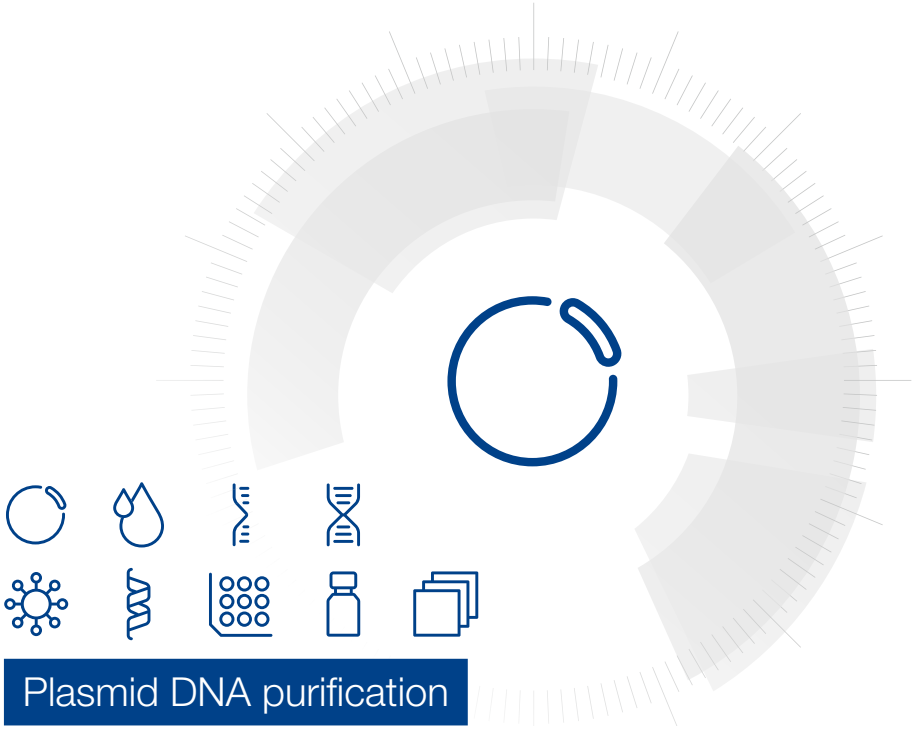
Bioanalysis

MACHEREY-NAGEL

User manual



Plasmid DNA purification

- NucleoSnap® Plasmid Midi

December 2021 / Rev. 03

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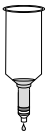
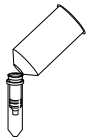
Plasmid DNA purification

Protocol at a glance (Rev. 03)

		NucleoSnap® Plasmid Midi
1	**Harvest bacterial cells**	4,500–6,000 x *g* 4 °C, ≥ 10 min
2	**Resuspend bacterial cells**	 5 mL SN1 Resuspend bacterial cells completely
3	**Lyse cells**	 5 mL SN2 RT, max. 2 min
4	**Neutralize**	 5 mL SN3 Mix thoroughly until colorless
5	**Clarify lysate**	 Transfer lysate to NucleoSpin® Plasmid Filter Column 3,000 x *g*, 2 min Discard Plasmid Filter Column
6	**Precipitate DNA**	 7 mL SN4 Mix
7	**Filtrate DNA**	 Vacuum Load onto Snap Column -0.3 bar* (passage approx. 2–3 min)
8	**Wash silica membrane**	 Vacuum **1st wash** 2 mL SN5 -0.3 bar* **2nd wash** 4 mL SN6 -0.3 bar*
9	**Dry silica membrane**	 Remove upper column part and discard 10,000 x *g*, 1 min
10	**Elute DNA**	  200-500 µL SNE 10,000 x *g*, 1 min

* Reduction of atmospheric pressure

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1 Components

1.1 Kit contents

	NucleoSnap® Plasmid Midi	
REF	**10 preps 740494.10**	**50 preps 740494.50**
Resuspension Buffer SN1	100 mL	2 x 150 mL
Lysis Buffer SN2	100 mL	2 x 150 mL
Neutralization Buffer SN3	100 mL	2 x 150 mL
Precipitation Buffer SN4	90 mL	400 mL
Endotoxin Removal Buffer SN5	25 mL	125 mL
Wash Buffer SN6 (Concentrate)*	12 mL	50 mL
Elution Buffer SNE**	13 mL	60 mL
RNase A (lyophilized)*	40 mg	2 x 60 mg
NucleoSpin® Plasmid Filter Columns	10	50
NucleoSnap® Plasmid Columns	10	50
Collection Tubes (2 mL)	10	50
User manual	1	1

* For preparation of working solutions and storage conditions see section 3.
** Composition of Elution Buffer SNE: 5 mM Tris/HCl, pH 8.5.

1.2 Reagents and equipment to be supplied by user

Reagents

- 96–100 % ethanol

Equipment

- Vacuum manifold with Luer adapters
- NucleoVac Vacuum Regulator (e.g., REF 740641)
- NucleoVac Valves (e.g., REF 740298.24)
- Vacuum pump capable of reaching -0.3 bar* (~ 10 in. Hg)
- Centrifuge with swing-out rotor capable of reaching ≥ 3,000 x *g* for 50 mL tubes
- Microcentrifuge capable of reaching ≥ 10,000 x *g*
- Centrifugation tubes (2 mL)
- Pipettes and pipette tips for 0.1–1 mL and 0.5–10 mL

1.3 About this user manual

It is strongly recommended reading the detailed protocol sections of this user manual if the **NucleoSnap® Plasmid Midi** kit is used for the first time. Experienced users, however, may refer to the Protocol at a glance instead. The Protocol at a glance is designed to be used only as a supplemental tool for quick referencing while performing the purification procedure.

All technical literature is available online at ***www.mn-net.com***. Please visit the MACHEREY-NAGEL website to verify that you are using the latest revision of this user manual.

* Reduction of atmospheric pressure

2 Product description

2.1 Basic principle

NucleoSnap® Plasmid Midi kits are based on a modification of the commonly used and unsurpassed alkaline lysis method that was first described by Birnboim and Doly*.

E. coli cells are grown in a standard culture medium under appropriate selective conditions and harvested by centrifugation.

Cells are resuspended in **Resuspension Buffer SN1** and afterwards lysed by **Lysis Buffer SN2** containing sodium dodecyl sulfate and sodium hydroxide. Alkaline conditions ensure a complete and almost immediate denaturation of DNA and proteins. Addition of **Neutralization Buffer SN3** precipitates potassium dodecyl sulfate complexes with bacterial cell debris, proteins, and macromolecular contaminants and neutralizes the pH value resulting in a re-annealing of the covalently closed circular plasmid DNA which remains soluble.

Debris is removed by a filtration step with the specially designed **NucleoSpin® Plasmid Filter Columns**. The clear flowthrough contains plasmid DNA while genomic DNA, cell remnants, and most of the protein are filtered out and can be discarded.

The flowthrough containing the plasmid DNA is mixed with **Precipitation Buffer SN4** and loaded into a **NucleoSnap® Plasmid Midi Column**, connected to a vacuum device. Vacuum is applied until the solution has passed the filtration matrix completely. Endotoxins are washed away by **Endotoxin Removal Buffer SN5**, salts, and further impurities are subsequently removed by a washing step with ethanolic **Wash Buffer SN6**.

Residual ethanol from Wash Buffer SN6 is efficiently removed by centrifugation in a microcentrifuge. To enable the use of a microcentrifuge, the **NucleoSnap® Columns** are equipped with a predetermined breaking point and can be divided into a funnel component and a Mini spin column by a simple break action.

Plasmid DNA is eluted in **Elution Buffer SNE** (5 mM Tris / HCl, pH 8.5) or other suitable solutions like TE buffer or pure water and is ready for any common downstream application. To achieve an optimal elution efficiency it is required to elute the DNA under neutral to slightly alkaline conditions, ensured by Buffer SNE. No further clean up steps are required.

2.2 Kit specifications

The **NucleoSnap® Plasmid Midi** kits are designed for the rapid purification of highly pure plasmid DNA from up to 50 mL of a standard *E. coli* overnight culture. See section 2.5 for possible adaptations to larger culture volumes. Plasmid DNA isolated with this kit is suitable for all common downstream applications like enzymatic digestion, cloning, sequencing, PCR amplification, transformation, and transfection (research use only).

* Birnboim, H.C. and Doly, J. (1979) Nucl. Acids Res. 7, 1513-1523

Table 1: Kit specifications at a glance

Parameter	NucleoSnap® Plasmid Midi
Sample material	50 mL *E. coli* culture
Vector size	< 25 kbp
Column capacity	1.5 mg
Typical yield	250 µg (50 mL culture, OD_{600} = 4, high-copy plasmid)
Preparation time	30 min/6 samples
Endotoxin level	Transfection-grade

2.3 Setup of NucleoSnap® Plasmid Columns

NucleoSnap® Plasmid Columns are adapted to a vacuum manifold either by a direct Luer connection or by the use of a NucleoVac Mini Adapter or NucleoVac Valves (recommended, see ordering information). A valve is useful to switch off vacuum selectively when using a large number of columns at the same time to prevent a pressure loss through empty columns and excessive filtration of potentially contaminated air.

The space between each two used inlets of the vacuum manifold should be sufficient not to bend or dislodge **NucleoSnap® Plasmid Columns** attached to the vacuum manifold.

The **NucleoSnap® Plasmid Columns** consist of one piece but can be split into two parts: a lower Mini spin column part and an upper funnel part. Handle the columns carefully to prevent accidental damage to the predetermined breaking point!

It is highly recommended to use a Vacuum regulator (see ordering information) for the adaptation of the required vacuum strength. Excessive vacuum strength will result in reduced plasmid yield. Optimal vacuum strength (-0,3 bar reduction of atmospheric pressure) will filtrate the lysate in approximately 2–3 min.

2.4 Reverse pipetting technique

Precipitation Buffer SN4 is viscous. Use of **reverse pipetting** is recommended to ensure accurate volumes. Reverse pipetting is done by pressing down the pipette's plunger button all the way down to the second stop before slowly aspirating the Precipitation Buffer SN4 until the plunger button rests again in the starting position. The buffer volume inside the pipette tip is larger than set now, so when dispensing the Precipitation Buffer SN4 to the cleared lysate, be sure to dispense to the first stop only! Liquid remaining in the pipette tip can be dispensed back to the buffer container.

For further details concerning the reverse pipetting technique and liquid handling of viscous fluids, you may also check your pipette manufacturer's information material.

2.5 Estimation of optimal culture volume

The **NucleoSnap® Plasmid Midi** kit is designed for the purification of plasmid DNA from a pellet of *E. coli* cells originating from 50 mL bacterial culture. Nevertheless, the amount of cells per milliliter (titer) varies and depends on many unpredictable factors; therefore, the total amount of pelleted cells varies according to the titer.

Cell lysis depends on the optimal ratio of bacteria to lysing substances. The total amount of the lysing substances sodium dodecyl sulfate and sodium hydroxide is fixed and specified by the volume of Lysis Buffer SN2 added. Lysing substances are consumed during cell lysis, so excess input of bacteria may result in suboptimal lysis and reduced yield.

As a consequence, the amount of cells is more important for optimal results than the culture volume the cells were pelleted from.

The titer can easily be estimated by measuring the optical density at 600 nm (OD_{600}), blanked against empty culture medium. Due to scattering of light, the OD_{600} increases according to the number of cells in the optical path with a linear range from about 0.1 to 1. The dilution factor corrected OD_{600} is directly correlated with the number of cells per volume. Multiplying the OD_{600} with the pelleted volume gives the ODV number which is relative to the number of cells in a pellet.

Experimental results show a strong correlation between the ODV, added volumes of buffers SN1, SN2, SN3, and plasmid DNA yield. While a high buffer to cell ratio does not have a negative effect, a high cell to buffer ratio decreases yield beyond a maximum cell input. The following formula can be used to calculate the maximal pelleted volume of culture dependent on the bacterial growth (OD_{600}) for the lysis conditions of the **NucleoSnap® Plasmid Midi** kit:

$$\frac{250}{OD_{600}} = \textbf{pelleted culture Volume [mL]}$$

E.g., if a bacterial culture grew to an OD_{600} of 5, the pelleted culture volume should not exceed 250:5 = 50 mL. With a culture grown to an OD_{600} of 3, a pelleted volume of 250:3 ≈ 80 mL would also be possible while a culture grown to an OD_{600} of 8 would need a decrease in pelleted volume to 250:8 ≈ 30 mL for optimal results.

2.6 Adaptations for low-copy plasmids

As explained in section 2.5, the amount of cells in relation to the amount of lysis buffer is of crucial importance for optimal results. Increasing the cell input without adapting the lysis buffer volumes accordingly will lead to decreased yield and is not recommended. For working with low-copy plasmids it is usually recommended to use double volumes of bacterial culture and lysis buffers. This is also possible with this kit and will yield similar results.

The **NucleoSpin® Plasmid Filter Columns** are limited in volume though, so if lysis buffer volumes are increased, the **NucleoSpin® Plasmid Filter Columns** cannot be used to clarify the lysates after neutralization. Larger lysate volumes must either be clarified by centrifugation or by filtration.

It is recommended to centrifuge the lysate after neutralization for at least 5 minutes at full speed, to transfer the supernatant into a fresh 50 mL tube (not supplied) and to recentrifuge the samples for at least 5 minutes at full speed. The resulting supernatant must be clear in order to prevent clogging of the NucleoSnap® Plasmid Columns.

Alternatively, a standard gravity flow filtration can be performed with NucleoBond® Folded Filters (see ordering information, section 6.2) that have been equilibrated with 2 mL of Buffer SN3.

Keep in mind that high-copy plasmids are usually present in 100–1000 copies per cell while low-copy plasmids are present in 1–10 copies per cell only. There is at least a difference of more than factor 10. A difference of factor 2 in cell input will only have a small total effect on yield. To greatly increase yield, all volumes need to be drastically increased.

For processing large culture volumes and thus preparing large amounts of highly concentrated low-copy plasmid DNA the NucleoBond® Xtra or NucleoBond® PC kits are recommended. Contact your local supplier or our technical support at tech-bio@mn-net.com for more information.

3 Storage conditions and preparation of working solutions

- All components can be stored at 15–25 °C and are stable for at least one year.
- Storage of Buffer **SN2** below 20 °C may cause precipitation of sodium dodecyl sulfate. **Check for precipitated salt in Buffer SN2 each time before starting a preparation!** Precipitates might form a firm layer at the bottom of the bottle which is difficult to see from the side or above. Gently invert the bottle a few times (avoid extensive foaming) and carefully inspect the buffer for white flocculates. If salt precipitate is observed, incubate buffer at elevated temperature (e.g., 30–40 °C) for several minutes and mix carefully (avoid extensive foaming) until all precipitate is redissolved completely. Cool down to room temperature before use.
- Dissolve the lyophilized **RNase A** by addition of 3 mL Buffer SN1 to the enzyme vial. Gently swirl the vial or mix by pipetting up and down until the RNase A is dissolved completely. Transfer the RNase A solution back to the bottle containing Buffer SN1 and mix well. Label the addition of RNase A on the check box of Buffer SN1. Store Buffer SN1 with RNase A at 4 °C for up to 6 months. Prepare each Buffer SN1 and RNase A in 740494.50 independently.
- If precipitated salt crystals are visible in Buffer SN5, incubate the Buffer in a tightly closed bottle for 15 minutes at 95 °C and mix well until all precipitates are redissolved.
  Let the buffer cool down to room temperature before use.

Before starting any **NucleoSnap® Plasmid Midi** protocol prepare the following:

- **Wash Buffer SN6**: Add the given volume of ethanol (96–100 %) as indicated on the bottle or in the table below to **Buffer SN6 (Concentrate)** before first use. Mark the label on the bottle to indicate that the ethanol is added. Prepared Buffer SN6 is stable at 15–25 °C for at least one year.

	NucleoSnap® Plasmid Midi	
REF	**10 preps** **740494.10**	**50 preps** **740494.50**
Buffer SN6 (Concentrate)	12 mL add 48 mL ethanol	50 mL add 200 mL ethanol

4 Safety Instructions

When working with the **NucleoSnap® Plasmid Midi** kit wear suitable protective clothing (e.g., lab coat, disposable gloves, and protective goggles). For more information consult the appropriate Material Safety Data Sheets (MSDS available online at http://***www.mn-net.com/msds***).

The waste generated with the **NucleoSnap® Plasmid Midi** kit has not been tested for residual infectious material. A contamination of the liquid waste with residual infectious material is highly unlikely due to strong denaturing lysis buffer but it cannot

be excluded completely. Therefore, liquid waste must be considered infectious and should be handled and discarded according local safety regulations.

4.1 Disposal

Dispose hazardous, infectious or biologically contaminated materials in a safe and acceptable manner and in accordance with all local and regulatory requirements.

5 NucleoSnap® Plasmid Midi protocol

Before starting the preparation:

- Check if RNase A was added to Resuspension Buffer SN1 according to section 3.
- Check Buffer SN2 for precipitates according to section 3.
- Check if Buffer SN6 was prepared according to section 3.
- Recommended: Measure the OD_{600} of the culture according to section 2.5.

All vacuum steps are performed with a reduction of atmospheric pressure of about -0.3 bar* (10 in. Hg). Do not exceed -0.3 bar (10 in. Hg)!

1 Harvest bacterial cells

Pellet **50 mL *E. coli* culture** by centrifugation at **4,500–6,000 x *g*** for ≥ **10 min** at **4 °C** and discard the supernatant completely.

See section 2.5 for recommendations concerning alternative culture volumes dependent on cell titer.

4,500–6,000 x *g*
4 °C, ≥ 10 min

2 Resuspend bacterial cells

Add **5 mL Buffer SN1**. Resuspend the cell pellet completely by vortexing or pipetting up and down. Make sure no cell clumps remain before addition of Buffer SN2!

+ 5 mL SN1

3 Lyse cells

Add **5 mL Buffer SN2**. Mix gently by inverting the tube 5 times. Do not vortex or pipette!

Incubate at **room temperature (18–25 °C)** for a maximum of **2 min**.

+ 5 mL SN2
RT, max. 2 min

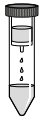
4 Neutralize

Add **5 mL Buffer SN3**. **Mix** gently by inverting the tube until the blue color has disappeared completely and an off-white flocculate has formed.

+ 5 mL SN3
Mix

* Reduction of atmospheric pressure.

5 Clarify lysate



Load sample

Transfer the lysate into a **NucleoSpin® Plasmid Filter Column**.

Centrifuge at **3,000 x *g*** for **2 min.**

3,000 x *g*, 2 min

The lysate should pass the column completely. If liquid is remaining on top of the filter membrane, repeat centrifugation until all liquid has passed the filter layers.

Save the flowthrough. Discard the filter column.

Discard Plasmid Filter Column

6 Precipitate DNA

+ 7 mL SN4

Add **7 mL Buffer SN4** to the clear flowthrough from step 5.

Mix

The added volume of Buffer SN4 must be about 0.5 volumes of the cleared lysate volume.

Note: Reverse pipetting is recommended (see chapter 2.4).

Vortex for **5 s**.

7 Filtrate DNA

Vacuum

Load

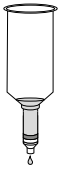
-0.3 bar*

Connect the **NucleoSnap® Plasmid Column** to a vacuum manifold and load mixture from step 6 into the column.

Apply **vacuum (-0.3 bar*)** until the solution has completely passed the filter membrane and then turn vacuum off.

8 Wash silica membrane

1st wash



Vacuum

+ 2 mL SN5

Remove endotoxin

Add **2 mL Buffer SN5** into the NucleoSnap® Plasmid Column. Apply **vacuum (-0.3 bar*)** until the solution has completely passed the filter membrane and then turn vacuum off.

-0.3 bar*

2nd wash

+ 4 mL SN6

Remove salt

Add **4 mL Buffer SN6** into the NucleoSnap® Plasmid Column. Apply **vacuum (-0.3 bar*)** until the solution has completely passed the filter membrane and then turn vacuum off.

-0.3 bar*

* Reduction of atmospheric pressure

9 **Dry silica membrane**

Remove the NucleoSnap® Plasmid Column from the vacuum manifold and place the bottom Mini spin column part into a 2 mL Collection Tube (supplied). Snap off the funnel part from the Mini spin column part placed in the Collection Tube. Discard the funnel.

Centrifuge Mini spin column and Collection Tube for **1 min** at > **10,000 x *g*** to remove any residual ethanol.

Discard the Collection Tube and place the Mini spin column into a new 2 mL Elution Tube (not supplied).

10 **Elute DNA**

Add **200 µL (high concentration)** or **500 µL (high yield)** of **Elution Buffer SNE** directly to the filter membrane and incubate at **room temperature** for **1 min**.

Centrifuge for **1 min** at **> 10,000 x *g*.**

Optional: Repeat elution with the eluate as elution buffer for optimal recovery.

Note: Using 200 µL as elution volume will result in a high DNA concentration but total yield might be reduced.

Note: See Chapter 2.1 for possible replacements of Buffer SNE

6 Appendix

6.1 Troubleshooting

Problem	Possible cause and suggestions
No or low DNA yield	*No plasmid DNA present in cells* • Check plasmid propagation by an alternative plasmid DNA isolation method, e.g., NucleoSpin® Plasmid EasyPure or NucleoSpin® Plasmid. *Insufficient resuspension* • Completely resuspend the pellet in Buffer SN1. Any remaining cell clumps will be lysed on the surface only, resulting in remaining intact bacteria after lysis. *SDS precipitation in Buffer SN2* • Check Buffer SN2 for precipitated SDS before adding the buffer to the resuspended cells. Precipitated SDS will result in very low yields. *Lysis buffer overloaded* • If too many cells were harvested, the lysing components will be consumed before sufficient cell lysis. See section 2.5 and check the OD_{600} of your culture to prevent an overloading of the lysis system. *Insufficient amount of Precipitation Buffer SN4 added.* • Buffer SN4 is viscous, make sure to add the correct volume. Use reverse pipetting according to section 2.4 to avoid inaccurate pipetting of precipitation buffer. • Precipiation works best when 0.5 vol of Buffer SN4 are added to each vol of cleared lysate. *Vacuum force too high* • Filtration works best when applied vacuum is at about -0.3 bar* (~ 10 in. Hg). Higher vacuum forces of above -0.7 bar* (~ 20 in. Hg) will result in faster flow rates but also in a loss of DNA. *Suboptimal pH of elution solution* • Optimal elution requires neutral to slightly alkaline conditions. When using other solutions than the supplied Buffer SNE, check pH and make sure the pH value is at least 7.0

* Reduction of atmospheric pressure.

Problem	Possible cause and suggestions
Slow flow rates	*Excess plasmid input* • Plasmid DNA is filtrated on top of the filter membrane. Increasing amounts of plasmid DNA will lead to reduced flow rates when more than 1.5 mg DNA have been loaded. *Insufficient vacuum force* • The lower the vacuum force the slower the flow rate will be. Use vacuum pumps only that enable a minimum of -0.3 bar*. *RNA present in cleared lysate* • Check if RNase A was added to buffer SN1 according to section 3. *Intact cells present in cleared lysate* • Remaining cell clumps after resuspension will lead to an incomplete lysis. Intact bacteria will clog the filter.
Lysate clarification not completely successful	*Divergent g-force used during centrifugation* • Volumes and times are optimized for 3,000 x *g*. Lower centrifugal forces result in insufficient lysate clearing, higher centrifugal forces might lead to filter damage.

6.2 Ordering information

Product	REF	Pack
NucleoSnap® Plasmid Midi	740494.10 / .50	10 / 50
NucleoVac 24 Vacuum Manifold	740299	1
NucleoVac Vacuum Regulator	740641	1
Snap Tubes 15 mL	740823.10 / .50	10 / .50
Snap Tubes 50 mL	740822.10 / .50	10 / .50
NucleoVac Mini Adapters	740297.100	100
NucleoVac Valves	740298.24	24
NucleoBond® Folded Filters	740561	5
NucleoSpin® Plasmid	740588.10 / .50 / .250	10 / 50 / 250
NucleoSpin® Plasmid Easy Pure	740727.10 / .50 / .250	10 / 50 / 250

* Reduction of the atmospheric pressure.

6.3 Product use restriction / warranty

NucleoSnap® Plasmid Midi kit components are intended, developed, designed, and sold FOR RESEARCH PURPOSES ONLY, except, however, any other function of the product being expressly described in original MACHEREY-NAGEL product leaflets.

MACHEREY-NAGEL products are intended for GENERAL LABORATORY USE ONLY! MACHEREY-NAGEL products are suited for QUALIFIED PERSONNEL ONLY! MACHEREY-NAGEL products shall in any event only be used wearing adequate PROTECTIVE CLOTHING. For detailed information please refer to the respective Material Safety Data Sheet of the product! MACHEREY-NAGEL products shall exclusively be used in an ADEQUATE TEST ENVIRONMENT. MACHEREY-NAGEL does not assume any responsibility for damages due to improper application of our products in other fields of application. Application on the human body is STRICTLY FORBIDDEN. The respective user is liable for any and all damages resulting from such application.

DNA/RNA/PROTEIN purification products of MACHEREY-NAGEL are suitable for IN VITRO-USES ONLY!

ONLY MACHEREY-NAGEL products specially labeled as IVD are also suitable for IN VITRO-diagnostic use. Please pay attention to the package of the product. IN VITRO-diagnostic products are expressly marked as IVD on the packaging.

IF THERE IS NO IVD SIGN, THE PRODUCT SHALL NOT BE SUITABLE FOR IN VITRO-DIAGNOSTIC USE!

ALL OTHER PRODUCTS NOT LABELED AS IVD ARE NOT SUITED FOR ANY CLINICAL USE (INCLUDING, BUT NOT LIMITED TO DIAGNOSTIC, THERAPEUTIC AND/OR PROGNOSTIC USE).

No claim or representations is intended for its use to identify any specific organism or for clinical use (included, but not limited to diagnostic, prognostic, therapeutic, or blood banking). It is rather in the responsibility of the user or - in any case of resale of the products - in the responsibility of the reseller to inspect and assure the use of the DNA/RNA/protein purification products of MACHEREY-NAGEL for a well-defined and specific application.

MACHEREY-NAGEL shall only be responsible for the product specifications and the performance range of MN products according to the specifications of in-house quality control, product documentation and marketing material.

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Last updated: 07/2010, Rev. 03

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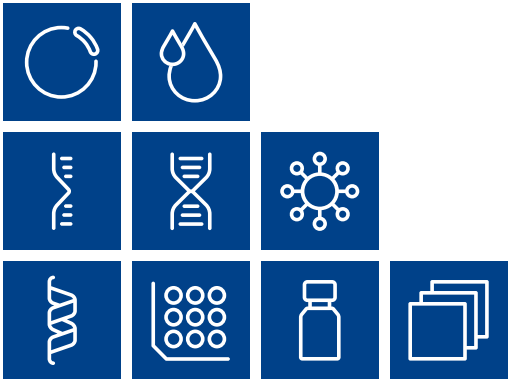

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A054119/1211