

**PRODUCT INFORMATION**

**T4 DNA Ligase, 5 u/μl**

#EL0011 1000 u

Lot Expiry Date

Store at -20°C

www.thermoscientific.com/fermentas

**Ordering Information**

**T4 DNA Ligase, 5 u\*μl**

Component	#EL0014	#EL0011	#EL0012
T4 DNA Ligase, 5 u/μl	200 u	1000 u	5x1000 u
10X T4 DNA Ligase Buffer	0.5 ml	1.5 ml	5x 1.5 ml
50% PEG Solution	0.3 ml	1.5 ml	5x 1.5 ml

**T4 DNA Ligase LC, 1 u\*μl**

Component	#EL0016
T4 DNA Ligase, 1 u/μl	2x500 u
10X T4 DNA Ligase Buffer	1.5 ml
50% PEG Solution	1.5 ml

**T4 DNA Ligase HC, 30 u\*μl**

Component	#EL0013
T4 DNA Ligase, 30 u/μl	5000 u
10X T4 DNA Ligase Buffer	5x1.5 ml
50% PEG Solution	5x1.5 ml

\*Weiss unit

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**Description**

T4 DNA Ligase catalyzes the formation of a phosphodiester bond between juxtaposed 5'-phosphate and 3'-hydroxyl termini in duplex DNA or RNA. The enzyme repairs single-strand nicks in duplex DNA, RNA or DNA/RNA hybrids, joins DNA fragments with either cohesive or blunt termini (1, 2). The T4 DNA Ligase requires ATP as a cofactor.

**Applications**

- Cloning of restriction enzyme generated DNA fragments.
- Cloning of PCR products.
- Joining of double-stranded oligonucleotide linkers or adaptors to DNA.
- Site-directed mutagenesis.
- Amplified fragment length polymorphism (AFLP).
- Ligase-mediated RNA detection (3).
- Nick repair in duplex DNA, RNA or DNA/RNA hybrids.
- Self-circularization of linear DNA.

**Definition of Activity Unit**

One Weiss unit of the enzyme catalyzes the conversion of 1 nmol of [<sup>32</sup>P] into Norit-adsorbable form in 20 min at 37°C (4). One Weiss unit is equivalent to approximately 200 cohesive end ligation units (CEU)\*.

Enzyme activity is assayed in the following mixture: 66 mM Tris-HCl (pH 7.6), 6.6 mM MgCl<sub>2</sub>, 0.066 mM ATP, 10 mM DTT, 3.3 μM [<sup>32</sup>P].

\* One CEU is defined as the amount of enzyme required to give 50% ligation of HindIII fragments of lambda DNA in 30 min at 16°C.

**Source**

*E. coli* cells with a cloned gene 30 from bacteriophage T4.

**Molecular Weight**

55.3 kDa monomer.

**Storage Buffer**

The enzyme is supplied in: 20 mM Tris-HCl (pH 7.5), 50 mM KCl, 1 mM DTT, 0.1 mM EDTA and 50% (v/v) glycerol.

**10X T4 DNA Ligase Buffer (#B69)**

400 mM Tris-HCl, 100 mM MgCl<sub>2</sub>, 100 mM DTT, 5 mM ATP (pH 7.8 at 25°C).

**50% PEG Solution**

50% (w/v) polyethylene glycol 4000.

**Inhibition and Inactivation**

- T4 DNA Ligase is strongly inhibited by NaCl or KCl at concentrations higher than 200 mM.
- Inactivated by heating at 65°C for 10 min or at 70°C for 5 min.

**CERTIFICATE OF ANALYSIS**

**Endodeoxyribonuclease Assay**

No conversion of covalently closed circular DNA to nicked DNA was detected after incubation of 50 units of T4 DNA Ligase with 1 μg of pUC19 DNA for 4 hours at 37°C.

**Ribonuclease Assay**

No contaminating RNase activity was detected after incubation of 50 units of T4 DNA Ligase with 1 μg of [<sup>3</sup>H]-RNA for 4 hours at 37°C.


**Labeled Oligonucleotide (LO) Assay**

No degradation of single-stranded and double-stranded labeled oligonucleotide was observed after incubation with 10 units of T4 DNA Ligase for 4 hours at 37°C.

**Blue/White Cloning Assay**

pUC57 DNA/HindIII, pUC57 DNA/PstI and pUC57 DNA/Smal digests were ligated using 10 units of T4 DNA Ligase for one hour at room temperature. Less than 1% of white colonies were detected after transformation of competent *E. coli* XL1-Blue cells with ligation mix.

**Quality authorized by:**

 Jurgita Zilinskiene

**References**

1. Rossi, R., et al., Functional characterization of the T4 DNA Ligase: a new insight into the mechanism of action, *Nucleic Acids Res.*, 25, 2106-2113, 1997.
2. Cherepanov, A.V., et al., Binding of nucleotides by T4 DNA Ligase and T4 RNA Ligase: optical absorbance and fluorescence studies, *Biophys. J.*, 81, 3545-3559, 2001.
3. Nilsson, M., et al., RNA-templated DNA ligation for transcript analysis, *Nucleic Acids Res.*, 29, 578-581, 2001.
4. Weiss, B., et al., Enzymatic breakage and joining of deoxyribonucleic acid, *J. Biol. Chem.*, 243, 4543-4555, 1968.
5. Pfeiffer, B.H., Zimmerman, S.B., Polymer-stimulated ligation: enhanced blunt- or cohesive-end ligation of DNA or deoxyribo-oligonucleotides by T4 DNA ligase in polymer solutions, *Nucleic Acids Res.*, 11, 7853-7871, 1983.

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**DNA INSERT LIGATION INTO VECTOR DNA**

**Sticky-end ligation**

1. Prepare the following reaction mixture:

Linear vector DNA	20-100 ng
Insert DNA	1:1 to 5:1 molar ratio over vector
10X T4 DNA Ligase Buffer	2 μl
T4 DNA Ligase	1 u
Water, nuclease-free (#R0581)	to 20 μl
Total volume	20 μl

2. Incubate 10 min at 22°C.

3. Use up to 5 μl of the mixture for transformation of 50 μl of chemically competent cells or 1-2 μl per 50 μl of electrocompetent cells.

**Note**

- The electrotransformation efficiency may be improved by:
  - heat inactivation of T4 DNA ligase at 65°C for 10 min or at 70°C for 5 min,
  - purification of DNA, using the Thermo Scientific GeneJET PCR Purification Kit (#K0701), or by chloroform extraction.
- The overall number of transformants may be increased by extending the reaction time to 1 hour.
- If more than 2 u of T4 DNA ligase is used in 20 μl reaction mixture, it is necessary to purify DNA (by spin column or chloroform extraction) before electrotransformation.

**Blunt-end ligation**

1. Prepare the following reaction mixture:

Linear vector DNA	20-100 ng
Insert DNA	1:1 to 5:1 molar ratio over vector
10X T4 DNA Ligase Buffer	2 μl
50% PEG 4000 Solution	2 μl
T4 DNA Ligase	5 u
Water, nuclease-free (#R0581)	to 20 μl
Total volume	20 μl

2. Incubate for 1 hour at 22°C.

3. Use up to 5 μl of the mixture to transform 50 μl of chemically competent cells. Purify DNA for electrotransformation, using the GeneJET™ PCR Purification Kit (#K0701), or by chloroform extraction. Use 1-2 μl of DNA solution per 50 μl of electrocompetent cells.

**Note**

If the ligation reaction mixture will be used for electroporation, replace the heat inactivation step with spin column purification or chloroform extraction.

**SELF-CIRCULARIZATION OF LINEAR DNA**

1. Prepare the following reaction mixture:

Linear DNA	10-50 ng
10X T4 DNA Ligase Buffer	5 μl
T4 DNA Ligase	5 u
Water, nuclease-free (#R0581)	to 50 μl
Total volume	50 μl

2. Mix thoroughly, spin briefly and incubate 10 min at 22°C;

3. Use up to 5 μl of the mixture to transform 50 μl of chemically competent cells and 1-2 μl per 50 μl of electrocompetent cells.

**Note**

- The electrotransformation efficiency may be improved by:
  - heat inactivation of T4 DNA ligase at 65°C for 10 min or at 70°C for 5 min,
  - purification of DNA, using the GeneJET PCR Purification Kit (#K0701), or by chloroform extraction.
- The overall number of transformants may be increased by extending the reaction time to 1 hour.

**Important Notes**

- Polyethylene glycol (PEG) greatly increases the ligation efficiency of blunt-end DNA ligation. The recommended concentration of PEG 4000 in the ligation reaction mixture is 5% (w/v).
- Do not exceed the recommended amount of T4 DNA Ligase in the reaction mixture.
- Binding of T4 DNA Ligase to DNA may result in a band shift in agarose gels. To avoid this, incubate samples with 6X Loading Dye & SDS Solution (#R1151) at 65°C for 10 min and chill on ice prior to loading.
- For efficient transformation, the volume of the ligation reaction mixture should not exceed 10% of the competent cell volume.

**LINKER LIGATION**

Double stranded oligonucleotide linkers are often used to generate overhangs not found in the insert. Linkers normally contain restriction enzyme recognition sequences and are digested after ligation to generate overhangs compatible with cloning vectors. Alternatively, linkers may have overhangs which are ready for ligation with a cloning vector and do not require further manipulation following ligation.

1. Prepare the following reaction mixture:

Linear DNA	100-500 ng
Phosphorylated linkers	1-2 μg
10X T4 DNA Ligase Buffer	2 μl
50% PEG 4000 Solution	2 μl
T4 DNA Ligase	2 u
Water, nuclease-free (#R0581)	to 20 μl
Total volume	20 μl

2. Mix thoroughly, spin briefly and incubate for 1 hour at 22°C.

3. Heat inactivate at 65°C for 10 min or at 70°C for 5 min.

**Note**

T4 DNA Ligase is active in PCR and restriction digestion buffers (see table below). Therefore, linker ligation reactions can be performed in the restriction enzyme buffer optimal for the subsequent digestion. In this case, the ligation reaction should be supplemented with ATP to a final concentration of 0.5 mM. After inactivation of the T4 DNA Ligase, add the restriction enzyme directly to the reaction mixture and incubate according to the digestion protocol.

**Activity in PCR and restriction digestion buffers**

Buffers	Activity*, %
PCR, <i>Taq</i> with KCl, <i>Taq</i> with (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> , <i>Pfu</i> and RT buffers	75
Reaction buffers for restriction enzymes	75-100
Thermo Scientific FastDigest, FastDigest® Green, 1X Thermo Scientific Tango, 2X Tango™, B, G, O, R, KpnI, BamHI, EcoRI	50
Ecl136II, PacI, SacI	50

\*Activity of T4 DNA Ligase in various buffers supplemented with 0.5 mM ATP.