GenTarget Inc

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Humanized Cas9 endonuclease expression lentivirus for CRISPR

Cat#	Product Name	Amounts
LVP681	CMV-h **Cas9** (Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP681-PBS	CMV-h **Cas9** (Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP682	CMV-h **Cas9** (Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP682-PBS	CMV-h **Cas9** (Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP683	CMV-h **Cas9** (Neo) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP683-PBS	CMV-h **Cas9** (Neo) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP678	CMV-h **Cas9** (GFP-Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP678-PBS	CMV-h **Cas9** (GFP-Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP679	CMV-h **Cas9** (RFP-Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP679-PBS	CMV-h **Cas9** (RFP-Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP680	CMV-h **Cas9** (GFP-Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP680-PBS	CMV-h **Cas9** (GFP-Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP707	CMV-h **Cas9** (RFP-Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP707-PBS	CMV-h **Cas9** (RFP-Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP684	EF1a-h **Cas9** (Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP684-PBS	EF1a-h **Cas9** (Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP685	EF1a-h **Cas9** (Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP685-PBS	EF1a-h **Cas9** (Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)

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LVP686	EF1a-h **Cas9** (Neo) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP686-PBS	EF1a-h **Cas9** (Neo) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP708	EF1a-h **Cas9** (GFP-Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP708-PBS	EF1a-h **Cas9** (GFP-Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP709	EF1a-h **Cas9** (RFP-Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP709-PBS	EF1a-h **Cas9** (RFP-Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP710	EF1a-h **Cas9** (GFP-Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP710-PBS	EF1a-h **Cas9** (GFP-Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP711	EF1a-h **Cas9** (RFP-Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP711-PBS	EF1a-h **Cas9** (RFP-Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP687	CAG-h **Cas9** (Puro) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP687-PBS	CAG-h **Cas9** (Puro) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP688	CAG-h **Cas9** (Bsd) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP688-PBS	CAG-h **Cas9** (Bsd) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)
LVP689	CAG-h **Cas9** (Neo) lentiviral particles	200ul, (5×10^6 IFU/mL)
LVP689-PBS	CAG-h **Cas9** (Neo) lentiviral particles, in vivo ready	200ul, (5×10^7 IFU/mL)

Storage: <-70 °C, avoid repeat freeze/thaw cycles, stable for > 6 months.

Product Description:

GenTarget's lentivector system is Human Immunodeficiency Virus-1 (HIV) based plasmids for gene expression and knockdown. The lentivectors are used to generate lentiviral particles (lentivirus) that can be transduced into almost all kinds of mammalian cells, including stem cells, primary cells, and non-dividing

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cells both *in vivo* and *in vitro*. Lentiviral Particles stably integrate into the transduced cells' genome for long term expression, making it a great gene transfer agent.

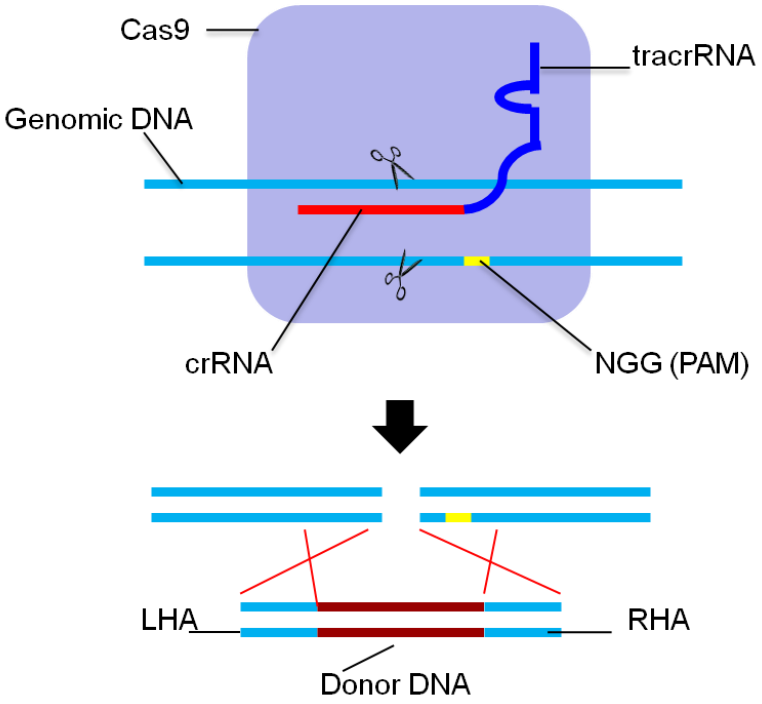
Targeted and precise genomic gene editing technologies are the tools for genomic correction, modification and gene therapy. The TALEN, ZFN and CRISPR/Cas are the three main genome editing technologies. The lately discovered, so called the third generation of gene editing technology, the **CRISPR/Cas** (Clustered Regularly Interspaced Short Palindromic Repeats) technology has (1) higher targeting accuracy; (2) much more target sequence selection; (3) much less complexity; and (4) much less off-target cell toxicity than the previous genome editing technologies: TALEN (transcription activator-like effector nuclease) and ZEN (Zinc-finger nuclease).

Mechanism of In CRISPR/Cas systems: A target sequence-specific guide RNA molecule (gRNA) directs a cas endonuclease to the genomic DNA target sequence. Then, the Cas enzyme creates a double-strand break at the target sequence that can be repaired by either Non-Homologous End-Joining (NHEJ), which can result in insertion or deletions (InDels), or correction / Homology Directed Repair (HDR). InDels can disrupt expression of the target gene while repair by HDR, which requires the presence of a repair template, allows modification of the gene. Cas9, the most frequently used cas endonuclease.

CRISPR/Cas based genomic knock in/out editing requires three components:

1. **Target specific guild RNA (gRNA)**: it comprises two segments: a targeting sequence (crRNA) containing the target complementary RNA, and an auxiliary trans-activating non-coding RNA sequence (tracrRNA). To make the gRNA, you first select a suitable target sequence, the crRNA region (see online tools for target selection below), and then synthesize and anneal the crRNA oligos, and clone it into the guild vector which transcripts the target specific "crRNA-tracrRNA" sequence.
2. **Cas9 endonuclease**: The co-existence of the gRNA sequence with Cas9 enzyme leads to the formation of a gRNA-Cas9 complex that will bind to and cleave the corresponding genomic DNA target sequence. In some cases, the Cas9 and the gRNA is made in one vector (So call "One vector system" or "All in one vector". However, the separating Cas9 expression and guild gRNA into two vectors, provides more flexibility in genomic editing because the Cas9 can be pre-made (like GenTargt's Cas9 expression lentivirus) which makes it easier to simply construct the desired gRNA vectors.

3. **The donor DNA sequence ("knock In")**: For genomic modification application, a double strand repair DNA is required after the Cas9 creates the double stranded breaks at desired genomic loci. The donor DNA provides the desired sequence insertion that flanked by the gene loci's homology sequences: left homologous arm (LHA) and right homologous arm (RHA), for the genomic editing via HDR mechanism. The double stranded donor DNA cassette can be provided from DNA fragment synthesized, or use a linearized donor vector.

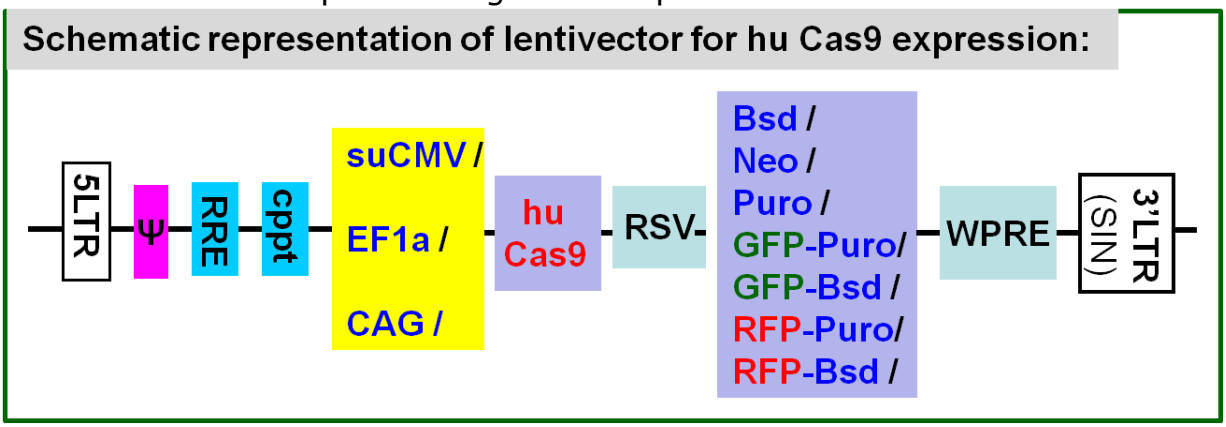


GenTarget's Cas9 expression lentiviruses: GenTarget is proud to offer the standalone Cas9 expression lentivirus products. The ready-to-use Cas9 lentivirus are produced from our proprietary high-titer lentivectors that express a nuclear penetrating humanized wild-type Cas9 gene. The Cas9 enzyme is driven by different promoters with a variety of antibiotic selection markers (see the core expression vector map scheme above), providing you an easy delivery for cas9 expression in almost all cell types, included the hard-to-transfected cell types, primary cells and non-dividing cells, which makes the gene editing possible in all cell types.

With using the ready-to-use Cas9 lentivirus, you can simply synthesize the "targeting expression cassette "(U6/H1-crRNA-tracrRNA)" or construct the guild vector (gRNA) by clone the target specific "crRNA-tracrRNA" into the a desired

gRNA vector (without cas9 cassette). Note: GenTarget provide Service to construct your target specific gRNA lentivectors and their ready-to-use gRNA lentivirus.

Humanized nuclear penetrating Cas 9 expression lentivector core structure:



Gentarget's Cas9 expression lentivirus has the following Key advantages:

- **High efficient Cas9 expression delivery with markers:** High titer lentivirus providing more efficient Cas9 delivery in almost all cell 9 types including primary cells and non-dividing cells; Some Cas9 products include a fluorescent-antibiotic dual marker allowing the real-time check the lentivirus transduction efficiency.
- **Different promoter selection** (**CMV, EF1a and CAG**) for Cas9 expression for different promoter strength in cell types
- **Best nuclear penetrating for Cas9 enzyme**: the Cas9 is expressed with **an optimized, proprietary Nuclear Localization Signal (NLS)**, providing the efficient cas9 delivery into the nuclear region where the gene editing occur.
- **No need for tedious cloning work or vector construction**: you can simply synthesize the gRNA (and donor cassette when desired) and used together with the Cas9 lentivirus for the gene editing.
- **Allow multiple gene editing at the same time:** no need to construct each targeting vector for different gene. Instead, you just select the target sequence and synthesize the gRNA (each single strand RNA or double stranded DNA cassette) that to used with the standalone Cas9 expression particles.

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CRISPR target sequence selection: Selection of the target sequence within the gene of interest is critical to the efficacy and specificity of genetic editing with CRISPR/Cas9. The crRNA segment of the gRNA will only bind to DNA targets that are immediately upstream of the proper Protospacer Adjacent Motif (PAM) sequence, which for CRISPR/Cas9 is NGG. The target sequence (**20bp ~ 30bp**) can be in either the sense or anti-sense orientation with respect to the target gene. It is a good idea to create several target sequences for your gene of interest and to select sequences with minimal homology to other genes, in order to find a sequence with good cleavage efficiency and minimal off-target effects. (See the links at the bottom of the page to online bioinformatics tools to assist in selecting a gRNA sequence with minimal off-target effects.

Online tools for target sequence selection: 5'- "(20-30 target sequence) + PAM (NGG)"
(Note: the selected sequences are in front of the NGG in genomic sequence, but NGG should not be included in the synthesized gRNA)

http://zifit.partners.org/ZiFiT/Introduction.aspx
http://crispr.mit.edu/
http://www.e-crisp.org/E-CRISP/designcrispr.html
http://www.genome-engineering.org/

CRISPR genomic editing protocol outline by using GenTarget's Cas9 lentivurs:

1. select or design the 20bp target specific sequence (crRNA) using a online CRISPR designer tool;
2. generate the gRNA that can be carried out by one of the methods listed below:
    - **method 1**: or construct the gRNA transcription vector by cloning the 20nt crRNA into a gRNA vector (that containing the tracrRNA already); (GenTarget provides services to construct your desired gRNA lentivector and ready-to-use gRNA lentivirus).

    - **method 2:** synthesize the linear double stranded DNA cassette that transcripts the gRNA ("crRNA-tracrRNA"), driven by either human U6 or H1 promoter:

      "U6 promoter==(crRNA-tracrRNA)-terminator (ttttttctag)" (~369bp)
      "H1 promoter==(crRNA-tracrRNA)-terminator (ttttttctag)" (~210bp)

- **method 3:** By synthesize the single stranded RNA: "20nt crRNA + 80nt tracrRNA" (100 bases);
  "crRNA/(20nt)---tracrRNA /(80nt)"

3. generate the Donor by the one of the methods listed below (optional for knock-in genomic editing:
   - **method 1**: synthesize the double stranded DNA cassette for sequence modification as:
     " LHA (500bp target specific left homologues arm) + (marker / insert +poly A terminator) + (RHA (500bp target specific right homologues arm)"
   - **method 2:** construct the donor vector clone by cloning the target specific "LHA-(marker / insert +poly A terminator)-RHA" into a donor vector;
4. Add Cas9 expression lentivirus and gRNA lentivirus to target cells;
   (Note: if gRNA is double stranded DNA or not lentivirus, then the gRNA has to be delivered via DNA transfection, such as lipid based delivery.)
5. If desirable for knock-In, apply Donor cassettes into target cells by lipid based transfection;
6. select the sequence modified colonies;

Note: If you want GenTarget to prepare the target specific gene editing reagents for you, please **contact GenTarget** for a service quote.

The human codon, nuclear penetrating Cas9 lentivirus are provided in two formats:
(1) **200ul** in DMEM medium with titer at $5x10^6$ IFU/ml.,
(2) **200ul** concentrated virus in PBS with titer at $5x10^7$ IFU/ml.

For general questions about our ready-to-use particles, please see **FAQ for pre-made lentiviral particles** (.pdf) on our website. (http://www.gentarget.com/pdf/FAQ-Premade-Lentiviral-particles.pdf).

Transduction Protocols:

Note: Pre-made lentivirus is provided ready to use, so it can be simply added into your cell culture; the amount of virus to add depends on cell type. For quick transduction, add 50 µl of virus into each well of 24-well-plate where cell density is 50% to 75%. After 24 ~ 72 hours (no need to change medium), visualize positive transduction rate by fluorescence

microscopy. For stable cell line generation, pass cells into medium containing antibiotic or perform fluorescence cell sorting followed by antibiotic selection.

Day 0:

Seed cells in complete medium at the appropriate density and incubate overnight.

Note: at the time of transduction, cells should be 50%-75% confluent. For example, seed HeLa cells at 0.5 x 10^5/ml x 0.5ml in a well of a 24-well plate.

Day 1:

- Remove the culture medium and add 0.5ml fresh, warm, complete medium.
- Thaw the pre-made lentiviral stock at room temperature and add the appropriate amount of virus stock to obtain the desired MOI.
- Return cells to 37°C, CO_2 incubator.
  Note: Try to avoid freezing and thawing. If you do not use all of the virus at one time, you may re-freeze the virus at -80 °C for future use; virus titer will decrease by ~10% for each freeze/thaw cycle.

Day 3:

At 48~72hr after transduction, check the transduction rate by fluorescence microscopy or calculate the exact transduction rate by flow cytometry (FACS or Guava) (only for the products containing a fluorescent marker)

Day 3 + (optional):

Sort transduced cells by FACS, and select for antibiotic resistance. A pilot experiment should be done to determine the antibiotic's kill curve for your specific cell line (refer to the pertinent literature on generation of stable cell lines).

Note: Filter wavelength settings:

GFP filter: ~Ex450-490; ~Em525; RFP filter: ~Ex545; ~Em620;

Safety Precaution:

Gentarget lentiviral particles adapts must advanced lentiviral safety features (using the third generation vectors with self-inactivation SIN-3UTR), and the premade lentivirus is replication incompetent. However, please use extra caution when using lentiviral particles. Use the lentiviral particles in Bio-safety II cabinet. Wear glove all the time when handling Lentiviral particles! Please refer CDC and NIH's guidelines for more details regarding to safety issues.

References:

1. Ishino, Y.; Shinagawa, H.; Makino, K.; Amemura, M.; Nakata, A. (1987).
2. Jinek, M.; Chylinski, K.; Fonfara, I.; Hauer, M.; Doudna, J. A.; Charpentier, E. (2012).

3. Hum Gene Ther (2003) 14: 1089-105.
4. Mol Ther (2002) 6: 162-8.
5. NIH Guidelines for Biosafety Considerations for Research with Lentiviral Vectors. (Link).

Warranty:

This product is for research use only. It is warranted to meet its quality as described when used in accordance with its instructions. GenTarget disclaims any implied warranty of this product for particular application. In no event shall GenTarget be liable for any incidental or consequential damages in connection with the products. GenTarget's sole remedy for breach of this warranty should be, at GenTarget's option, to replace the products.

Related Products: GenTarget's pre-made lentivirus product catagory.

Product Category	Product Description (please click category name to see product's pages)
Human, mouse or rat ORFs	Premade lentivirus expressin a **human, mouse or rat** gene with RFP-Blastididin fusion dual markers.
Fluorescent markers	Preamde lentivirus express human codon optimized fluorescent protein, **GFP / RFP/ CFP/ BFP / YFP**.
Luciferase expression	Premade lentivirus for all kinds of luciferase protein expression**: firefly and Renilla** with different antibiotic selection markers.
CRE recombinase	Premade lentivirus for expressing **nuclear permeant CRE** recombinase with different flurescent and antibiotic markers.
LoxP ColorSwitch	Premade lentivirus expressing "LoxP-GFP-Stop-LoxP-RFP" cassette, used to monitor the CRE recombination event in vivo.
TetR inducible expression repressor	Premade lentivirus expressin **TetR** (tetracycline regulator) protein, the repressor protein for the inducible expression system.
iPS factors	Premde lentivirus for human and mouse iPS **(Myc, NANOG, OCT4, SOX2, FLF4**) factors with different fluorescent and antibitoic markers
T-antigen Expression	Express **SV40 large T antigen** with different selection markers
Cell Organelle imaging	Premade lentivirus for cell organelle imaging. The fluorescent marker **GFP/RFP/CFP was sub-cellular localized** in different cell organelle for living cell imaging.
LacZ expression	Express different full length **β- galactosidase (lacZ)** with different selection markers

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Anti-miNA lentivirus	Pre-made lentivirus expression a specific **anti-miRNA** cassette.
Fluorescent-ORF fusion	Pre-made lentivirus expression a "**GFP/RFP/CFP-ORF**" fusion target.
Pre-made shRNA lentivirus	Premade shRNA lentivirus for knockdown a specific genes (**P53, LacZ, Luciferase** and more).
microRNA and anti-microRNA lentivirus	Premade lentivirus expression human or mouse **precursor miRNA**. And **anti-miRNA** lentivector and virus for human and mouse miRNA.
Negative control lentiviruses	Premade **negative control lentivirus with different markers**: serves as the negative control of lentivurs treatment, for validation of the specificity of any lentivirus target expression effects.
Other Enzyme expression	Ready-to-use lentivirus, expressing **specific enzymes** with different selection markers.