Escherichia coli*: mutant hosts that allow synthesis of some membrane proteins and globular proteins at high levels. *J Mol Biol.* 260, 289-298.
2. L. Dumon-Seignovert, G. Cariot, and L. Vuillard (2004). The toxicity of recombinant proteins in *Escherichia coli*: a comparison of overexpression in BL21(DE3), C41(DE3), and C43(DE3). *Protein Expression and Purification* 37, 203-206. Data used with permission.
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5. F.W. Studier (2005). Protein production by auto-induction in high-density shaking cultures. *Protein Expression and Purification* 41, 207-234.