

# TrueORF™ cDNA Clones and PrecisionShuttle™ Vector System

## Application Guide

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Revision 01.10.OP

## **Package Contents and Related Products**

The following components are included:

- One (1) vial containing the cDNA clone as 10 ug lyophilized plasmid DNA\*.
- Forward (VP1.5) and reverse (XL39) DNA vector sequencing primers; dried onto the bottom of screw cap tubes.
- Certificate of Analysis
- Application Guide

\* OriGene plasmids are purified using ion-exchange columns for high-yield, low endotoxin preparations (PowerPrep® HP Midiprep Kit [www.origene.com/other/Plasmid\\_Purification](http://www.origene.com/other/Plasmid_Purification).)

The cDNA clone is shipped at room temperature, but should be kept at -20°C for long-term storage. If properly stored, clones are guaranteed to be stable for 12 months.

## **Related Optional Reagents**

Restriction enzymes and buffers

Sgf I or ASIS I from Fermentas

Mlu I from New England Biolabs (NEB)

Nuclease free water

T4 DNA ligase and buffer

Competent *E. coli* cells

LB agar plates with kanamycin, 25 µg/ml (Entry vector)

LB agar plates with ampicillin, 100 µg/ml (Destination vectors)

LB broth (10 g/L Tryptone, 5 g/L Yeast Extract, 10 g/L NaCl. Adjust pH to 7.0 with 1 N NaOH)

DNA purification reagents

Anti-FLAG Antibody – 4C5-AntiDDK (OriGene TA50011)

## **Related OriGene Products**

RapidShuttling Kit <http://www.origene.com/cdna/rapid-shuttling-kit>

TrueClone™ FL cDNA clones <http://www.origene.com/cdna>

HuSH™ shRNA Plasmids <http://www.origene.com/rnai>

VERIFY™ Tagged Antigens <http://www.origene.com/lysate/>

Validated Antibodies <http://www.origene.com/antibody>

Functional Proteins <http://www.origene.com/protein>

Transfection Reagents <http://www.origene.com/cdna/transfection.mspk>

GFC-Transfection Arrays <http://www.origene.com/cdna/gfc-array>

4C5-AntiDDK Antibody <http://www.origene.com/antibody/4C5-AntiDDK>

2H8-Anti-GFP Antibody <http://www.origene.com/antibody/2H8-AntiGFP>

## **Notice to purchaser**

This product is for research use only. Use in and/or for diagnostics and therapeutics is strictly prohibited. By opening and using the product, the purchaser agrees to the following: The plasmids may not be distributed, resold,

modified for resale or used to manufacture commercial products without prior written approval from OriGene Technologies, Inc. If you do not agree to the above conditions, please return the UNOPENED product to OriGene Technologies, Inc. within ten (10) days of receipt for a full refund.

### Vector Information

#### Two Most Common TrueORF Vectors, pCMV6-Entry and pCMV6-AC-GFP

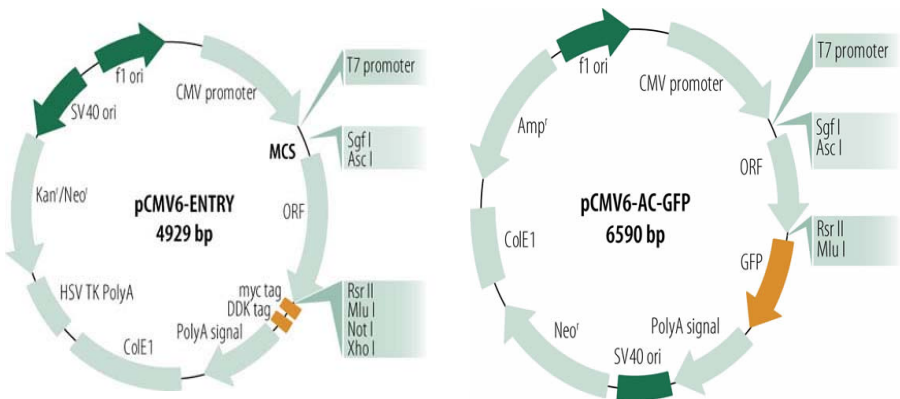
RC123456: TrueORFs with a C-terminal fusion of MYC/DDK tag. The cloning expression vector is pCMV6-Entry. The antibiotic selection marker in *E. coli* is Kanamycin at 25 ug/ml. Unlike other shuttling systems, the entry vector is a functional mammalian expression vector.

RG123456: TrueORFs with a C-terminal fusion of tGFP. The cloning expression vector is pCMV6-AC-GFP. The antibiotic selection marker in *E. coli* is Ampicillin at 100 ug/ml.

TrueORFs, OriGene's ready-to-use expression vectors, are provided in two forms. One is tagged with C-terminal MYC/DDK tag for easy antibody detection and purification. OriGene recommends 4C5-AntiDDK high affinity mAb (Cat # TA50011) for this work. The other form is tagged with C-terminal tGFP which can be visualized under a fluorescence microscope and also be detected by Western blotting with anti-tGFP specific antibody. The fusion protein is under a CMV promoter for strong constitutive expression. The ORF insert can also be easily shuttled into over 40 destination vectors to create different tagging options via a simple "cut-and-ligate" mechanism/ OriGene offers the RapidShuttling Kits specifically for this use ([origene.com/rapid-shuttling-kit](http://origene.com/rapid-shuttling-kit))

All TrueORF clone vectors are described in detail on OriGene's website at <http://www.origene.com/cdna/trueorf/destinationvector.msp>

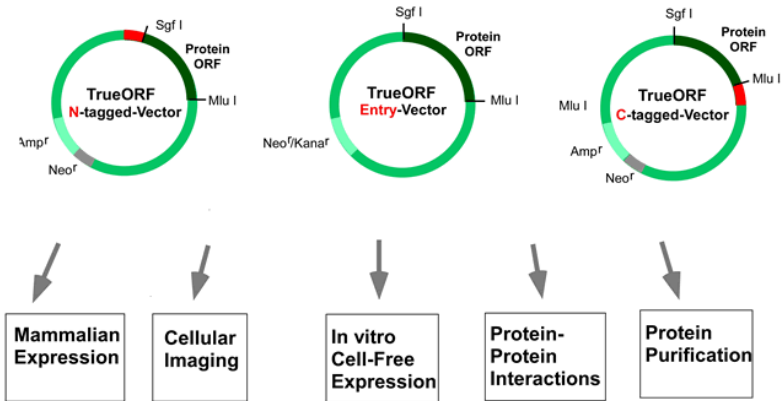
Figure 1. The Vector Maps of pCMV6-Entry and pCMV6-AC-GFP.





# The PrecisionShuttle Vector System

The TrueORF vector system is designed to express the ORF of a gene with one or more epitope tags or with a fluorescent marker. There are more than twenty destination vectors in the PrecisionShuttle vector system. These vectors are either N-terminally tagged (pCMV6-AN) or C-terminally tagged (pCMV6-AC). Available tags include Myc, DDK, His, HA, and t-GFP. One untagged PrecisionShuttle vector is also available to express the native (untagged) protein in mammalian cells, or using an *in vitro* protein expression system. Due to the requirement for the Mlu I restriction site, the untagged vector does still append two amino acids (TR) to the C-terminus of the encoded protein.

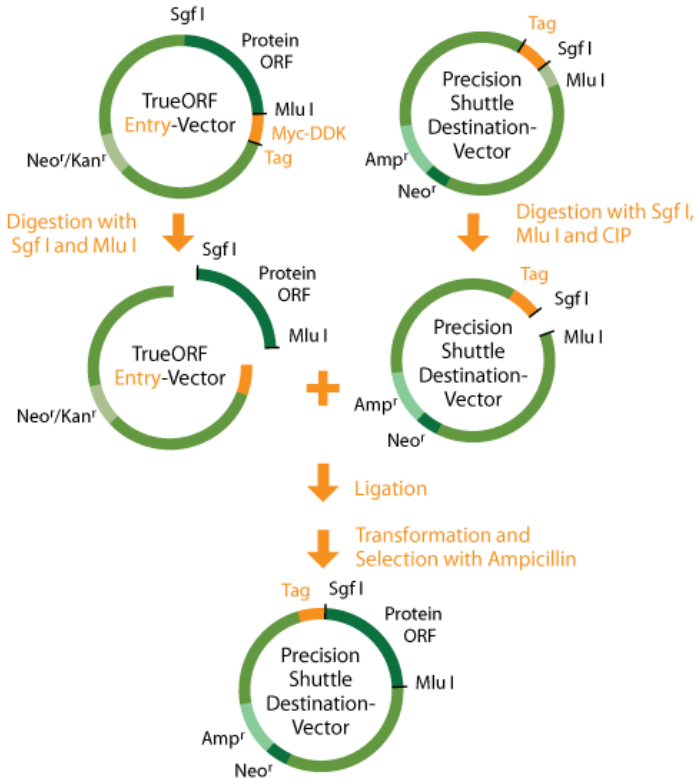


**Figure 2.** Potential applications of the PrecisionShuttle system for protein analysis. The TrueORF cDNA clones in the pCMV6-Entry vector and other N- or C-tagged-vectors can be directly used in your experiments of protein functional analysis.

All of the plasmids in the PrecisionShuttle™ vector system are designed for high-level target gene expression in mammalian cells or *in vitro* translation in a cell-free system. The plasmids contain the promoter and enhancers of the human cytomegalovirus (CMV) immediate-early gene to drive mammalian gene expression, and the T7 promoter for *in vitro* transcription/translation. A Kozak consensus sequence is included in the plasmid to enhance mammalian expression.

The PrecisionShuttle vector system employs a basic “cut and ligate” molecular cloning method (Figure 3). It is faster, cheaper, more reliable and flexible than a recombination strategy, and no intellectual license is required for either academic or commercial users. The transfer of the ORF from the Entry clone to any destination vector is a rapid process. Digestion, ligation and transformation take as little as 3 hrs (Figure 3) since the Entry vector and destination vectors use different antibiotic selection markers. Unlike recombination-based systems in which the Entry clone is only a preliminary product, OriGene’s Entry Vector

contains C-terminal Myc and DDK tags, and can be used directly for many applications including 1) tagged protein expression (C-terminal Myc/DDK in mammalian cells and 2) tagged protein expression in a cell-free system using the T7 promoter.



**Figure 3.** Schematic of the PrecisionShuttle subcloning procedure. The Entry and destination vectors are digested with Sgf I and Mlu I or other specified enzymes. After a ligation reaction, the resulting clones are grown on ampicillin-containing plates to select for successful subcloning of the ORF into the destination vector.

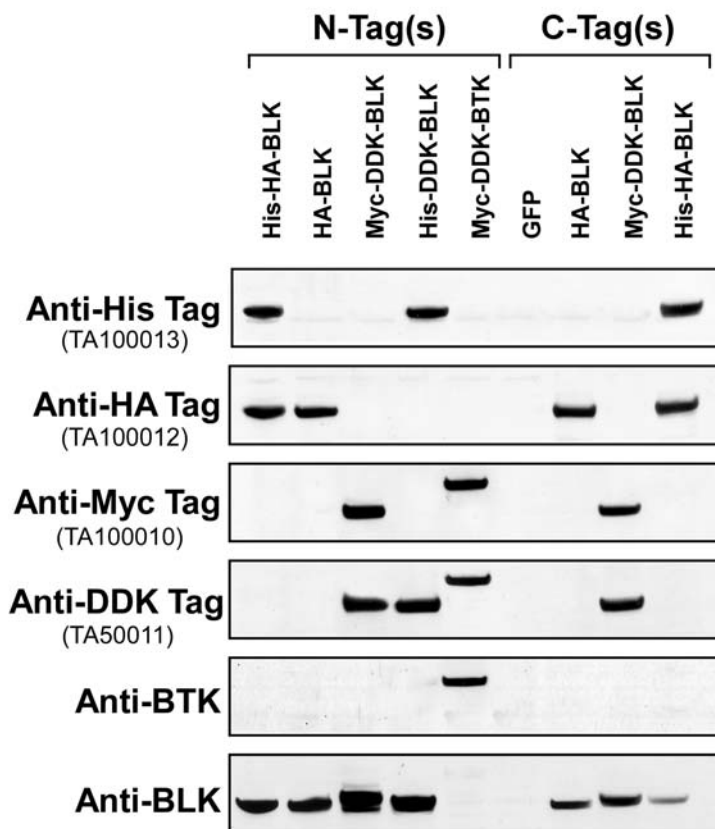
Two rare-cutting restriction enzymes are utilized in transferring an ORF between vectors. Most subcloning from the Entry to a destination vector involves *Sgf I*/Asi I (present in 0.37% of human ORF) and *Mlu I* (4%). In the very unusual case when *Sgf I* and *Mlu I* sites are inside the ORFs, the TrueORF vector MCS provides other rare restriction sites, such as Asc I, Rsr II, and Not I so that any ORF can be shuttled from the Entry vector to a destination vector by using some combination of these five rare restriction enzymes. Unlike site-specific recombination vector systems, the TrueORF Clone System does not append

multiple amino acids to the amino or carboxy terminus of the protein of interest. The subcloning strategy maintains insert orientation and reading frame, eliminating the need to resequence the insert after each transfer. Because the Entry and destination vectors have different antibiotic resistance genes, selection after subcloning is a very simple process. Therefore, the shuttling process can be readily adapted to a 384-well format. With the availability of over 32,000 unique full-length human cDNA clones and mouse clones, OriGene is in an enviable position to develop and support such high throughput applications.

While the PrecisionShuttle vector system can be used for any cDNA, we have developed this system to take advantage of the largest collection of full-length cDNA clones available at OriGene. Every cDNA clone is offered in the Entry vector as a TrueORF clone, and the customer can easily transfer this ORF into any destination vector. A special effort has been made during the synthesis of these TrueORF clones to minimize the generation of mutations. Using a large quantity of high-quality cDNA template, a minimum of PCR cycles and a polymerase with the highest fidelity (one mutation in 40,000,000 bp), the number of PCR mutations is very limited. No mutations were identified during the initial cloning of over 200 ORF cDNAs (ranging from 500-6000bp) into the Entry vector after full-length sequencing of each of these clones. The MCS of the PrecisionShuttle vectors was engineered to be compatible with most other commercially available vector systems including Gateway vectors (Invitrogen), PET vectors (Novagen) and Flexi vectors (Promega). In this sense, the TrueORF vector system is truly universal.

The PrecisionShuttle Entry and destination vectors contain the neomycin phosphotransferase gene under the SV40 promoter. Expression of the neomycin phosphotransferase gene in mammalian cells allows stable cell selection with a neomycin analog such as G418. Destination vectors with alternative selection markers (e.g. puromycin, blasticidin, hygromycin, etc., are also available. A complete and up to date listing of these vectors can be found on our website at <http://www.origene.com/cdna/trueorf/destinationvector.aspx> .

The development of the PrecisionShuttle vector system has gone through a rigorous quality control (QC) process. Both the Entry vector and the destination vectors have been validated for transient and stable mammalian cell transfections using a T-GFP marker (data not shown). The expression of N-terminal and C-terminal fusion tags has been validated by Western blot analysis (shown in Figure 4).



**Figure 4.** Western blot analysis of proteins expressed from N-terminally and C-terminally tagged PrecisionShuttle vectors. Each lane of the blot contains the whole cell lysate from an overexpression experiment using a PrecisionShuttle vector. BLK represents human B lymphoid tyrosine kinase (NM\_001715); BTK represents human Bruton agammaglobulinemia tyrosine kinase (NM\_000061). These two cDNAs were cloned into the destination vectors identified at the top of the blot. GFP represents one empty destination vector, pCMV6-AC-GFP, used for cloning C-terminal GFP fusion proteins. Specific antibodies against BLK and BTK detected the same size proteins as antibodies against the N-terminal and C-terminal tags.

## **Experimental protocols**

### **Detect protein over-expression using anti-DDK antibody**

The protein expression level can be detected using anti-DDK antibody (OriGene product number TA50011, 4C5-AntiDDK monoclonal antibody) with Western blotting method. This antibody is shown to be of higher sensitivity than Sigma's M2 anti-FLAG antibody. Therefore, it is important to use TA50011 mAb when accessing protein over-expression using OriGene's TrueORF clones. When OriGene's 4C5-Anti-DDK monoclonal antibody is used, the suggested starting dilutions are 1:2000 for Western blot, 1:200 for immunoprecipitation and immunostaining, and 1:1000 for immunofluorescence.

### **Primer Design and PCR Amplification of ORF**

The open reading frame (ORF) of the clone must be PCR amplified in order to append cloning sites to the 5' and 3' ends of the sequence. Add the target sequences of the selected restriction enzymes to the forward and reverse PCR primers; examples are shown below.

Forward primer with Sgf I

5' GAG**GCGATCGCC**NNNNNNNNNNNNNNNNNNNNNNNNNNNNNN 3'

Ns represent the sequence of the ORF beginning with the start codon, ATG. It is important to add the additional "C" base after the Sgf I site to maintain appropriate reading frames with N-terminal tags in some destination vectors.

Reverse primer with Mlu I

5' GCG**ACGCGT**NNNNNNNNNNNNNNNNNNNNNNNNNNNNNN 3'

Ns represent the reverse complement of the ORF sequence starting **with the stop codon** for N-terminally tagged or untagged destination vectors. This ensures that the expressed fusion protein will end at the native C-terminal end of the ORF. For C-terminally tagged vectors, the reverse complement of the ORF sequence should start **with the second-to-last codon**, as the stop codon must be removed to generate a fusion protein.

If the recognition sites for Sgf I or Mlu I are present internally in the ORF, another rare cutter such as Asc I, Rsr II or Not I can be used in the cloning strategy. In these cases, the sequences of these alternate restriction sites should be used in place of Sgf I and/or Mlu I (examples below). This same primer design strategy described above should be used for the design of other primers. The Ns in the forward primer represent the sequence of the ORF beginning with the start codon, ATG. The Ns in the reverse primers represent the reverse complement of the ORF sequence starting **with the stop codon** for N-terminally tagged or untagged destination vectors, or starting **with the second-to-last codon** for C-terminally tagged vectors.

Forward primer with Asc I:

5' GCC**GCGCGCC**NNNNNNNNNNNNNNNNNNNNNNNNNNNNNN 3'

An extra nucleotide after Asc I is important to maintain reading frames with N-terminal tags in some destination vectors.



|              |      |        |
|--------------|------|--------|
|              | 72°C | 4 min  |
| 15 cycles of | 95°C | 10 sec |
|              | 56°C | 20 sec |
|              | 72°C | 4 min  |
|              | 72°C | 10 min |
|              | 4°C  | hold   |

### Cloning of ORF into the Entry Vector

1. Confirm that the size of the amplification product is correct by agarose gel electrophoresis, and purify the remainder of the reaction using a purification column or similar method. Elute the DNA from the purification column in 26  $\mu$ l of 10 mM Tris buffer. Set up a digestion reaction as described below, substituting other restriction enzymes as appropriate.

| <u>Component</u>       | <u>Volume</u> |
|------------------------|---------------|
| 10X restriction buffer | 3 $\mu$ l     |
| Sgf I (10U/ $\mu$ l)   | 0.6 $\mu$ l   |
| Mlu I (10U/ $\mu$ l)   | 0.6 $\mu$ l   |
| Purified PCR product   | 26 $\mu$ l    |
| Total volume           | ~30 $\mu$ l   |

Mix well, and incubate at 37°C for 3 hrs.

2. Purify the digestion reaction using a purification column and elute in 18  $\mu$ l of 10 mM Tris buffer. Quantitate the DNA by UV at A260, or by OriGene's QuantiLadder (Cat# QLD200).

3. Digest pCMV6-Entry with the restriction enzymes corresponding to the sequences added to the ORF. pCMV6-Entry is available from OriGene as 10  $\mu$ g lyophilized DNA (Cat# PS100001). Resuspend the lyophilized DNA in 100  $\mu$ l dH<sub>2</sub>O, and incubate for at least 30 min before use. Set up a digestion reaction as described below, substituting other restriction enzymes as appropriate.

| <u>Component</u>       | <u>Volume</u> |
|------------------------|---------------|
| 10X restriction buffer | 3 $\mu$ l     |
| Sgf I (10U/ $\mu$ l)   | 0.8 $\mu$ l   |
| Mlu I (10U/ $\mu$ l)   | 0.8 $\mu$ l   |
| Nuclease free water    | 15.4 $\mu$ l  |
| Vector DNA             | 10 $\mu$ l    |
| Total volume           | 30 $\mu$ l    |

Incubate at 37°C for 3 hrs, then add 1  $\mu$ l antarctic phosphatase (units used according to the manufacturer's protocol), and continue the incubation at 37°C for another 30 min. Dephosphorylation of the digested vector is essential to eliminate self-ligation.

4. Purify the desired vector fragment by running the digestion reaction on an agarose gel, and isolating the appropriate band using a gel purification column. Elute the digested plasmid vector in 40  $\mu$ l of 10 mM Tris buffer.

5. Set up a ligation reaction with the purified vector and insert fragments:

| <u>Component</u>    | <u>Volume</u>                              |
|---------------------|--|
| 10X ligase buffer   | 1 $\mu$ l                                  |
| nuclease free water | 3.5 $\mu$ l                                |
| T4 DNA ligase       | 0.5 $\mu$ l                                |
| Vector fragment     | 2 $\mu$ l (approx 10 ng)*                  |
| <u>PCR product</u>  | <u>3 <math>\mu</math>l (approx 30 ng)*</u> |
| Total volume        | 10 $\mu$ l                                 |

Incubate the ligation reaction at room temperature for 30-60 minutes. \* Alternate ratios may need to be tested to obtain optional ligation efficiency.

6. Transform 1  $\mu$ l of the ligation mixture using 20  $\mu$ l high efficiency competent *E. coli* cells (ideally  $1 \times 10^8$  CFU/ $\mu$ g). Following transformation, resuspend cells in 200  $\mu$ L LB.

7. Plate the entire transformation reaction on a standard LB-agar plate containing 25  $\mu$ g/ml kanamycin. Incubate at 37°C overnight.

8. Pick at least 4-8 independent colonies to do miniprep from each ligation. Confirm the insert by restriction digestion and/or vector primer sequencing (primers included in the kit).

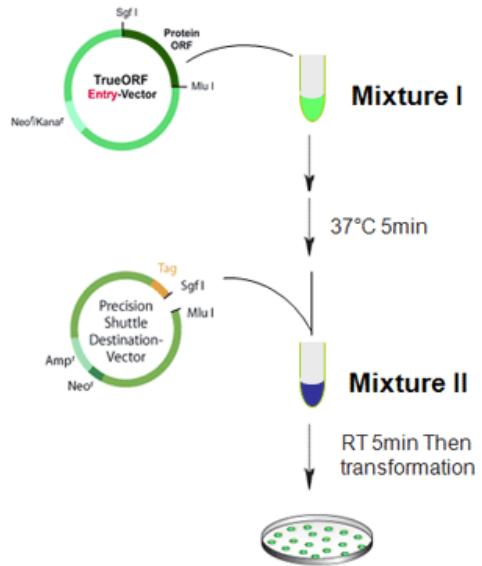
## Transfer of ORF from TrueORF Entry Vector to destination vectors

### Subcloning with OriGene's RapidShuttling Kit:

OriGene has created the RapidShuttling kit to make subcloning to any of our other vectors a simple and efficient process. The RapidShuttling kit provides all required reagents and protocols allowing any TrueORF insert to be transferred to any PrecisionShuttle destination vector in a mere 30 minutes.

#### Kit Components Include:

- Shuttle-ready destination vector (pre-digested and dephosphorylated)
- Sgf I (Asis I) and Mlu I (20 uL) or
- Sgf I (Asis I) and Rsr II (20 uL)
- 10X Rapid digestion buffer
- T4 DNA ligase (for 10 reactions)
- 5X Rapid ligation buffer
- Water, nuclease free



### Subcloning without OriGene's RapidShuttling Kit:

To transfer the protein-coding region from the TrueORF Entry Vector (donor) to a PrecisionShuttle destination vector (recipient), choose the appropriate destination vector with the desired tag options

(<http://www.origene.com/cdna/trueorf/destinationvector.msp>). There are three main types of PrecisionShuttle destination vectors, each of which is designed to express 1) a native (untagged) protein, 2) an N-terminally tagged protein, or 3) a C-terminally tagged protein. The translation of an N-terminally tagged protein initiates from the ATG of the tag and continues through the ORF of the gene of interest, whereas translation of an untagged or a C-terminally tagged protein initiates from the ATG of the protein of interest. The ORF of a C-terminally tagged protein is followed by either a single tag, or a double tag including a short spacer (5-6 amino acid residues). The transfer protocol between TrueORF vectors is shown schematically in Figure 3, and is detailed below.\*

1. Digest the TrueORF Entry clone:

| <u>Component</u>              | <u>Volume</u>               |
|-------------------------------|-----------------------------|
| 10X restriction buffer**      | 2 $\mu$ l                   |
| Sgf I (10 U/ $\mu$ l)         | 0.6 $\mu$ l                 |
| Mlu I (10 U/ $\mu$ l)         | 0.6 $\mu$ l                 |
| nuclease-free water           | 13.8 $\mu$ l                |
| TrueORF Entry vector (200 ng) | 3 $\mu$ l                   |
| <u>Total volume</u>           | <u>20 <math>\mu</math>l</u> |

Incubate at 37°C for 3 hrs.

2. Digest the TrueORF destination vector:

| <u>Component</u>                   | <u>Volume</u>               |
|------------------------------------|-----------------------------|
| 10X restriction buffer**           | 2 $\mu$ l                   |
| Sgf I (10 U/ $\mu$ l)              | 0.6 $\mu$ l                 |
| Mlu I (10 U/ $\mu$ l)              | 0.6 $\mu$ l                 |
| nuclease-free water                | 14.8 $\mu$ l                |
| TrueORF destination vector (200ng) | 2 $\mu$ l                   |
| <u>Total volume</u>                | <u>20 <math>\mu</math>l</u> |

\* For the 4% of the clones that have internal Sgf I or Mlu I sties, please use the appropriate combination of restriction sites as recommended by OriGene

\*\* NEB buffer 3 has been shown to work well with dual digestion of Sgf I and Mlu I.

Incubate at 37°C for 3 hrs. Add 0.5  $\mu$ l antarctic phosphatase (units used according to the manufacturer's protocol) to the digestion, and continue to incubate at 37°C for an additional 30 minutes.

3. Purify the digestion using a commercial PCR purification column and elute in 20  $\mu$ l 10 mM Tris.
4. Set up a ligation reaction:

| <u>Component</u>                              | <u>Volume</u>               |
|---|-----------------------------|
| 10 x T4 DNA ligation buffer                   | 1 $\mu$ l                   |
| T4 DNA Ligase (4U/ $\mu$ l)                   | 0.75 $\mu$ l                |
| nuclease-free water                           | 3.25 $\mu$ l                |
| digested DNA from Step 1 (ORF clone)          | 2 $\mu$ l                   |
| digested DNA from Step 2 (destination vector) | 3 $\mu$ l                   |
| <u>Total volume</u>                           | <u>10 <math>\mu</math>l</u> |

Incubate the ligation reaction at room temperature for 1 hour.

5. Transform the ligation reaction into high-efficiency, competent *E. coli* cells ( $\geq 1 \times 10^8$  CFU/ $\mu$ g DNA) following the appropriate transformation

protocol. Plate the transformants on LB-agar plates supplemented with 100 µg/ml ampicillin.

6. Pick at least four colonies for subsequent DNA purification and screening. Amplify and purify the selected clone(s) by growing overnight in liquid LB-amp media, then isolating the DNA using standard plasmid purification procedures.
7. Confirm the insert by restriction digestion and/or vector primer sequencing using the provided V1.5 for 5' end sequencing and XL39 for 3' end sequencing. A different set of sequencing primers are used for TrueORFs cloned in the pTUNE vector; pTUNE-F as the forward sequencing primer, pTUNE-R as the reverse sequencing primer.

### **Protocol for Transient Transfection**

A sample protocol is listed here for experiments performed in 24-well plates. If performing experiments in other cell culture plates, simply multiply the suggested quantities by the relative surface area of your plate. See Table 2 for more details. OriGene recommends using TurboFectin 8.0 (TF81001) for all transfections. It consistently produces high transfection efficiency and high protein overexpression.

1. Preparation of cells
  - a. Plate  $\sim 5 \times 10^4$  adherent cells or  $\sim 5 \times 10^5$  suspension cells per well 24 hrs prior to transfection.
2. Preparation of the Turbofectin 8.0/DNA Complexes:
  - a. (Prepare immediately prior to transfection)
  - b. Dilute 1 µg of DNA in 100 uL of Opti-MEM I (Gibco 51985). Vortex gently.
  - c. Add 3 uL of Turbofectin 8.0 to the diluted DNA (not the reverse order) and vortex the solution immediately for 10 seconds.
  - d. Incubate for 10 minutes at room temperature.

Note: We recommend starting with the ratios of Turbofectin 8.0 and DNA listed in Table 2; however, subsequent optimization may further increase the transfection efficiency.

3. Transfection
  - a. Gently add the Turbofectin 8.0 / DNA mixture from step 2 to each well (already containing about 900 uL culture medium). Generally, the volume of the Turbofectin 8.0 / DNA mixture represents 1/10 of the total volume of the culture medium. Gently rock the plate to achieve even distribution of the complexes. Incubate at 37°C for 24-48 hrs.

Note: The above incubation is designed for transfection without a media change. If a media change is preferred, incubate for 30 minutes (if centrifugation is possible) or for 3-4 hrs (if centrifugation is not possible). Replace the media with the fresh complete growth media. Incubate for 24-48 hrs. Expression of the transgene can often be detected in as little as 24-48 hrs post-transfection.

**Table 1. Recommended starting transfection conditions for Turbofectin 8**

| Tissue Culture Vessel | Growth area, cm <sup>2</sup> /well | µg of DNA | Ratio of Turbofectin:DNA |
|-----------------------|------------------------------------|-----------|--------------------------|
| 96-well plate         | 0.3                                | 0.05-0.25 | 3:1                      |
| 24-well plate         | 2                                  | 0.25-1.25 | 3:1                      |
| 12-well plate         | 4                                  | 0.5-2.5   | 3:1                      |
| 6-well plate          | 9.5                                | 1-5       | 3:1                      |
| 35 mm plate           | 8                                  | 1-5       | 3:1                      |
| 60 mm plate           | 20                                 | 2-10      | 3:1                      |
| 100 mm plate          | 60                                 | 5-25      | 3:1                      |

**Protocol for Stable Transfection**

Perform a transfection as described above (protocol for transient transfection). Twenty-four hrs post-transfection, passage the cells (at 1:10 or higher dilution) into fresh growth medium containing selective agent. A mock transfection should be performed in parallel as a control. Grow and passage the cells as necessary, maintaining selection pressure by keeping the selective agent in the growth medium. After 1-2 weeks, a large number of the cells will be killed; the cells that remain growing in the selective medium have retained the expression plasmid, which stably integrates into the genome of the targeted cells. Monitor the mock control to ensure the cells are dying.

**Troubleshooting**

For questions not addressed here, please contact OriGene's Technical Support professionals. You may dial 888-267-4436 from any US location, or 301-340-3188 outside the US. E-mail inquiries to [techsupport@origene.com](mailto:techsupport@origene.com) are also invited.

**No colonies or low number of colonies from transformation**

| Cause  | Remedy   |
|--|--|
| The competent cells used in the transformation were not as efficient as necessary. | Obtain a fresh batch of competent cells and ensure that the efficiency is $\geq 1 \times 10^8$ CFU/µg DNA by performing a separate transformation reaction with a transformation-qualified control (usually a fixed amount of supercoiled plasmid such as pUC19). In some extreme cases, especially for larger inserts (>5 kb), higher efficiency cells or |

|  |  |
|--|--|
|  | electroporation may be required. Should a gene be toxic to the cells, growing bacteria at a lower temperature, such as 30°C or transforming into strains that reduce the copy number can increase the odds of obtaining colonies (i.e. ABLE-C or ABLE-K strains from Stratagene; CopyCutter from Epicentre).             |
| Too little DNA was used in the transformation reaction.                          | Add more DNA (but not more than 10% of the volume of competent cells used).  |
| The ligation of the ORF donor DNA into the recipient plasmid was not successful. | 1) The ligase enzyme may not work properly. Repeat the reaction with fresh ligase and ligation buffer (which contains the temperature-sensitive component, ATP) or perform troubleshooting as recommended by the manufacturer of the ligase. 2) Change amounts and ratios of DNA (ORF insert vs vector) in the reaction. |
| The wrong antibiotic selection plate was used.                                   | Make sure to use an LB-agar plate containing the correct antibiotics (e.g. 25 µg/ml kanamycin for Entry vector and 100 µg/ml ampicillin for other destination vectors).  |

### Too high self-ligation background (no insert) from destination vector

| Cause  | Remedy   |
|--|--|
| The destination plasmid was not completely digested.   | Allow the digestion reaction to continue for 3 hrs or overnight at 37°C.   |
| The dephosphorylation of the destination plasmid was not complete, and the destination vector religated with its own fragment. | Increase the concentration of antartc phosphatase and/or the length of the dephosphorylation incubation as recommended by the ligase manufacturer. |

### Frequently Asked Questions

#### What is the PrecisionShuttle System?

Answer: The PrecisionShuttle System provides a restriction-enzyme-based approach to append different tags to one's open reading frame (ORF) of interest.

#### What is the difference between OriGene's Entry vector and the destination vectors?

Answer: The major differences are the antibiotic selection marker and the epitope tags or markers. The Entry vector carries kanamycin resistance (25 µg/ml), while all destination vectors contain the ampicillin resistance gene (100 µg/ml). This

allows simple screening for successful subcloning products. All of the vectors have a unique combination of N- and C-terminal epitope tags or a fluorescent marker, as described in Table I.

**How do you transfer the ORF insert I purchased into another tagging vector?**

Answer: Over 40 destination vectors are designed with compatible MCS for easy shuttling of TrueORF inserts. This can be performed easily using a specific pair of restriction enzymes to cut-and-ligate subclone into the desired destination vector. OriGene simplifies this process by offering the RapidShuttling Kit (see <http://www.origene.com/rapid-shuttling-kit>). OriGene also provides a custom cloning service available through our website.

**What are the functional aspects of the pCMV6-AC-GFP vector?**

Answer: Like all OriGene vectors, the CMV promoter drives the heterologous expression of the specified open reading frame (ORF) which is in-frame with Turbo Green Fluorescent Protein (tGFP) on the C-terminus. tGFP expression permits the positive identification of mammalian cells transfected with plasmid. The neomycin resistance gene is also expressed downstream of the SV40 promoter within the same vector and permits positive selection of transfected cells as well as stable cell line production. For bacterial amplification, the ampicillin resistance gene is engineered on the opposite strand.

**OriGene's GFP is listed as TurboGFP. How is this different from other available GFPs?**

Answer: TurboGFP is a fully licensed, 26kDA protein product from Evrogen JSC that works well in standardized GFP assays. Excitation max is 482nm and emission max is 502nm. It yields 112% of the brightness compared to eGFP and has no known cellular toxicity. It is an isoform of the naturally occurring protein from *Pontellina plumata* that has been optimized for rapid labeling of cells/organelles and tracking of promoter activity. It is a perfect choice for monitoring transient protein expression.

**Has OriGene fully sequenced all TrueORF clones?**

Answer: Not always. When transferring the cDNA into the TrueORF Entry Vector, OriGene always uses fully sequenced plasmids as templates and Phusion High-Fidelity DNA Polymerase (New England Biolabs), which has a mutation rate less than  $4 \times 10^{-7}$ . This ensures the highest fidelity of every TrueORF clone. After cloning into the Entry vector, each of OriGene's TrueORF clones was sequenced at both the 5' and 3' ends, and the resulting sequence was matched to the corresponding reference sequence. For ORFs of 1 Kb or less in length, the 5' and 3' sequencing reads have covered the full ORF. For longer cDNAs, the ORF was not fully covered by sequencing reads.

**Do TrueORF clones exactly match the reference gene sequence?**

Answer: All TrueORF clones are guaranteed to match the corresponding ORF sequence posted on our website. However, some clones may contain nucleotide changes compared to the published reference sequences. This is due to SNPs (single nucleotide polymorphisms) reflecting the unique differences from genes expressed in different tissues and different individuals. Published references may

represent a different SNP than the OriGene transcript. Should a specific SNP be required, this can be obtained via our ExactORF cloning service (<http://www.origene.com/cdna/exactorf.msp>).

### **Sequences of the sequencing primers, VP1.5, XL39, pTUNE-F Forward and pTUNE-R Reverse**

Answer: VP1.5 (forward seq primer)  
5' GGACTTTCCAAAATGTCG 3' Tm=51C

XL39 (reverse seq primer)  
5' ATTAGGACAAGGCTGGTGGG 3' Tm=60C

pTUNE-F Forward  
5' TAGAGTCGACCTGCAGCCGG 3' Tm=58C

pTUNE-R Reverse  
5' TCGCTGATTTGTGTAGGGGA 3' Tm=52C

### **Can I transfer large ORFs using this system?**

Answer: It has been reported that ORFs larger than 4 Kb are unstable in recombination-based systems; conversely, our restriction digest-based vector system has no real size limitation. An ORF up to 18 Kb can be readily transferred from one vector to another.

### **What restriction enzymes should I use if Sgf I or Mlu I sites are present in my ORF?**

Answer: While 96% of all human and mouse ORFs can use the Sgf I - Mlu I combination, some ORFs do contain internal Mlu I site(s). Most of those ORFs with an internal Mlu I site can be transferred using another rare cutter (Rsr II), whose restriction site is upstream of Mlu I, or Not I, whose site is immediately downstream of Mlu I. Using one of the four different subcloning combinations, any ORF can be transferred from one vector to another. The recommended subcloning combination for every TrueORF cDNA is listed in the product information on our website.

### **Why does my Certificate of Analysis (COA) indicate cloning sites other than Sgf I and Mlu I?**

Whenever one or both of these sites is present within the ORF of the transcript, the PrecisionShuttle vectors share other sites engineered to accommodate this, e.g. Rsr II or Asc I.

### **What sites should I use to transfer a TrueORF clone into the Gateway system?**

Answer: There are multiple sites in pCMV6-Entry than can be used to move the insert of a TrueORF clone into any of Gateway's Entry vectors (pENTR-1A, -2B, -3C, -4, and -11). These sites are EcoR I, Sal I, BamH I and Kpn I at the 5' end, and Not I at the 3' end.

### **What restriction sites are available for subcloning into other vectors?**

Answer: The vector map and nucleotide sequence can be found at <http://www.origene.com/cdna/trueorf/destinationvector.msp>

**How many amino acids are present in the linker between my protein and tGFP?**

Answer: To accommodate the Mlu I cloning site, which maintains the proper reading frame, this vector appends a threonine and arginine. This is far fewer than with other recombination-based shuttling systems.

**Which vector serves the negative control for the GFP fusion clone?**

Answer: We recommend pCMV6-AN-GFP (Cat# PS100019).

**I can not detect any protein expression from the TrueORF clone in a pCMV6-Entry vector. What are my options?**

Answer: 1) Check your transfection efficiency. We recommend using a plasmid that expresses a fluorescent marker (pCMV6-AN-GFP PS100019). 2) AntiFLAG antibodies from other vendors are not as sensitive as OriGene's optimized 4C5-AntiDDK antibody (TA50011) when directed at the same epitope.

**I can not see any green fluorescence with the TrueORF clone in a pCMV6-AC-GFP vector. What are my options?**

Answer: Your protein of interest might quench the fluorescence of tGFP. To confirm, we suggest you first run a Western Blot with a protein specific antibody or anti-tGFP. The molecular weight of the tGFP fusion protein is approximately 26 kDa larger than the endogenous protein. We recommend OriGene's Anti-tGFP antibody (part number TA50041 <http://www.origene.com/antibody/2H8-AntitGFP>). Antibodies against other GFPs will not recognize tGFP.

**What does your disclaimer mean?**

Answer: OriGene's disclaimer for the TrueORF clones reads as follows: "Our molecular clone sequence data has been matched to the accession number below as a point of reference. Note that the complete sequence of our molecular clones may differ from the sequence published for this corresponding accession number, e.g., by representing an alternative RNA splicing form or single nucleotide polymorphism (SNP)."

The NCBI RefSeq mRNA sequences are continuously being revised, as some may have been derived from aberrantly spliced transcripts or generated by incorrect prediction of intron-exon junctions in silico. These sequences are therefore used only as a "reference" and not as a "standard". OriGene's clones are isolated from full-length cDNA libraries and may differ from the reference sequence for this reason.

**What is the TrueORF Guarantee?**

Answer: OriGene warrants that the product will meet specifications listed. At OriGene's discretion, free replacement of any non-conforming product will be made if OriGene is notified within 30 days of product receipt. If you experience any difficulty with any OriGene product, please contact our Technical Support Staff at 888-267-4436, or 301-340-3188 outside the US.