BioResearch

Lonza

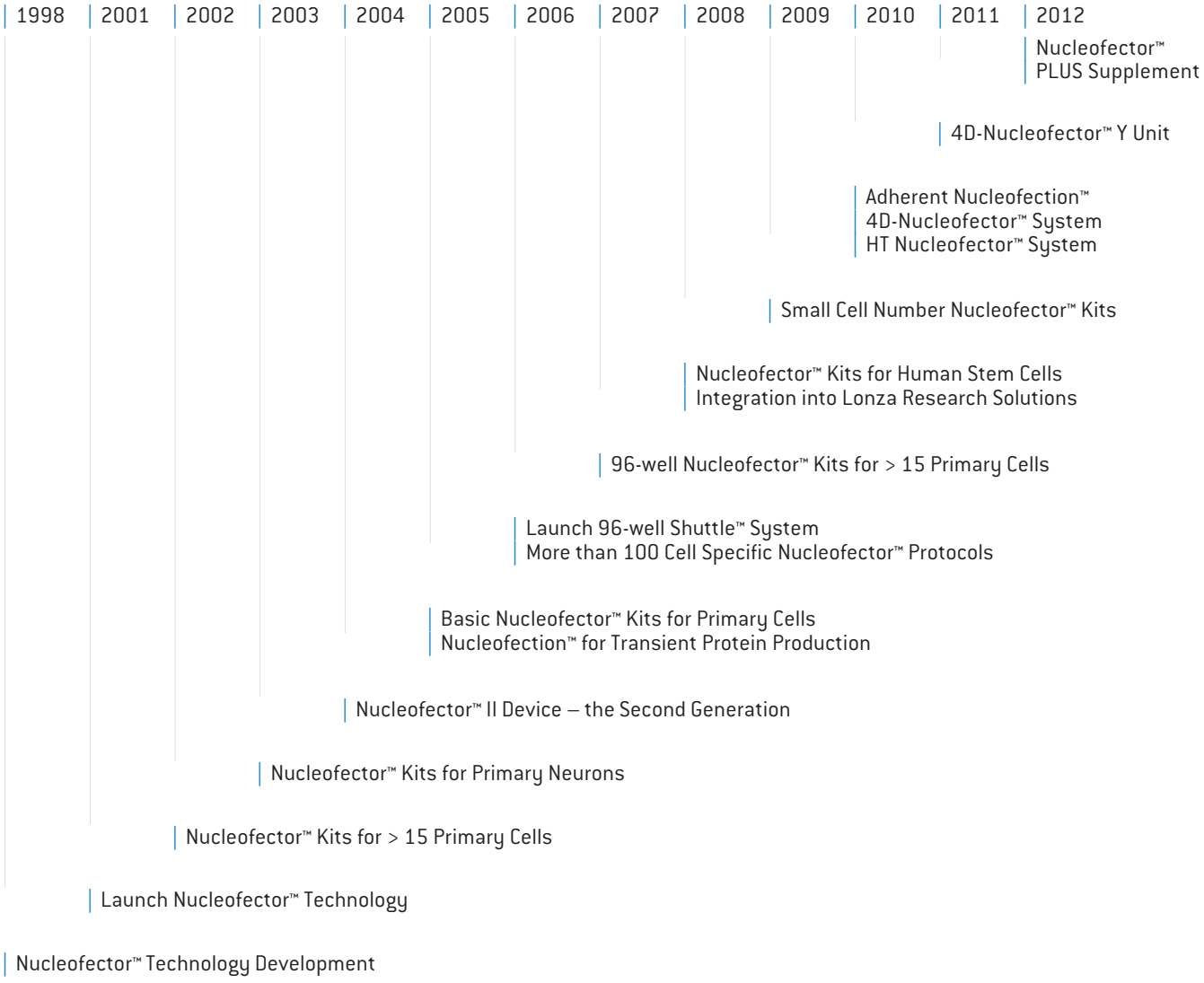
Nucleofector™ Technology

Stretching Transfection Dimensions

Nucleofector™ Technology
for Hard-to-transfect Cells

Contents

History of Constant Innovation



Introduction: Nucleofector™ Technology

The application of systems biology and multidisciplinary approaches require that cells and model systems display in vivo like cellular functionality. This means that the future of cell transfection is in using primary cell types, and that transfecting these physiologically relevant cell types is typically a very difficult task using traditional methods. Additionally, when using relevant cell lines as model systems, the critical issues are to achieve reproducibly efficient transfection with high levels of viability while matching throughput capability with the number of transfections required at each project phase – from proof of concept, through to scale-up and screening-like approaches. With the Nucleofector™ Technology primary cells and stem cells, as well as cell lines, can be consistently transfected at high efficiency.

Developed in 1998, the Nucleofector™ Technology was introduced to the research market in 2001 as the first efficient non-viral transfection method for primary cells and hard-to-transfect cell lines. Since then the technology has evolved through constant innovation (see history).

The Principle

Nucleofection™ is a technology based on the momentary creation of small pores in cell membranes by applying an electrical pulse. The comprehensive way in which Nucleofector™ Programs and cell type-specific solutions are developed enables nucleic acid substrates delivery not only to the cytoplasm, but also through the nuclear membrane and into the nucleus. This allows for high transfection efficiencies up to 99% and makes the transfection success independent from any cell proliferation.

Nucleofector™ Technology – the Superior Non-viral Method

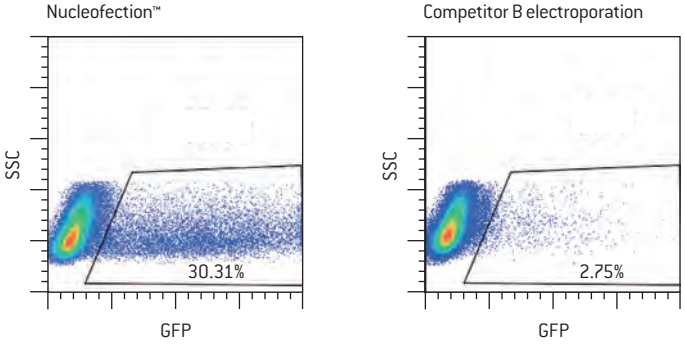


Figure 1. Transfection of the human natural killer cell line NKL using traditional electroporation and Nucleofection™. 5 x 10^6 NKL cells were transfected with 2.5 µg of pmaxGFP™ Vector. Nucleofection™: Nucleofector™ Solution V; Program O-017. Competitor B electroporation: 25 mV, 96 µF. Transfection efficiency was monitored by flow cytometry after 24 hours. Cells transfected by Nucleofection™ show a significantly better transfection efficiency compared to cells transfected by traditional electroporation. Cell viability, as measured 18 hours after transfection, was also superior using Nucleofection™.
(Data courtesy of Dr. John Coligan, Laboratory of Immunogenetics, NIH/NIAID, Rockville, MD, USA. J Immunol Methods (2004) 284: 133-140.)

DNA Delivery Straight Into the Nucleus

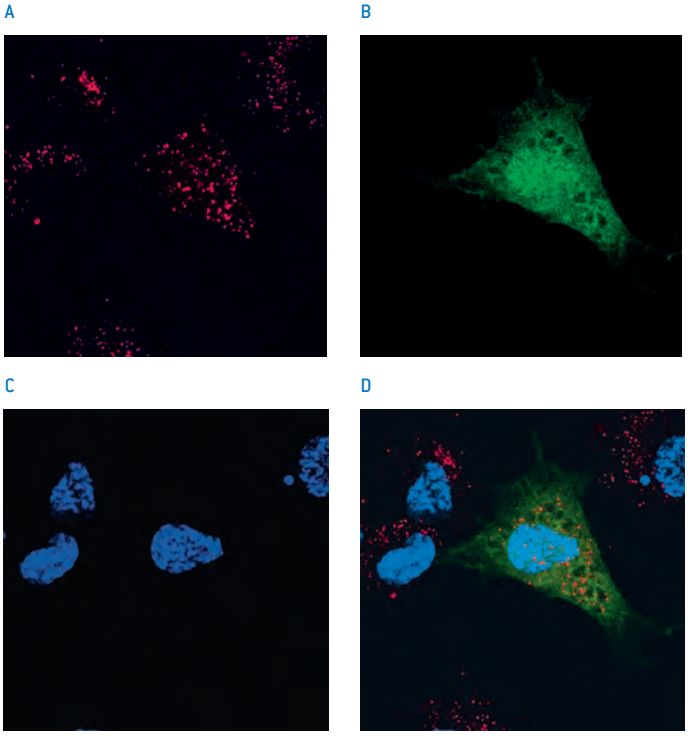


Figure 2. Normal human dermal fibroblasts (neonatal) were transfected with 2.5 µg TMR-labeled plasmid DNA encoding eGFP. After 2 hours, cells were fixed with 3.5% PFA and analyzed by confocal micros copy. TMR label is shown in (A), GFP fluorescence in (B), DAPI nuclear staining in (C) and a merge of all three fluorescent labels in (D).

What Benefits Are Important for Your Work?

Looking for Superior Transfection Performance?
- Electrical parameters are optimized to gain high transfection efficiency and retain high viability
- Excellent preservation of the physiological status of transfected cells

Easy-to-use Technology?
- More than 650 cell-type specific protocols lead to direct transfection success with a multitude of different cell types
- Easy optimization protocols for cell lines and primary cells allow for quick and streamlined optimization of virtually any cell type

Excellent Technical and Applicative Support?
- Highly-skilled scientific support team to assist you in your research
- Scientific Support Team members have a masters or PhD level education in biology, biochemistry or biotechnology
- Many of them with over 10 years experience in transfection support

Relying on a Proven and Innovative Technology?
- More than 4000 peer-reviewed publications and thousands of systems placed worldwide
- Modularity of the 4D-Nucleofector™ System allows easy adaptation to new applications
- Invention of Nucleofection™ of cells in adherence

Using Various Cell Numbers for Different Applications?
- Nucleofection™ of 2 x 10^4 to 2 x 10^7 cells are feasible within one single device
- Transferability of protocol conditions from small to larger cell numbers with the new 4D-Nucleofector™ System

Easy Expansion of Your Research?
- Explore complex systems by using the same conditions to deliver DNA, RNA, oligonucleotides, PNA, peptides or proteins
- Different device platforms fulfill your choice of sample throughput from 1 through 384 transfections per run including automated high throughput

Avoiding Cross-contamination?
- Disposable, sterile Nucleofection™ Vessels minimize the risk of cross-contamination with cell or substrate leftovers

Average Transfection Effciency for Primary Cells and Human Stem Cells

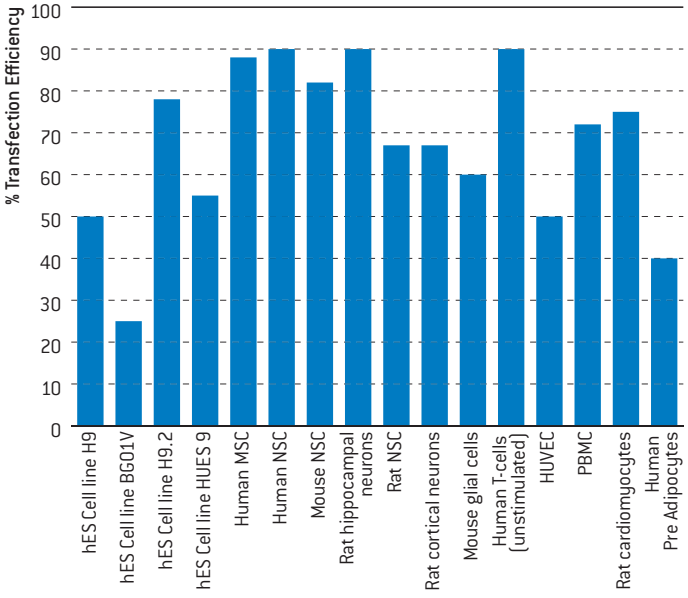


Figure 3. Overview about transfection efficiencies achieved by Nucleofection™ for various primary cells and stem cells.

Conserving Functionality – the First Step to Meaningful Analysis

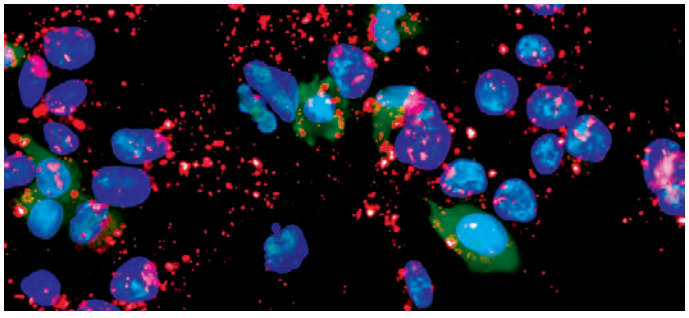


Figure 4. Human H9 ES cells preserve pluripotency post Nucleofection™. H9 cells were transfected by Nucleofection™ with the pmaxGFP™ Vector. (A) Cells analyzed after 24 hours show expression of GFP (green) as well as of the pluri potency markers SSEA4 (red) and Oct4 (purple). The blue signals refer to nuclear staining by DAPI. (B) The percentage of double-positive cells (GFP/SSEA) was analyzed by flow cytometry.
(Data kindly provided by Jennifer Moore, Rutgers University, Piscataway, USA.)

The Components of the Nucleofector™ Technology

The Nucleofector™ Technology relies on the combination of a Nucleofector™ Device and cell specific Nucleofector™ Kits.

– The **Nucleofector™ Device** delivers unique electrical parameters. The electrical settings are pre-programmed for each optimized cell type and can be selected via the device or PC software. We offer three different device platforms plus an add-on device (see table below)

– The **Nucleofector™ Kits** contain a specific Nucleofector™ Solution and Supplement, specified cuvettes, pipettes, and the pmaxGFP™ Control Vector. All Nucleofector™ Solutions provide a protective environment that allows for high transfection efficiency and cell viability, while helping to maintain physiologically relevant cellular functions. A collection of Nucleofector™ Kits with optimized protocols for primary cells and cell lines is available

– Besides providing optimal Nucleofection™ Conditions, **Optimized Protocols** offer comprehensive guidance, including tips for cell sourcing, passage, growth conditions and media, and post transfection culture

Overview About Nucleofection™ Platforms

	Advanced Platform	96-well Add-on	High-throughput Platform	Basic Device
Device	4D-Nucleofector™ System	96-well Shuttle™ Device	HT Nucleofector™ System	Nucleofector™ 2b Device
Unit				
Throughput (samples per run)	Low to medium (1-16)	Low to high (1-96)	High (384)	Low (1)
Reaction volume	20 µl + 100 µl	20 µl	20 µl	100 µl
Electrode material	Conductive polymer	Conductive polymer	Conductive polymer	Aluminum
Low cell numbers (20 µl)	2 x 10^4 to 1 x 10^6	2 x 10^4 to 1 x 10^6	2 x 10^4 to 1 x 10^6	–
High cell numbers (100 µl)	2 x 10^5 to 2 x 10^7	–	–	2 x 10^5 to 2 x 10^7
DNA Vector amount/sample	0.2 – 1 µg (20 µl) 1 – 5 µg (100 µl)	0.2 – 1 µg	0.2 – 1 µg	1 – 5 µg
siRNA amount/sample (concentration 2 nM – 2 µM)	0.2 – 200 pmol (100 µl) 0.04 – 40 pmol (20 µl)	0.04 – 40 pmol	0.04 – 40 pmol	0.2 – 200 pmol
Adherent Nucleofection™ (20 µl Nucleocuvette™ Strips)	■	■	–	–
Adherent Nucleofection™ (24-well culture plates)	■	–	–	–
Compatibility with 96-well Shuttle™ Device	■	–	–	–

The Add-on Component: Nucleofector™ PLUS Supplements

The new Nucleofector™ PLUS Supplements bypass the need of postponing a transfection experiment due to problems with cell culture or primary cell isolation. Moreover they allow for a more efficient time-management as freshly isolated or cultured cells do not have to be transfected at the day of isolation or harvesting.

Nucleofector™ PLUS Supplements can be used in conjunction with almost all existing Nucleofector™ Kits. Just substitute the standard supplement (delivered with regular Nucleofector™ Kit) for the appropriate Nucleofector™ PLUS Supplement and generate your own cryopreserved ready-to-transfect competent cells.

Benefits

- Minimize variations caused by donor variance, isolation process or cell culture
- More convenient workflow by decoupling of cell isolation and transfection
- Cryopreserved transfection competent cells ready-to-use any time

www.lonza.com/n-plus

Comparison of Transfection Performance for Fresh and Cryopreserved Cells

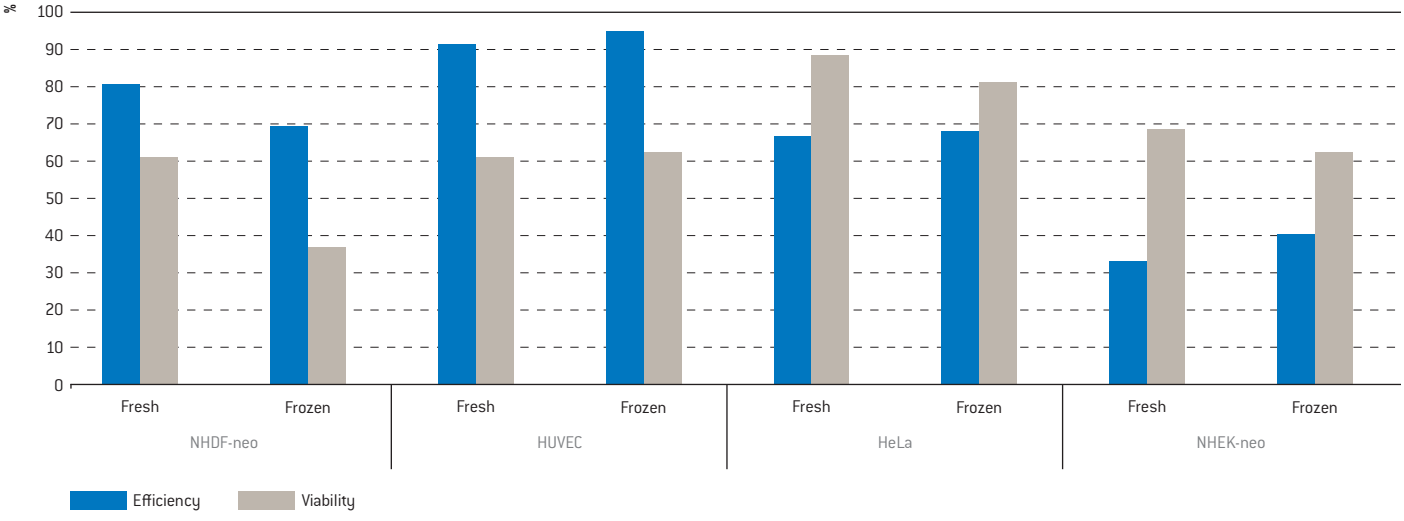


Figure 5. Comparison of transfection performance for fresh cells and cells that were cryopreserved in Nucleofector™ PLUS Solution. Data were collected from various experiments to account for variances in cell handling.

The Advanced Platform: 4D-Nucleofector™ System Offering Multi-dimensional Flexibility

Based on numerous user feedback, Lonza engineers and scientists have developed the new innovative 4D-Nucleofector™ System. This system is designed for maximum flexibility and enables Nucleofection™ of cells in several formats combined with advanced performance and convenience.

The 4D-Nucleofector™ System is a modular system comprising one Core Unit and the X Unit as first available functional unit. Core and X Unit can be assembled side by side or on top of each other. Due to its modular design the 4D-Nucleofector™ System is extremely flexible in regard to the supported applications.

What Benefits Are Important for Your Work?

Using Different Cell Numbers for Different Applications?
- Same protocol for 100 µl and 20 µl transfection volume
- 100 µl Nucleocuvette™ for high cell numbers up to 2 x 10^7
- 20 µl Nucleocuvette™ Strip for low cell numbers down to 2 x 10^4

Working with Various Throughputs?
- Flexible throughput from 1 to 16 samples
- Parallel processing of one or two 100 µl Nucleocuvette™ Vessels
- Pre-programming of settings for up to 50 single 100 µl Nucleocuvette™ Vessels or one 20 µl Nucleocuvette™ Strip
- Kit costs tailored to your throughput

Transfecting Different Primary Cell Types?
- Only 5 primary cell kits covering a broad range of primary cells
- New Primary Cell Optimization Kit for cells lacking an Optimized Protocol
- Easy optimization of a variety of cell lines using the 96-well Shuttle™ Add-on Device

Preserving Cell Functionality?
- Adherent Nucleofection™ of neurons at later developmental stages
- No release of metal ions due to conductive polymer electrodes

1 The Core Unit – Controlling the 4D-Nucleofector™ System
- Intuitive operation software for designing and saving experiments
- Predefined Nucleofection™ Parameters and Experiments
- PC editor for predefinition of experiments
- 5.7" foldable touch screen to operate the system
- Controls up to 5 functional units
- USB port for software update and data transfer
- Comprises USB and serial connectivity for the 96-well Shuttle™ Device

2 The X Unit – Supporting Nucleofection™ of Various Cell Numbers in Different Formats
- Features positions for 20 µl Nucleocuvette™ Strips and 100 µl single Nucleocuvette™
- Seamless transfer of conditions between different Nucleofection™ Vessels
- Suited for Nucleofection™ of cells in adherence in 16-well Nucleocuvette™ AD Strips
- Comprises HV connectivity for the 96-well Shuttle™ Device

3 The Y Unit – Enabling Adherent Nucleofection™ in 24-well Culture Plates
- Features position for one 24-well Dipping Electrode Array

The Most Flexible Unit: 4D-Nucleofector™ X Unit

Different Vessels for Flexible Cell Numbers

The X Unit of the 4D-Nucleofector™ System can handle two different Nucleocuvette™ Vessels both composed out of the same conductive polymer electrode material:

Single 100 µl Nucleocuvette™ Vessels:

- Novel conductive polymer 100 µl cuvettes replacing former aluminum cuvettes
- For high cell numbers at low throughput (e.g. for biochemical applications or Western Blots)

16-well 20 µl Nucleocuvette™ Strips

- Same strips as those assembled to a 96-well Nucleocuvette™ Plate
- For low cell numbers at medium throughput (e.g. reporter gene assays, RNAi)
- Alternative version available for adherent Nucleofection™

Same Conditions for Different Cells Numbers

As the same electrode material is now used for 20 and 100 µl cuvettes, Nucleofection™ Conditions are transferable between the different Nucleocuvette™ vessels offering maximum flexibility and convenience:

- Once the conditions are known for one format they can be easily transferred to the other format.
- Conditions are transferable between different throughput formats (4D-Nucleofector™ System, 96-well Shuttle™ Device and HT Nucleofector™ System).
- Existing 96-well Shuttle™ Protocols can be used with the 4D-Nucleofector™ system.

Transferability Between Nucleofection™ Conditions Between Different Formats

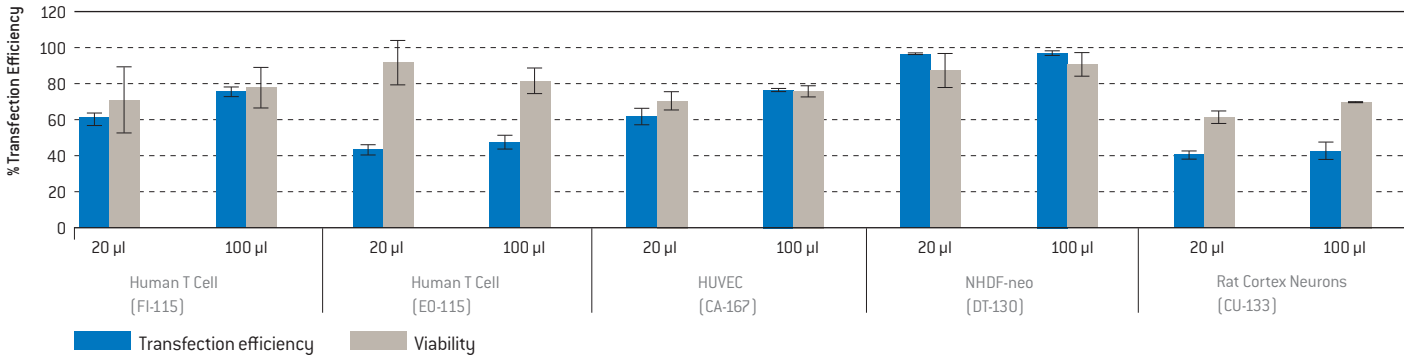


Figure 6. Various primary cells were transfected in the two Nucleocuvette™ vessel formats (20 µl and 100 µl) using the indicated programs. Twenty-four hours post Nucleofection™ cells were analyzed for transfection efficiency (flow cytometry) and viability (cell number normalized to no program control).

The Adherent Nucleofection™ Module: 4D-Nucleofector™ Y Unit

Electroporation-based methods have so far required cells to be in suspension for transfection. The Nucleofector™ technology entered a new era and allows direct Nucleofection™ of cells in adherence. Cells which typically grow in adherence in cell culture, can be kept and transfected by Nucleofection™ in their physiological state.

With the 4D-Nucleofector™ System adherent Nucleofection™ can be performed in two different ways. The 4D-Nucleofector™ X Unit (or 96-well Shuttle™ Add-on) utilizes specialized 16-well Nucleocuvette™ AD Strips in which cells can be cultured and transfected. In contrast, the more evolved **4D-Nucleofector™ Y Unit** works with disposable conductive polymer dipping electrode arrays that can be inserted into standard 24-well culture plates for the Nucleofection™

Benefits

- Pre- and post Nucleofection™ culture in 24-well culture plates
- Nucleofection™ of cells at any time point during this culture period, i.e. at a later developmental stage
- Transfection efficiencies up to 70% combined with high viabilities
- Compatible with Clonetics™ primary animal neurons

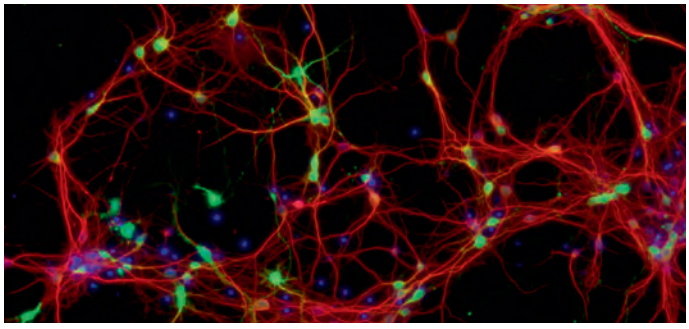
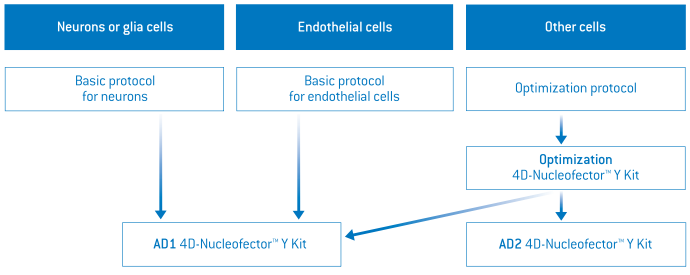


Figure 7. Efficient adherent Nucleofection™ of neurons in 24-well culture plates. Mouse cortical neurons were seeded into poly-D-lysine coated 24-well plates (1 x 10^5 cells/well). After 6 DIV, cells were transfected with pmaxGFP™ Vector using the AD1 4D-Nucleofector™ Y Kit. One day post Nucleofection™, cells were stained by MAP2 antibody (red) and analyzed by fluorescence microscopy for maxGFP™ protein expression.

Consumables

Following our new simplified kit strategy invented with the 4D-Nucleofector™ System we offer two Nucleofector™ Solutions called AD1 and AD2 both available as separate kits or combined to an optimization kit. Each solution may serve different cell types. You can easily find out which solution is optimal for your cell of interest by using the following guideline:



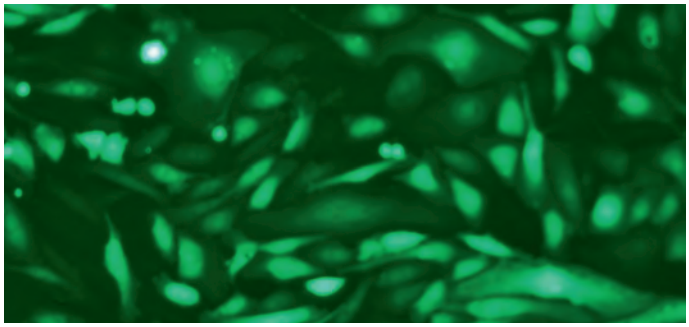


Figure 8. Human umbilical vein endothelial cells (HUVEC) were isolated and plated in passage 1 into collagen-coated 24-well plates at a density of 50,000 cells/well. After 1DIV cells were transfected with 16 µg pmaxGFP™ Vector using AD1 4D-Nucleofector™ Y Solution and program CA-215. Cells were analyzed for maxGFP™ Protein expression after 24h. (Data kindly provided by M. Sauvage, Pharmaceutical Industry, FR)

www.lonza.com/adherent-nucleofection

The Add-on: 96-well Shuttle™ Device

The 96-well Shuttle™ Device delivers flexible throughput combined with economical processing, speed, and pre-optimized protocols for a range of both primary cells and cell lines. It is a medium throughput extension to the 4D-Nucleofector™ Device suited for convenient optimization of Nucleofection™ Conditions or as assay establishment tool. The complete system consists of three components:

- The **4D-Nucleofector™ Device (Core and X Unit)** serving as the program delivery unit
- The **96-well Shuttle™ Device** as contacting unit which mediates the transfer of the respective 96-well program to a specific well of the 96-well Nucleocuvette™ Plate
- A **laptop computer** with the 96-well Shuttle™ Software controlling the interaction between the devices

Consumables

- P1 – P5 96-well Nucleofector™ Kits for transfection primary cells
- SE, SF and SG 96-well Nucleofector™ Kits for transfection cell lines
- Optimization kits for primary cells and cell lines

Benefits

- Up to 96 independent programs can be run per plate, processed automatically in <5 minutes
- Modular 6 × 16 Nucleocuvette™ plate for scalable throughput
- Fulfills prerequisites for liquid handling integration
- Optimization of any difficult-to-transfect cell line in just 1 plate
- Variable cell numbers from 10^4 – 10^6 cells per reaction
- Adherent Nucleofection™ of neurons at later developmental stages

Optimization of Nucleofection™ Conditions Within Just One Experiment

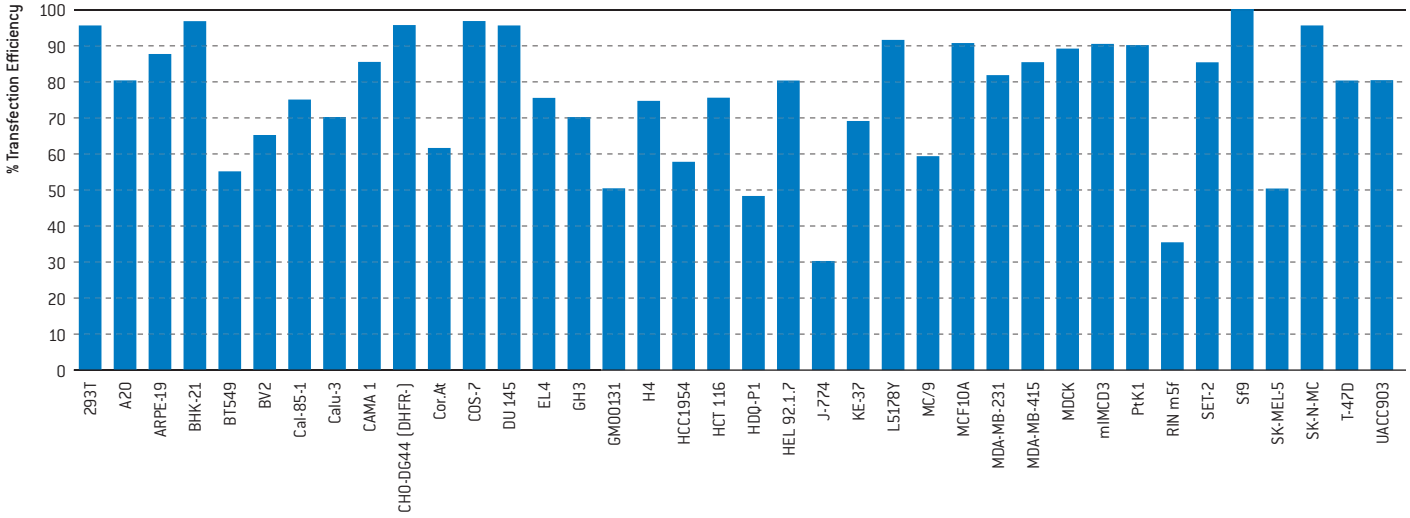


Figure 9. Examples of cell lines that have been optimized by customers using the Cell Line Optimization 96-well Nucleofector™ Kit.

The High-throughput Platform: HT Nucleofector™ System

The new HT Nucleofector™ System is an independent platform for high-throughput Nucleofection™ in 384-well format. With an extremely fast plate processing time of one minute and high reproduciblity it is the ideal tool for screening applications. Furthermore cell storage time in Nucleofector™ Solution is reduced to a minimum and all existing 96-well Shuttle™ Protocols can be used without further optimization.

The HT Nucleofector™ System consists of three components:

- A **Power Supply** Unit generating the high voltage pulses.
- The **Plate Handler** Unit with an electrically driven carousel that comprises two plate positions.
- An intuitive **PC-based Operation Software** which allows easy parameterization of HT Nucleofection™ Experiments and can be seamlessly integrated into market leading liquid handling systems.

Consumables

The HT Nucleofector™ Kits use existing 96-well Shuttle™ Protocols but contain newly developed conductive polymer 384-well Nucleocuvette™ Plates. The plates fulfill SBS standards to allow handling by automated liquid handling systems. Each of the 384 wells is individually addressable. Due to the use of new conductive polymer cuvettes there is no contamination of cell suspension with metal ions.

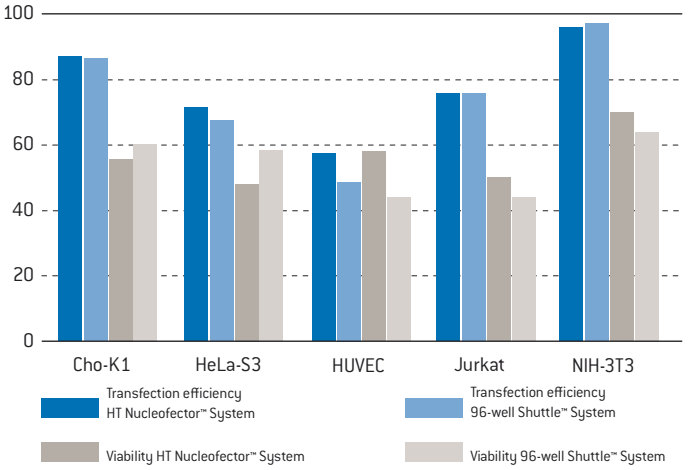


Figure 10. Same conditions used for the 96-well Shuttle™ and the HT Nucleofector™ Systems. The HT Nucleofector™ System works with 96-well Shuttle™ Parameters, thus the full spectrum of already optimized protocols is available for the HT Nucleofector™ System.

Benefits

Does Speed Count for Your Screens?

- Processes a 384-well plate in one minute
- Carousel handling two plates

Combining High Performance with Minimum Material Consumption?

- Nucleofection™ of low cell numbers down to $2x10^4$ cells
- Option to adapt transfection volumes down to 5 µl

Easy-to-use and Automatable System?

- Uses existing 96-well Shuttle™ Protocols
- Operated by intuitive PC-software
- Seamless integration into automated liquid handling environments

The Basic Device: Nucleofector™ 2b Device

The Nucleofector™ Device is the single cuvette based system that has been used in research labs since 2001. It allows efficient transfection of hard-to-transfect cell lines and primary cells with different substrates (e.g. DNA vectors or siRNA oligonucleotides) in low throughput format.

Consumables

- More than 50 dedicated primary cell kits, e.g. for blood cells or stem cells
- A collection of 5 cell line kits and an optimization kit covering a broad range of cell lines
- cGMP kits for protein production applications

Benefits

Highly Efficient Transfection in Single Cuvette Format?

- Up to 90% efficiency with plasmid DNA
- Up to 99% efficiency with siRNA duplexes
- Also suited for peptides, proteins or small molecules

Easy-to-use Technology with Reliable Results?

- More than 150 ready-to-use Optimized Protocols contain cell type-specific guidance
- Lonza's Cell Database contains user-developed protocols and data for more than 650 cell types
- Reliable and reproducible results due to high viability and preservation of cell functionality
- Approaching 4000 peer-reviewed publications

Consumables Tailored to Your Needs?

- Nucleofector™ Kits are available in low, normal and high usage format, reducing the waste of precious consumables and offer flexible pricing for different transfection throughputs

High Transfection Efficiencies in Suspension Cell Lines

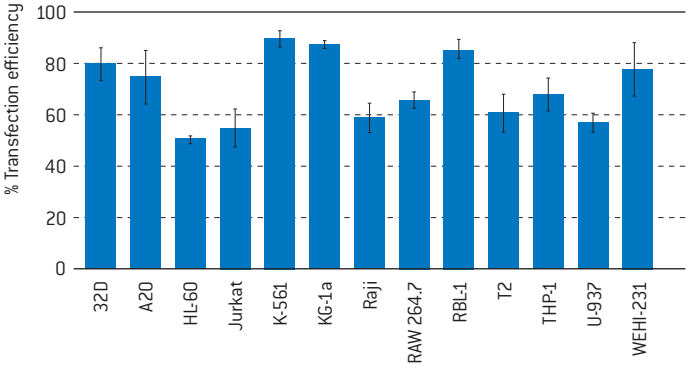


Figure 11. Transfection efficiencies 24 hours post Nucleofection™ in selected cell lines relevant for immunology research. Cells were transfected with either eGFP, maxGFP™ Reporter Protein or H-2KK and analyzed 24 hours post Nucleofection™. Viability ranged from 60 – 90%.

Nucleofector™ Kits Tailored to Your Needs

Kits for 4D-Nucleofector™, 96-well Shuttle™ and 384-well Nucleofector™ Systems

As Nucleofection™ Vessels for the 4D-Nucleofector™, 96-well Shuttle™ and HT Nucleofector™ Systems utilize the same conductive polymer electrode material, Nucleofection™ Conditions are transferable between the different vessels or platforms offering maximum flexibility and convenience.

Nucleofector™ Kits for Primary Cells – High Convenience Due to Simplified Concept

With our new conductive polymer cuvette concept, which was first established for the 96-well Shuttle™ System and now transferred to the new platforms, we were able to streamline our kit concept for primary cells. The number of required Nucleofector™ Solutions for primary cells is narrowed down to only 5 solutions which makes Nucleofection™ of several different primary cell types much more convenient.

- A total of 5 dedicated primary cell Nucleofector™ Kits P1 – P5, each suited for several primary cell types
- Primary cell optimization Nucleofector™ Kits of primary cells lacking an optimized protocol

Nucleofector™ Kits for Cell Lines

For transfection of cell lines using the 4D-Nucleofector™, 96-well Shuttle™ or 384-well Nucleofector™ Systems

- Selection of 3 cell line Nucleofector™ Kits SE, SF and SG
- Cell line optimization Nucleofector™ Kits for cell lines lacking an optimized protocol

	100 µl Nucleocuvette™	16-well Nucleocuvette™ Strip	16-well Nucleocuvette™ AD Strips	Dipping Electrode Array
	4D-Nucleofector™ X Unit	4D-Nucleofector™ X Unit	4D-Nucleofector™ X Unit	4D-Nucleofector™ Y Unit
				
Application	high cell numbers at low throughput e.g. for biochemical applications or Western Blots	low cell numbers at medium throughput e.g. reporter gene assays, RNAi	low cell numbers analysis by fluorescence microscopy, absorption, fluorescence or luminescence assays	analysis by confocal microscopy high cell numbers
Cells/sample	2 x 10^5 to 2 x 10^7 cells	2 x 10^4 to 1 x 10^6 cells	0.5 – 3 x 10^4 cells	0.5 – 3 x 10^5 cells
Reaction volume	100 µl	20 µl	20 µl	350 µl
Size(s) available	12 or 24 reactions	32 reactions	32 reactions	24 reactions

Table 1 – Kits types and sizes for the 4D-Nucleofector™, 96-well Shuttle™ or HT Nucleofector™ System.

4D-Nucleofector™ Kits for Adherent Nucleofection™

There are two different formats available for adherent Nucleofection™, both based on conductive polymer electrode material:

- 16-well Nucleocuvette™ AD Strips for use with the 4D-Nucleofector™ X Unit or the 96-well Shuttle™ Device
- 24-well dipping electrode arrays for use with the 4D-Nucleofector™ Y Unit

Adherent Nucleofector™ Kits for 4D-Nucleofector™ Y Unit

- 2 Nucleofector™ Y Kits that may serve different cell types
- An Optimization Nucleofector™ Y Kit for primary cells lacking an optimized protocol

Adherent Nucleofector™ Kits for 4D-Nucleofector™ X Unit or 96-well Shuttle™ Device

- Basic kits for adherenet Nucleofection™ of neural cells

Kits for Nucleofector™ II/2b Device

Nucleofector™ Kits for Primary Cells

The Nucleofector™ II/2b uses cell type specific kits, each of them dedicated to an individual primary cell.

- Individually developed Nucleofector™ Kits for more than 35 primary cell types

Nucleofector™ Kits for Cell Lines

- 5 different Cell line Nucleofector™ Kits C, L, R, T, and V
- Optimized Protocols outlining the optimal Nucleofector™ Kit for a large selection of cell lines can be downloaded from our website
- Cell line optimization Nucleofector™ Kit for cell lines lacking an Optimized Protocol
- cGMP Cell Line Nucleofector™ Kits available for Kit I and V

All Nucleofector™ II/2b Kits are available in different package variations (10, 25 and 4 × 25 reactions)

To find out which kit is the optimal one for your cell type of interest please check out our cell database for most up-to-date information **www.lonza.com/celldatabase**

	96-well Nucleocuvette™ Plate	96-well Nucleocuvette™ AD Plate	384-well Nucleocuvette™ Plate	Aluminum Cuvettes
	96-well Shuttle™ Device	96-well Shuttle™ Device	384-well Nucleofector™ System	Nucleofector™ II/2b Device
				
Application	low cell numbers at higher throughput e.g. reporter gene assays, RNAi, optimization	low cell numbers analysis by fluorescence microscopy, absorption, fluorescence or luminescence assays	low cell numbers at high throughput e.g. screening	high cell numbers at low throughput e.g. for biochemical applications or Western Blots
Cells/sample	2 x 10^4 to 1 x 10^6 cells	0.5 – 3 x 10^4 cells	2 x 10^4 to 1 x 10^6 cells	2 x 10^5 to 2 x 10^7 cells
Reaction volume	20 µl	20 µl	20 µl	100 µl
Size(s) available	96 or 960 reactions	96 reactions	768 or 3840 reactions	10, 25, or 100 reactions

Ordering Information

Description	Cat. No.	
Nucleofector™ Devices		
4D-Nucleofector™ Core Unit	AAF-1001B	–
4D-Nucleofector™ X Unit	AAF-1001X	Requires core unit to build complete system
4D-Nucleofector™ Y Unit	AAF-1001Y	Requires core unit to build complete system
4D-Nucleofector™ Guarantee, 2-year extension	AWE-1002	Has to be purchased at the time the device is purchased
4D-Nucleofector™ Service Contract	AWC-1001	Can be purchased at any time during the guarantee period
96-well Shuttle™ add-on (including laptop)	AAM-1001S	Requires core and X unit to build complete system
96-well Shuttle™ Guarantee, 2-year extension	AWM-1002	Has to be purchased at the time the device is purchased
96-well Shuttle™ Service Contract	AWB-1001	Can be purchased at any time during the guarantee period
HT Nucleofector™ System	AAU-1001	–
HT Nucleofector™ Installation and Training	AWT-1001	
HT Nucleofector™ Service Contract	AWU-1001	Can be purchased at any time during the guarantee period
Nucleofector™ 2b Device	AAB-1001	–
Nucleofector™ 2b Guarantee, 2-year extension	AWD-2002	Has to be purchased at the time the device is purchased
Nucleofector™ 2b Service Contract	AWA-2001	Can be purchased at any time during the guarantee period

	100 µl Nucleocuvette™		20 µl Nucleocuvette™; 16-well	Dipping Electrode
	12rxn	24 rxn	32 rxn	24 rxn
4D-Nucleofector™ Kits				
P1 Primary Cell 4D-Nucleofector™ X Kit	V4XP-1012	V4XP-1024	V4XP-1032	–
P2 Primary Cell 4D-Nucleofector™ X Kit	V4XP-2012	V4XP-2024	V4XP-2032	–
P3 Primary Cell 4D-Nucleofector™ X Kit	V4XP-3012	V4XP-3024	V4XP-3032	–
P4 Primary Cell 4D-Nucleofector™ X Kit	V4XP-4012	V4XP-4024	V4XP-4032	–
P5 Primary Cell 4D-Nucleofector™ X Kit	V4XP-5012	V4XP-5024	V4XP-5032	–
Primary Cell Optimization 4D-Nucleofector™ X Kit	–	–	V4XP-9096 (96 rxn)	–
Basic Neuron 4D-Nucleofector™ X AD Kit (adherent)	–	–	V4XP-1A32	–
AD1 4D-Nucleofector™ Y Kit (adherent)	–	–	–	V4YP-1A24
AD2 4D-Nucleofector™ Y Kit (adherent)	–	–	–	V4YP-2A24
Optimization 4D-Nucleofector™ Y Kit (adherent)	–	–	–	V4YP-9A48
SE Cell line 4D-Nucleofector™ X Kit	V4XC-1012	V4XC-1024	V4XC-1032	–
SF Cell line 4D-Nucleofector™ X Kit	V4XC-2012	V4XC-2024	V4XC-2032	–
SG Cell line 4D-Nucleofector™ X Kit	V4XC-3012	V4XC-3024	V4XC-3032	–
Cell Line Optimization 4D-Nucleofector™ X Kit	–	–	V4XC-9096 (64 rxn)	–

	20 µl Nucleocuvette™; 96-well	
	96 rxn	960 rxn
96-well Shuttle™ Kits		
P1 Primary Cell 96-well Nucleofector™ Kit	V4SP-1096	V4SP-1960
P2 Primary Cell 96-well Nucleofector™ Kit	V4SP-2096	V4SP-2960
P3 Primary Cell 96-well Nucleofector™ Kit	V4SP-3096	V4SP-3960
P4 Primary Cell 96-well Nucleofector™ Kit	V4SP-4096	V4SP-4960
P5 Primary Cell 96-well Nucleofector™ Kit	V4SP-5096	V4SP-5960
Primary Cell Optimization 96-well Nucleofector™ Kit	V4SP-9096 (160 rxn)	–
SE Cell line 96-well Nucleofector™ Kit	V4SC-1096	V4SC-1960
SF Cell line 96-well Nucleofector™ Kit	V4SC-2096	V4SC-2960
SG Cell line 96-well Nucleofector™ Kit	V4SC-3096	V4SC-3960
Cell Line Optimization 96-well Nucleofector™ Kit	V4SC-9096	–
Basic Neuron 96-well Nucleofector™ AD Kit (adherent)	VIPI-10003	–

Ordering Information

	20 µl Nucleocuvette™; 384-well	
	768 rxn	3840 rxn
384-well Nucleofector™ Kits		
P1 Primary Cell 384-well Nucleofector™ Kit	V5SP-1002	V5SP-1010
P2 Primary Cell 384-well Nucleofector™ Kit	V5SP-2002	V5SP-2010
P3 Primary Cell 384-well Nucleofector™ Kit	V5SP-3002	V5SP-3010
P4 Primary Cell 384-well Nucleofector™ Kit	V5SP-4002	V5SP-4010
P5 Primary Cell 384-well Nucleofector™ Kit	V5SP-5002	V5SP-5010
Primary Cell Optimization 384-well Nucleofector™ Kit	V5SP-9001 (384 rxn)	–
SE Cell line 384-well Nucleofector™ Kit	V5SC-1002	V5SC-1010
SF Cell line 384-well Nucleofector™ Kit	V5SC-2002	V5SC-2010
SG Cell line 384-well Nucleofector™ Kit	V5SC-3002	V5SC-3010
Cell Line Optimization 384-well Nucleofector™ Kit	V5SC-9001 (384 rxn)	–

Nucleofector™ II/2b Kits	100 µl Aluminum Cuvette		
	10 rxn	25 rxn	4x25 Reactions
Primary Blood Cells			
Human B Cell Nucleofector™ Kit	VAPA-1001	VPA-1001	VVPA-1001
Human T Cell Nucleofector™ Kit	VAPA-1002	VPA-1002	VVPA-1002
Human CD34+ Cell Nucleofector™ Kit	VAPA-1003	VPA-1003	VVPA-1003
Human Dendritic Cell Nucleofector™ Kit	VAPA-1004	VPA-1004	VVPA-1004
Human NK Cell Nucleofector™ Kit	VAPA-1005	VPA-1005	VVPA-1005
Mouse T Cell Nucleofector™ Kit (incl. medium)	–	VPA-1006	VVPA-1006
Human Monocyte Nucleofector™ Kit	–	VPA-1007	VVPA-1007
Human Macrophage Nucleofector™ Kit	VAPA-1008	VPA-1008	VVPA-1008
Mouse Macrophage Nucleofector™ Kit	VAPA-1009	VPA-1009	VVPA-1009
Mouse B Cell Nucleofector™ Kit	VAPA-1010	VPA-1010	VVPA-1010
Mouse Dendritic Cell Nucleofector™ Kit	VAPA-1011	VPA-1011	VVPA-1011
Primary Bone/Cartilage Cells			
Human Chondrocyte Nucleofector™ Kit	VAPF-1001	VPF-1001	VVPF-1001
Primary Cardiac Cells			
Rat Cardiomyocytes - Neonatal Nucleofector™ Kit	VAPE-1002	VPE-1002	VVPE-1002
Primary Dermal Cells			
Human Keratinocyte Nucleofector™ Kit	VAPD-1002	VPD-1002	VVPD-1002
Normal Human Epidermal Melanocyte-Neo Nucleofector™ Kit	VAPD-1003	VPD-1003	VVPD-1003
Primary Endothelial Cells			
Human Coronary Artery Endothelial Cell Nucleofector™ Kit	VAPB-1001	VPB-1001	VVPB-1001
Human Umbilical Vein Endothelial Cell Nucleofector™ Kit	VAPB-1002	VPB-1002	VVPB-1002
Human Microvascular Endothelial Cell Lung Nucleofector™ Kit	VAPB-1003	VPB-1003	VVPB-1003
Basic Nucleofector™ Kit for Mammalian Endothelial Cells	VAPI-1001	VPI-1001	VVPI-1001
Primary Epithelial Cells			
Normal Human Bronchial Epithelial Cell Nucleofector™ Kit	VAPK-1001	VPK-1001	VVPK-1001
Basic Nucleofector™ Kit for Mammalian Epithelial Cells	VAPI-1005	VPI-1005	VVPI-1005

Ordering Information

Nucleofector™ II/2b Kits	100 µl Aluminum Cuvette		
	10 rxn	25 rxn	4x25 Reactions
Primary Fibroblasts			
Human Dermal Fibroblast Nucleofector™ Kit	VAPD-1001	VVPD-1001	VPD-1001
Mouse Embryonic Fibroblast Nucleofector™ Kit 1	VAPD-1004	VPD-1004	VVPD-1004
Mouse Embryonic Fibroblast Nucleofector™ Kit 2	VAPD-1005	VPD-1005	VVPD-1005
Mouse Embryonic Fibroblast Starter Nucleofector™ Kit	VPD-1006	–	–
Basic Nucleofector™ Kit for Mammalian Fibroblasts	VAPI-1002	VPI-1002	VVPI-1002
Primary Hepatocytes			
Mouse/Rat Hepatocyte Nucleofector™ Kit	VAPL-1004	VPL-1004	VVPL-1004
Primary Neural Cells			
Mouse Neuron Nucleofector™ Kit	VAPG-1001	VPG-1001	VVPG-1001
Chicken Neuron Nucleofector™ Kit	VAPG-1002	VPG-1002	VVPG-1002
Rat Neuron Nucleofector™ Kit	VAPG-1003	VPG-1003	VVPG-1003
Basic Nucleofector™ Kit for Mammalian Neurons	VAPI-1003	VPI-1003	VVPI-1003
Basic Nucleofector™ Kit for Mammalian Glial Cells	VAPI-1006	VPI-1006	VVPI-1006
Primary Smooth Muscle Cells			
Human Aortic Smooth Muscle Cell Nucleofector™ Kit	VAPC-1001	VPC-1001	VVPC-1001
Basic Nucleofector™ Kit for Smooth Muscle Cells	VAPI-1004	VPI-1004	VVPI-1004
Primary Stem Cells			
Human CD34+ Cell Nucleofector™ Kit	VAPA-1003	VPA-1003	VVPA-1003
Human Mesenchymal Stem Cell Nucleofector™ Kit	VAPE-1001	VPE-1001	VVPE-1001
Human Stem Cell Nucleofector™ Kit 1	VAPH-5012	VPH-5012	VVPH-5012
Human Stem Cell Nucleofector™ Kit 2	VAPH-5022	VPH-5022	VVPH-5022
Human Stem Cell Starter Nucleofector™ Kit	VPH-5002 (18 rxn)	–	–
Mouse Embryonic Stem Cell Nucleofector™ Kit	VPH-1001	VAPH-1001	VVPH-1001
Mouse Neural Stem Cell Nucleofector™ Kit	VAPG-1004	VPG-1004	VVPG-1004
Rat Neural Stem Cell Nucleofector™ Kit	VAPG-1005	VPG-1005	VVPG-1005
Parasite Kits			
Basic Parasite Nucleofector™ Kit 1	VAMI-1011	VMI-1011	VVMI-1011
Basic Parasite Nucleofector™ Kit 2	VAMI-1021	VMI-1021	VVMI-1021
Basic Parasite Starter Nucleofector™ Kit	VMI-1001	–	–
Cell Line Kits			
Cell Line Nucleofector™ Kit R	VACA-1001	VCA-1001	VVCA-1001
Cell Line Nucleofector™ Kit T	VACA-1002	VCA-1002	VVCA-1002
Cell Line Nucleofector™ Kit V	VACA-1003	VCA-1003	VVCA-1003
Cell Line Nucleofector™ Kit C	VACA-1004	VCA-1004	VVCA-1004
Cell Line Nucleofector™ Kit L	VACA-1005	VCA-1005	VVCA-1005
Cell Line Optimization Nucleofector™ Kit	VCO-1001N (18 rxn)	–	–
cGMP Cell Line Nucleofector™ Kit L	–	VGA-1005	–
cGMP Cell Line Nucleofector™ Kit V	–	VGA-1003	–

Nucleofector™ PLUS Supplements

	150 µl	500 µl	Suited for
Nucleofector™ PLUS Supplement 1	VS1-00150P	VS1-00500P	Cell line kits SE, SF, SG, R, T, V, L Primary cell kits: P1, P2, P3, P4, and Nucleofector™ II / 2b Kits*
Nucleofector™ PLUS Supplement 2	–	VS2-00500P	Cell line kits: C Primary cell kits: Nucleofector™ II / 2b Kits*
Nucleofector™ PLUS Supplement 3	VS3-00150P	VS3-00500P	Primary cell kits: P5, and Nucleofector™ II / 2b Kits*
Nucleofector™ PLUS Supplement 4	–	VS4-00500P	Primary cell kits: Nucleofector™ II / 2b Kits*

*To determine the supplement required for your Primary Cell Nucleofector™ II / 2b Kit please refer to the table provided on our website: www.lonza.com/n-plus

www.lonza.com

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