

## Product Information

### MISSION® Lentiviral Transduction Particles

Catalog Number **SHVRS**  
Storage Temperature  $-70^{\circ}\text{C}$

## TECHNICAL BULLETIN

### Product Description

Small interfering RNAs (siRNAs) expressed from short hairpin RNAs (shRNAs) are a powerful way to mediate gene specific RNA interference (RNAi) in mammalian cells. The MISSION product line is a viral vector-based RNAi library against annotated mouse and human genes. shRNAs that generate siRNAs intracellularly are expressed from amphotropic lentivirus particles, allowing screening in a wide range of mammalian cell lines. In these cell lines, MISSION shRNA clones permit rapid, cost efficient loss-of-function and genetic interaction screens.

The Lentiviral Transduction Particles are produced from a library of sequence-verified shRNA lentiviral plasmid vectors for mouse and human genes. Each gene is represented by a clone set, designed using a proprietary algorithm, which consists of 3–5 individual constructs or clones targeting different regions of the gene sequence. Therefore, a range of knockdown efficiency, with at least one construct from each gene set being  $>70\%$ , can be expected when using these clones. This allows one to examine the effect of loss of gene function over a large series of gene knockdown efficiencies. Each shRNA construct has been cloned and sequence verified to ensure a match to the target gene.

Unlike murine-based MMLV or MSCV retroviral systems, lentiviral-based particles permit efficient infection and integration of the specific shRNA construct into differentiated and non-dividing cells, such as neurons and dendritic cells,<sup>1</sup> overcoming low transfection and integration difficulties when using these cell lines. Self-inactivating replication incompetent viral particles are produced in packaging cells (HEK293T) by co-transfection with compatible packaging plasmids.<sup>2,3</sup>

In addition, the lentiviral transduction particles are pseudotyped with an envelope G glycoprotein from Vesicular Stomatitis Virus (VSV-G), allowing transduction of a wide variety of mammalian cells.<sup>4</sup>

The lentiviral transduction particles are titered via a p24 antigen ELISA assay and pg/ml of p24 are then converted to transducing units per ml using a conversion factor. The conversion can be viewed at: [www.tronolab.com](http://www.tronolab.com).

### Components/Reagents

The individual constructs are provided as a 200  $\mu\text{L}$  frozen stock containing  $1.0 \times 10^6$  lentiviral transducing particles per milliliter in Dulbecco's Modified Eagle's Medium with 10% heat-inactivated fetal bovine serum and penicillin-streptomycin.

Orders of 5 or less clone sets are provided in individual vials. Each vial contains a unique one dimensional barcode label that can be read using a corresponding reader. A printed value corresponding to the The RNAi Consortium (TRC) clone number is also provided on each tube.

Orders of  $>5$  clone sets are provided in a 96-well plate with a one dimensional barcode label on the plate. 96-well plates are provided with a CD containing plate map positions.

The hairpin sequence and other unique clone information may be obtained by searching the MISSION search database at [www.sigma-aldrich.com/missionsearch](http://www.sigma-aldrich.com/missionsearch) using RefSeq accession numbers (e.g., NM\_027088), unique clone identification numbers (e.g., NM\_027088.1-989s1c1), or TRC numbers (e.g., TRCN000030720).

### Precautions and Disclaimer

These products are for R&D use only, not for drug, household, or other uses. Though the lentiviral transduction particles produced are replication incompetent, it is highly recommended that they be treated as **Risk Group Level 2 (RGL-2)** organisms.<sup>5</sup> Follow all published RGL-2 guidelines for handling and waste decontamination. Also, use extra caution when using lentiviral transduction particles that express shRNA-targeting genes involved in cell cycle control, e.g., tumor suppressor genes.

**Storage/Stability**

All components are stable for at least six months after receipt when stored at  $-70^{\circ}\text{C}$ . Avoid repeated freeze/thaw cycles, which will severely reduce transduction efficiency.

**Procedure for the Use of MISSION Lentiviral Transduction Particles****Day 1**

Plate the mammalian cell line of choice in complete medium 24 hours prior to transduction. Take into account the length of time that the cells will be cultured prior to performing RNAi analysis when determining plating density.

**Day 2**

Thaw the lentiviral stock at room temperature. Add hexadimethrine bromide (the chemical equivalent of Polybrene) to the cells at a final concentration of  $8\ \mu\text{g/ml}$ .

**Note:** Hexadimethrine bromide enhances transduction of most cell types. However, some cells, like primary neurons, are sensitive to hexadimethrine bromide. When using sensitive cells, do not add the hexadimethrine bromide and the cells should still be transduced.

Following addition of hexadimethrine bromide, gently swirl the plate to mix. Add the appropriate amount of viral particles at a suitable multiplicity of infection (MOI) and swirl the plate gently to mix. Incubate the cell-viral particle mixture at  $37^{\circ}\text{C}$  overnight.

**Multiplicity of Infection (MOI)** is the number of transducing lentiviral particles per cell. It is highly recommended that for each new cell type to be transduced, a range of MOI be tested.  
To calculate:  $(\text{total number of cells per well}) \times (\text{desired MOI}) = \text{total transducing units needed (TU)}$   
 $(\text{total TU needed}) / (\text{TU/ml reported on C of A}) = \text{total ml of lentiviral particles to add to each well}$

**Notes**

- When transducing a lentiviral construct into a cell line for the first time, it is recommended that a range of MOIs (e.g., 0.5, 1, 2, and 5) be used to find the optimal degree of target knockdown.
- When overnight incubation presents a toxicity concern, cells may be incubated for as little as 4 hours before changing the medium.

**Day 3**

Remove the viral particle-containing medium and replace it with fresh, complete culture medium.

**Day 4**

Perform one of the following based on whether the transduction experiment is transient or stable:

- For transient expression experiments - Harvest the cells and assay for interference of the target gene. This can be done by a variety of methods such as qRT-PCR or Western blot.
- For stable expression experiments - Remove the medium and replace it with fresh, complete medium that contains the appropriate amount of puromycin for selection of transduced cells. Proceed to step 5.

**Note:** When the appropriate concentration of puromycin for a specific cell type is unknown, perform a kill curve experiment. Typically, puromycin concentrations ranging from  $2\text{--}10\ \mu\text{g/ml}$  are sufficient to kill most untransduced mammalian cell lines.

**Puromycin titration (kill curve)** should be performed when working with a new cell type.

- Plate  $1.6 \times 10^4$  cells into wells of a 96-well plate with  $120\ \mu\text{L}$  fresh media.
- The next day add  $500\text{--}10,000\ \text{ng/ml}$  of puromycin to selected wells.
- Examine viability every 2 days.
- Culture for 3 – 14 days depending on the growth rate of the cell type and the length of time that cells would typically be under selection during a normal experimental protocol. Replace the media containing puromycin every 3 days. The minimum concentration of puromycin that causes complete cell death after the desired time should be used for that cell type and experiment.

**Note:** Excess puromycin can cause many undesired phenotypic responses in most cell types.

**Day 5 and forward**

Replace medium with fresh, puromycin-containing medium every 3-4 days until resistant colonies can be identified (generally, 10-12 days after selection). Pick a minimum of 5 puromycin-resistant colonies and expand each clone to assay for knockdown of the target gene.

**Note:** Due to the random integration of the lentivirus into the genome, varying levels of target gene knockdown may be seen from different puromycin-resistant clones. Testing a number of puromycin-resistant clones will allow a determination of which one provides the optimal degree of gene knockdown.

## Troubleshooting Guide

| Problem   | Cause   | Solution   |
|---|---|--|
| Low levels of target gene knockdown due to low transduction efficiency. | Hexadimethrine bromide not included during transduction.      | Transduce in the presence of hexadimethrine bromide.   |
|   | Non-dividing cell type used.                                  | Transduce at a higher MOI.   |
|   | MOI is too low.   | Transduce at a higher MOI.   |
|   | Cells were harvested and assayed too soon after transduction. | The shRNA must be permitted to accumulate in cells. Harvest 48–72 hours after transduction. Alternatively, knockdown results may be improved by placing cells under puromycin selection because untransduced cells will be killed. |
| No gene knockdown is observed.  | Viral stock stored incorrectly.                               | Store stocks at $-70^{\circ}\text{C}$ . Do not freeze/thaw more than 3 times.  |
|   | MOI is too low.   | Transduce at a higher MOI.   |
| Cytotoxic effects observed after transduction.                          | Target gene is essential for cell viability.                  | Be sure that target gene is not essential for cell growth or viability.  |
|   | Hexadimethrine bromide was used during transduction.          | Be sure that cells are not sensitive to hexadimethrine bromide. Omit the hexadimethrine bromide during the transduction.   |
|   | Too much puromycin was used for selection.                    | Determine the puromycin sensitivity of the cells by performing a kill curve and use the minimum concentration required to kill the untransduced cells.   |

## Control Selection Table

Sigma's recommended controls for any shRNA experiment are closely aligned with the controls suggested in the *Nature Cell Biology* editorial.<sup>6</sup>

| Recommended Control  | Objective   |
|--|---|
| Negative Control:<br>Untreated Cells   | Untreated cells will provide a reference point for comparing all other samples.   |
| Negative Control:<br>Transduction with empty viral particles, containing no shRNA insert | MISSION pLKO.1-puro Control Transduction Particles, Catalog Number SHC001V<br>The empty viral particles, produced from pLKO.1-puro, are a useful negative control that will not activate the RNAi pathway because they do not contain an shRNA insert. It will allow for observation of cellular effects of the transduction process. Cells transduced with the empty viral particles provide a useful reference point for comparing specific knockdown.  |
| Negative Control:<br>Transduction with non-targeting shRNA                               | MISSION Non-Target shRNA Control Transduction Particles, Catalog Number SHC002V<br>This non-targeting shRNA is a useful negative control that will activate RISC and the RNAi pathway, but does not target any human or mouse genes. The short-hairpin sequence contains 5 base pair mismatches to any known human or mouse gene. This allows for examination of the effects of shRNA transduction on gene expression. Cells infected with the non-target shRNA will also provide a useful reference for interpretation of knockdown.   |
| Positive Control:<br>Transduction with positive reporter viral particles                 | MISSION TurboGFP™ Control Transduction Particles, Catalog Number SHC003V<br>This is a useful positive control for measuring transduction efficiency and optimizing shRNA delivery. The TurboGFP Control transduction particles are produced from the lentiviral backbone vector, pLKO.1-puro, containing a gene encoding TurboGFP, driven by the CMV promoter. Transfection of this control provides fast visual confirmation of successful transduction.   |
| Positive Control:<br>Transduction with shRNA targeting reporter vector                   | MISSION TurboGFP shRNA Control Transduction Particles, Catalog Number SHC004V<br>The TurboGFP shRNA transduction particles are produced from the sequence-verified lentiviral plasmid, pLKO.1-Puro vector containing shRNA that targets TurboGFP (Catalog # SHC004). These particles can be used as a positive control to quickly visualize knockdown. This TurboGFP shRNA has been experimentally shown to reduce GFP expression by 99.6% in HEK 293T cells after 24 hours. Because this shRNA targets TurboGFP, and it does not target any human or mouse genes, it can also be used as a negative non-target control in shRNA experiments. |

## References

1. Stewart, S.A., *et al.*, Lentivirus-delivered stable gene silencing by RNAi in primary cells. *RNA*, **9**, 493-501 (2003).
2. Zufferey, R., *et al.*, Multiply attenuated lentiviral vector achieves efficient gene delivery *in vivo*. *Nat. Biotechnol.* **15**, 871-85 (1997).
3. Zufferey, R., *et al.*, Self-inactivating lentivirus vector for safe and efficient *in vivo* gene delivery. *J Virol.*, **72**, 9873-80 (1998).
4. Burns, J.C., *et al.*, Vesicular Stomatitis Virus G Glycoprotein Pseudotyped Retroviral Vectors: Concentration to a Very High Titer and Efficient Gene Transfer into Mammalian and Nonmammalian Cells. *Proc. Natl. Acad. Sci. USA*, **90**, 8033-8037 (1993).
5. NIH Guidelines for Research Involving Recombinant DNA Molecules (NIH Guidelines) 2002 (<http://www4.od.nih.gov/oba>)
6. Whither RNAi? *Nature Cell Biology*, **5**, 489-490 (2003).

## Related Products

- Hexadimethrine Bromide, Catalog Number [H9268](#)
- Puromycin Ready Made Solution (10 mg/ml in H<sub>2</sub>O), Catalog Number [P9620](#)
- Minimum Essential Medium containing 10% fetal calf serum or growth medium optimized for the specific cell line

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