



# Total RNA isolation

## User manual

NucleoSpin<sup>®</sup> 8 RNA

NucleoSpin<sup>®</sup> 8 RNA Core Kit

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# 1 Components

## 1.1 Kit contents

| NucleoSpin® 8 RNA                                                   |                        |                          |
|---------------------------------------------------------------------|------------------------|--------------------------|
| REF                                                                 | 12 x 8 preps<br>740698 | 60 x 8 preps<br>740698.5 |
| Lysis Buffer RA1                                                    | 60 mL                  | 250 mL                   |
| Wash Buffer RA2                                                     | 60 mL                  | 360 mL                   |
| Wash Buffer RA3<br>(Concentrate) <sup>1</sup>                       | 50 mL                  | 2 x 100 mL               |
| Wash Buffer RA4<br>(Concentrate) <sup>1</sup>                       | 65 mL                  | 3 x 65 mL                |
| Reaction Buffer for rDNase                                          | 30 mL                  | 2 x 60 mL                |
| rDNase, RNase-free<br>(lyophilized) <sup>1</sup>                    | 2 vials                | 10 vials                 |
| RNase-free H <sub>2</sub> O                                         | 30 mL                  | 125 mL                   |
| NucleoSpin® RNA Binding<br>Strips (blue rings)                      | 12                     | 60                       |
| Collection Tubes (1.5 mL) <sup>2</sup>                              | 8                      | 40                       |
| MN Wash Plates<br>(including six Paper Sheets) <sup>3</sup>         | 2                      | 5                        |
| Racks of Tube Strips with Cap<br>Strips <sup>4</sup>                | 3                      | 15                       |
| MN Square-well Blocks                                               | 2                      | 2                        |
| Elution Plates U-Bottom<br>(including one Self adhering<br>PE Foil) | 1                      | 5                        |
| User manual                                                         | 1                      | 1                        |

<sup>1</sup> For preparation of working solutions and storage conditions see section 3.

<sup>2</sup> For rDNase working solution during automated use

<sup>3</sup> Is not used when following the centrifuge protocol in section 5.4 for the isolation of total RNA.

<sup>4</sup> Set consists of 1 Rack, 12 Tube Strips with 8 tubes each, and 12 Cap Strips.

## Kit contents continued

| NucleoSpin® 8 RNA Core Kit                     |                          |
|------------------------------------------------|--------------------------|
| REF                                            | 48 x 8 preps<br>740465.4 |
| Lysis Buffer RA1                               | 2 x 125 mL               |
| Wash Buffer RA2                                | 360 mL                   |
| Wash Buffer RA3 (Concentrate) <sup>1</sup>     | 2 x 100 mL               |
| Wash Buffer RA4 (Concentrate) <sup>1</sup>     | 2 x 65 mL                |
| Reaction Buffer for rDNase                     | 60 mL                    |
| rDNase, RNase-free (lyophilized) <sup>1</sup>  | 8 vials                  |
| RNase-free H <sub>2</sub> O                    | 2 x 125 mL               |
| NucleoSpin® RNA Binding Strips<br>(blue rings) | 48                       |
| User manual                                    | 1                        |

## 1.2 Reagents to be supplied by user

- 96–100% ethanol (for preparation of working solutions; see section 3)
- Reducing agent (β-mercaptoethanol, or DTT (dithiothreitol), or TCEP (BisTris (Bis-(2-hydroxyethyl)-imino-tris(hydroxymethyl)-methane)) as supplement for Lysis Buffer RA1
- NucleoSpin® RNA Filter Strips (optional; see section 2.7)

For more detailed information regarding special hardware required for centrifuge or vacuum processing, please see section 2.4. For ordering information, please see section 6.2.

For recommended accessories for use of the flexible **NucleoSpin® 8 RNA Core Kit** (reduced kit composition; REF 740465.4), please see section 2.5.

<sup>1</sup> For preparation of working solutions and storage conditions see section 3.

## 2 Product description

### 2.1 The basic principle

One of the most important aspects while working with RNA is to prevent RNA degradation during the isolation procedure. With the **NucleoSpin® 8 RNA** kits, cells or tissues are lysed by incubation in a solution containing large amounts of chaotropic salt. This lysis buffer immediately inactivates RNases which are present in virtually all biological materials. In combination with Buffer RA4, it furthermore creates the appropriate binding conditions that favor RNA adsorption to the silica membrane. Contaminating DNA, which is also bound to the silica membrane, is removed by directly applying DNase onto the silica membrane during the preparation (RNase-free recombinant DNase is supplied with the kit). Salts, proteins, and other cellular components are removed by simple washing steps with three different buffers. Finally, pure RNA is eluted under low ionic strength conditions with RNase-free water (supplied).

### 2.2 Kit specifications

- The **NucleoSpin® 8 RNA** kits are designed for fast 8-well small-scale purification of total RNA from tissue or cells. Fresh, frozen, or stabilized sample material can be processed.
- The **NucleoSpin® 8 RNA** kits can be used manually under vacuum or under centrifugation.
- The **NucleoSpin® 8 RNA** kits can be used fully automated on common laboratory workstations (see section 2.6).
- The kits provide reagents and consumables for purification of up to 100 µg highly-pure total RNA suitable for direct use in standard molecular biology applications, like RT-PCR, TaqMan, Northern Blot, or microarray analysis.
- The **NucleoSpin® 8 RNA** kits yield RNA of highest purity and integrity.
- Using the **NucleoSpin® 8 RNA** kits allows for simultaneous processing of up to 48 samples typically within less than 45 minutes. Actual automated processing time depends on the configuration of workstation used.

### 2.3 Yield and quality of total RNA

- **NucleoSpin® 8 RNA** can be used under vacuum or in a centrifuge. In a centrifuge, however, slightly higher yields are possible because of the higher amount of starting material that can be processed and the reduced dead volume of the membrane.
- Typical amounts of starting material and anticipated yields are shown in Table 1. Please note that yield of total RNA strongly depends on the starting material and on complete lysis/homogenization. Results may vary. For more information about the lysis/homogenization process, see section 2.7.

**Table 1: Kit specifications at a glance**

| Parameter                          | NucleoSpin® 8 RNA                                                                                                                                                 |              |                           |                           |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------|---------------------------|
| Technology                         | Silica membrane technology                                                                                                                                        |              |                           |                           |
| Format                             | 8-well strips                                                                                                                                                     |              |                           |                           |
| Processing                         | Manual or automated, vacuum or centrifugation                                                                                                                     |              |                           |                           |
|                                    | Animal tissue                                                                                                                                                     |              | Cell culture              |                           |
|                                    | Vacuum                                                                                                                                                            | Centrifuge   | Vacuum                    | Centrifuge                |
| Max. sample size                   | 10–30 mg                                                                                                                                                          | 30 mg        | 2 x 10 <sup>6</sup> cells | 1 x 10 <sup>7</sup> cells |
| Typical yield                      | Up to 40 µg                                                                                                                                                       | Up to 100 µg | Up to 20 µg               | Up to 100 µg              |
| Fragment size                      | > 200 nt                                                                                                                                                          |              |                           |                           |
| A <sub>260</sub> /A <sub>280</sub> | 1.9–2.1                                                                                                                                                           |              |                           |                           |
| Typical RIN (RNA integrity number) | Sharp rRNA bands with no substantial degradative bands visible; 28S:18S ~ 2.1<br>Excellent RNA Integrity Number (RIN) values typically: > 9 (cells), ≥ 7 (tissue) |              |                           |                           |
| Typical concentration              | 50–200 ng/µL                                                                                                                                                      |              |                           |                           |
| Elution volume                     | 50–130 µL                                                                                                                                                         |              |                           |                           |
| Preparation time                   | 45 min/6 strips                                                                                                                                                   |              |                           |                           |
| Binding capacity                   | 100 µg                                                                                                                                                            |              |                           |                           |

- The final concentration of eluted RNA is 50–500 ng/µL (depending on elution volume and starting material). Suitable elution volumes range from 50 µL to 130 µL. For RNA purity typically, the A<sub>260</sub>/A<sub>280</sub> ratio is 1.9–2.1.
- Isolated RNA is of highest quality and integrity indicating a highly efficient inactivation of RNases and gentle purification.

## 2.4 Required hardware

**NucleoSpin® 8 RNA** can be processed under vacuum or centrifugation. Certain hardware for processing is required.

### *Centrifugation*

For processing the 8-well strips under centrifugation, the **Starter Set C** (see ordering information, section 6.2), containing Column Holders C, NucleoSpin® Dummy Strips, MN Square-well Blocks, and Rack of Tube Strips is required.

For centrifugation with Column Holder C (with inserted NucleoSpin® RNA Binding Strips) stacked on a MN Square-well Block or Rack of Tube Strips, a microtiter plate centrifuge is required which is able to accommodate the above stacked plates and reach accelerations of 5,600–6,000 x *g* (bucket height: 85 mm).

Regarding waste collection, suitable consumables (e.g., MN Square-well Blocks) are necessary and they are not included in the kit. For the most convenient handling, without the need of emptying and reusing the MN Square-well Blocks, we recommend using six MN Square-well Blocks if two column holders are processed at once (see ordering information). Alternatively, it is possible to empty the MN Square-well Blocks after every centrifugation step, reducing the amount of MN Square-well Blocks needed.

### *Vacuum processing*

For processing 8-well strips under vacuum, the **Starter Set A** (see ordering information, section 6.2), containing Column Holders A and NucleoSpin® Dummy Strips is required.

For **automation** on laboratory platforms with standard 96-well plate manifolds, the use of Starter Set A is also required.

The **NucleoSpin® 8 RNA** kit can be used **manually** with the NucleoVac 96 Vacuum Manifold (see ordering information, section 6.2).

Establish a reliable vacuum source for the NucleoVac 96 Vacuum Manifold. The manifold may be used with a vacuum pump, house vacuum, or water aspirator. We recommend a vacuum of -0.2 to -0.4 bar (reduction of atmospheric pressure). The use of the NucleoVac Vacuum Regulator (see ordering information) is recommended. Alternatively, adjust the vacuum so that during the purification the sample flows through the column with a rate of 1–2 drops per second. Depending on the amount of sample being used, the vacuum times may need to be increased for complete filtration.

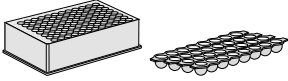
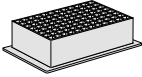
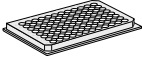
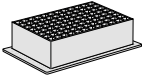
Additionally, a suitable centrifuge for sample preparation steps may be required.

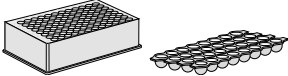
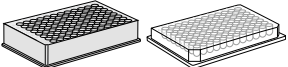
## 2.5 Recommended accessories for use of the NucleoSpin® 8 RNA Core Kit

The **NucleoSpin® 8 RNA Core Kit** provides buffers, rDNase, and NucleoSpin® RNA Binding Strips. Accessory plates (e.g., lysis plates, elution plates) are not provided with the core kit. The reduced kit composition along with a variety of separately available accessories, allow optimal adjustment of the kit to individual user needs. The user can select additional consumables according to his / her requirements for highest flexibility.

For use of **NucleoSpin® 8 RNA Core Kit**, follow the standard protocols (see section 5.1 and 5.2).

Recommended accessories for use of the **NucleoSpin® 8 RNA Core Kit** (48 x 8 preps) are available from MACHEREY-NAGEL (see ordering information, section 6.2).

| Protocol step               | Suitable consumables, not supplied with the core kits                                                                                                                                                                                                                                                                                                                                                                     | Remarks                                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Lyse samples             | <p>or 8 x Rack of Tube Strips with Cap Strips per 48 x 8 preps</p>  <p>or 8 x Round-well Block with Cap Strips per 48 x 8 preps</p>  <p>8 x MN Square-well Block</p>  | Round-well Blocks and Tube Strips can be closed with Cap Strips.                                                                                  |
| 5. Bind RNA to the membrane | <p>8 x MN Wash Plate per 48 x 8 preps</p>  <p>2 x MN Square-well Block</p>                                                                                                                                                                          | <p>MN Wash Plate minimizes the risk of cross contamination (vacuum processing).</p> <p>For waste collection during centrifugation (reusable).</p> |

| Protocol step | Suitable consumables,<br>not supplied with the core kits                                                                                             | Remarks                                                                                |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 10. Elute RNA | 8 x Rack of Tube Strips with Cap Strips<br>per 48 x 8 preps<br>     | Tube Strips can be closed with Cap Strips.<br><br>For vacuum or centrifuge processing. |
|               | or 8 x Round-well Block with Cap Strips<br>per 48 x 8 preps<br>     | Round-well Blocks can be closed with Cap Strips.                                       |
|               | or 8 x Elution Plate U-bottom or<br>or 8 x Round-well Block Low<br> | For vacuum processing only.                                                            |

## 2.6 Automated processing on robotic platforms

**NucleoSpin® 8 RNA** can be used fully automated on many common laboratory workstations. Please contact MN for the availability of scripts and general considerations about adapting **NucleoSpin® 8 RNA** on a certain workstation.

Visit MN online at [www.mn-net.com](http://www.mn-net.com) or contact your local MACHEREY-NAGEL distributor for technical support regarding hardware, software, setup instructions, and selection of the protocol. Several application notes of the **NucleoSpin® 8 RNA** kit on various liquid handling instruments can also be found at [www.mn-net.com](http://www.mn-net.com) at Bioanalysis / Literature.

Full processing under vacuum enables complete automation without the need of centrifugation steps for drying or elution. However, a final elution step by centrifugation is recommended in order to achieve higher concentrated DNA eluates.

The risk of cross-contamination is reduced by optimized vacuum settings during the elution step and by the improved shape of the outlets of the NucleoSpin® RNA Binding Strips.

Drying of the NucleoSpin® RNA Binding Strips only under vacuum is sufficient, as the bottom of the plate is protected by the MN Wash Plate during the washing steps. As a result, it is recommended integrating the MN Wash Plate into the automated procedure. The MN Frame (see ordering information) can be used to place the disposable MN Wash Plate inside the vacuum chamber. This also reduces the risk of cross-contamination, as

common metal adaptors tend to get contaminated by gDNA. Thorough cleaning of the vacuum chamber is recommended after each run to prevent DNA-containing aerosols from forming.

## 2.7 Sample storage and homogenization

RNA is not protected against digestion until the sample material is flash frozen or disrupted in the presence of RNase inhibiting or denaturing agents. Therefore, it is important that samples are either immediately frozen and stored at -70 °C, placed in a RNA stabilizing reagent (not included in the kit), or processed as soon as harvested. After disruption samples can be stored at -70 °C in Lysis Buffer RA1. Frozen samples are stable for up to 6 months. Frozen samples in Buffer RA1 should be thawed completely and centrifuged before starting with the isolation of total RNA.

If larger cell numbers or large amounts of tissue are used, a filtration step of the RA1 lysate through the NucleoSpin® RNA Filter Strips (see ordering information, section 6.2) is recommended for optimal homogenization and removal of particles.

### Cell culture

- Up to  $2 \times 10^6$  cells can be processed under vacuum. Using a centrifuge, up to  $1 \times 10^7$  cells can be processed. Transfer the cell suspension to a suitable square-well block (not included in the kit) and centrifuge for 5 min at 500 x *g*. The supernatant has to be removed completely. Lyse cells by addition of 300 µL Buffer RA1. Follow the standard protocol for cell cultures.
- For adherent cell cultures in 96-well format, make sure that the culture medium is completely removed. Lyse cells by addition of 130 µL Buffer RA1. Follow the standard protocol for cell cultures grown in 96-well plates.
- If using more than  $1 \times 10^6$  cells, it is recommended using a commercial homogenizer for lysis with Buffer RA1 in order to reduce viscosity. To prevent the NucleoSpin® RNA Binding Strips from clogging, it is also recommended filtrating the lysates through the NucleoSpin® RNA Filter Strips (not included in the kit) before applying them to the NucleoSpin® RNA Binding Strips.

### Tissue

- Depending on the type of sample, up to 30 mg (see also Table 2) can be processed. Add 300 µL Buffer RA1 for tissue homogenization. Follow the standard protocol for tissue samples.
- If working with tissue or nuclease-rich cells, add 1 % β-mercaptoethanol to Buffer RA1. β-mercaptoethanol supports the inhibition of RNases.
- For sample homogenization and removal of cell debris, it is recommended filtering the lysates through the NucleoSpin® RNA Filter Strips (not included in the kit) before applying them to the NucleoSpin® RNA Binding Strips. Alternatively: Centrifuge homogenized tissue samples for 5 min at maximum *g*-forces, transfer

supernatant to suitable plate, and proceed with the standard protocol by adding Buffer RA4.

- Binding capacity of the membrane is up to 100 µg. Depending on type of tissue and homogenization, yield will differ and has to be tested individually. Some typical results are depicted in the following table:

**Table 2: Yields of total RNA with NucleoSpin® 8 RNA**

| Sample source | Max. starting material | Max. yield of total RNA |
|---------------|------------------------|-------------------------|
| Spleen        | 20 mg                  | 50 µg                   |
| Kidney        | 30 mg                  | 45 µg                   |
| Brain         | 30 mg                  | 20 µg                   |
| Liver         | 30 mg                  | 80 µg                   |

Yield of total RNA depends strongly on the tissue and the effectiveness of lysis / homogenization. Therefore, results may strongly vary.

### Methods for sample homogenization

Commercial homogenizers, for example, 2010 Geno/Grinder (COPS Diagnostics) can be used for sample homogenization.

### Use of NucleoSpin® RNA Filter Strips

For sample homogenization and to prevent clogging of the NucleoSpin® RNA Binding Strips, the use of the NucleoSpin® RNA Filter Strips is recommended under vacuum or centrifugation.

#### *Centrifugation*

Insert desired number of NucleoSpin® RNA Filter Strips into the Column Holder C (see ordering information) and place it on a MN Square-well Block (Starter Set C, see ordering information). Transfer lysates in Buffer RA1 to the wells of the NucleoSpin® RNA Filter Strips.

Centrifuge at 5,600–6,000 x *g* until all samples have passed the filter (approx. 5 min). Start the RNA purification procedure with the filtrate collected in the MN Square-well Block.

#### *Vacuum*

Insert spacers 'SQUARE-WELL BLOCK' into the NucleoVac 96 Vacuum Manifold. Put a Square-well Block in the manifold and close the manifold with the manifold lid.

Insert desired number of NucleoSpin® RNA Filter Strips into the Column Holder A (Starter Set A, see ordering information) and place it on top of the manifold.

Transfer the sample lysate in Buffer RA1 to the filter and apply vacuum until the lysates have passed the filter. Start the RNA purification procedure with the flowthrough collected in the MN Square-well Block. Please note that the dead volume of the NucleoSpin®

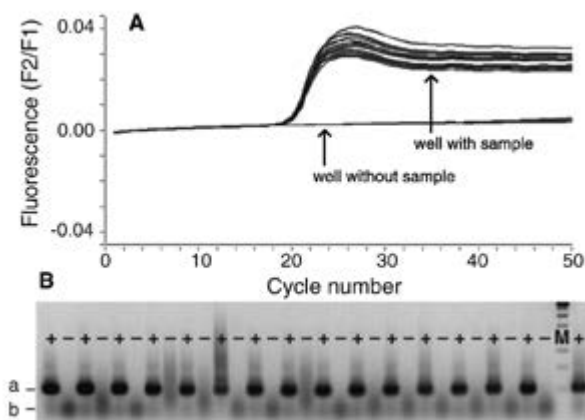
RNA Filter Strips is rather large compared to the processing under centrifugation, thus processing under vacuum is only recommended when complete automation is desired.

## 2.8 Elution of pure total RNA

Due to dead volume of the silica membrane by using vacuum, please notice that the difference between the dispensed elution buffer and the recovered elution buffer containing total RNA is approx. 20  $\mu\text{L}$ . For RNA elution, a volume of 50–130  $\mu\text{L}$  nuclease free water is recommended. Higher RNA concentrations are obtained when using a dispense volume of 50  $\mu\text{L}$ , however, higher elution efficiencies are obtained when using dispense volumes of > 100  $\mu\text{L}$ .

Recovered elution volume = Dispensed elution volume - 20  $\mu\text{L}$

Elution is possible under vacuum and in a centrifuge **without any cross-contamination** (see Figure 1). To achieve this, vacuum settings during the elution have to be adjusted carefully (smooth elution) to avoid splattering of liquid.



**Figure 1** HeLa cells ( $5 \times 10^5$  each) were pelleted in a culture plate in a chess board pattern. **Total RNA was prepared using NucleoSpin® 96 RNA.**

(a) RT-PCR detection of total RNA was performed with 1.5  $\mu\text{L}$  of the eluate (total eluate 80  $\mu\text{L}$ ) in a LightCycler® (0.5  $\mu\text{M}$  GAPDH primer, LightCycler®-RNA Amplification Kit Hybridization Probes).

(b) 20  $\mu\text{L}$  of the LightCycler® assay were loaded on a 2 % agarose gel.

+: Total RNA from  $5 \times 10^5$  HeLa cells

–: Empty control well (next to a well containing cells)

a: 200 bp product of the GAPDH gene

b: Primers

### 3 Storage conditions and preparation of working solutions

**Attention:** Buffers RA1 and RA2 contain chaotropic salts. Wear gloves and goggles!

**CAUTION:** Buffers RA1 and RA2 contain guanidinium thiocyanate which can form highly reactive compounds when combined with bleach (sodium hypochlorite). DO NOT add bleach or acidic solutions directly to the sample-preparation waste.

Storage conditions:

- Store lyophilized **RNase-free rDNase** at 4 °C on arrival (stable for at least one year).
- All other components of the NucleoSpin® 8 RNA kit should be stored at room temperature and are stable for at least one year. Storage at lower temperatures may cause precipitation of salts. If a salt precipitate is observed, incubate the bottle at 30–40 °C for some minutes and mix well until all of the precipitate is redissolved.

Before starting with any **NucleoSpin® 8 RNA** protocol, prepare the following:

- **Reconstitute RNase-free rDNase:** Add 540 µL RNase-free H<sub>2</sub>O to the rDNase vial and incubate for 1 min at room temperature. Gently swirl the vial to completely dissolve the rDNase. In case of not processing a whole 96-well plate, dispense the reconstituted rDNase solution into aliquots and store at -20 °C. This rDNase solution is stable for at least six months. Do not freeze/thaw the aliquots more than three times.  
Prepare **rDNase reaction mixture:** For each sample to be processed mix 10 µL reconstituted rDNase with 90 µL Reaction Buffer for rDNase.
- **Wash Buffer RA3:** Add the indicated volume of 96–100 % ethanol to the Buffer RA3 Concentrate. Indicate that ethanol is added by marking the bottle label. Store Wash Buffer RA3 at room temperature (18–25 °C) for at least one year.
- **Wash Buffer RA4:** Add the indicated volume of 96–100 % ethanol to the Buffer RA4 Concentrate. Mark the bottle label to indicate that ethanol has been added. Store Wash Buffer RA4 at room temperature (18–25 °C) for at least one year.

| NucleoSpin® 8 RNA                |                                 |                                                    |
|----------------------------------|---------------------------------|----------------------------------------------------|
| REF                              | 12 x 8 preps<br>740698          | 60 x 8 preps<br>740698.5                           |
| Wash Buffer RA3<br>(Concentrate) | 1 x 50 mL<br>Add 200 mL ethanol | 2 x 100 mL<br>Add 400 mL ethanol<br>to each bottle |
| Wash Buffer RA4<br>(Concentrate) | 1 x 65 mL<br>Add 150 mL ethanol | 2 x 65 mL<br>Add 150 mL ethanol<br>to each bottle  |

| NucleoSpin® 8 RNA Core Kit       |                                                 |
|----------------------------------|-------------------------------------------------|
| REF                              | 48 x 8 preps<br>740465.4                        |
| Wash Buffer RA3<br>(Concentrate) | 2 x 100 mL<br>Add 400 mL ethanol to each bottle |
| Wash Buffer RA4<br>(Concentrate) | 2 x 65 mL<br>Add 150 mL ethanol to each bottle  |

## 4 Safety instructions

The following components of the **NucleoSpin® 8 RNA (Core Kit)** kits contain hazardous contents.

*Wear gloves and goggles and follow the safety instructions given in this section.*

Only harmful features do not need to be labeled with H and P phrases up to 125 mL or 125 g.  
*Mindergefährliche Eigenschaften müssen bis 125 mL oder 125 g nicht mit H- und P-Sätzen gekennzeichnet werden.*

| Component | Hazard contents                                                                                                                                     | GHS symbol                                                                                                         | Hazard phrases              | Precaution phrases                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------|
| Inhalt    | Gefahrstoff                                                                                                                                         | GHS-Symbol                                                                                                         | H-Sätze                     | P-Sätze                                                            |
| RA1       | Guanidinium thiocyanate<br>30–60 %<br><i>Guanidinthiocyanat 30–60 %</i><br><br>CAS 593-84-0                                                         | <br><br>WARNING<br><i>ACHTUNG</i> | 302, 412,<br>EUH031         | 260, 273,<br>301+312, 330                                          |
| RA2       | Guanidinium thiocyanate<br>30–60 % and ethanol<br>20–35 %<br><i>Guanidinthiocyanat 30–60 %<br/>und Ethanol 20–35 %</i><br><br>CAS 593-84-0, 64-17-5 | <br><br>WARNING<br><i>ACHTUNG</i> | 226, 302,<br>412,<br>EUH031 | 210, 233, 260,<br>273, 301+312,<br>330, 370+378,<br>403+235        |
| rDNase    | RNase 90–100 %<br><i>RNase 90–100 %</i><br><br>CAS 9003-98-9                                                                                        | <br><br>DANGER<br><i>GEFAHR</i>   | 317, 334                    | 261, 272, 280,<br>302+352,<br>304+340,<br>333+313,<br>342+311, 363 |

### Hazard phrases

|         |                                                                                                                                                                          |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| H 226   | Flammable liquid and vapour.<br><i>Flüssigkeit und Dampf entzündbar.</i>                                                                                                 |
| H 302   | Harmful if swallowed.<br><i>Gesundheitsschädlich bei Verschlucken.</i>                                                                                                   |
| H 317   | May cause an allergic skin reaction.<br><i>Kann allergische Hautreaktionen verursachen.</i>                                                                              |
| H 334   | May cause allergy or asthma symptoms or breathing difficulties if inhaled.<br><i>Kann bei Einatmen Allergie, asthmaartige Symptome oder Atembeschwerden verursachen.</i> |
| H 412   | Harmful in contact with skin.<br><i>Schädlich für Wasserorganismen, mit langfristiger Wirkung.</i>                                                                       |
| EUH 031 | Contact with acids liberates toxic gas.<br><i>Entwickelt bei Berührung mit Säure giftige Gase.</i>                                                                       |

## Precaution phrases

- P 210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
*Von Hitze, heißen Oberflächen, Funken, offenen Flammen sowie anderen Zündquellenarten fernhalten. Nicht rauchen.*
- P 233 Keep container tightly closed.  
*Behälter dicht verschlossen halten.*
- P 260 Do not breathe dust / fume / gas / mist / vapours / spray.  
*Staub / Rauch / Gas / Nebel / Dampf / Aerosol nicht einatmen.*
- P 273 Avoid release to the environment.  
*Freisetzung in die Umwelt vermeiden.*
- P 301+312 IF SWALLOWED: Call a POISON CENTER / doctor / ... / if you feel unwell.  
*BEI VERSCHLUCKEN: Bei Unwohlsein GIFTINFORMATIONSZENTRUM/Arzt / ... anrufen.*
- P 302+352 IF ON SKIN: Wash with plenty of water / ...  
*BEI BERÜHRUNG MIT DER HAUT: Mit viel Wasser / ... waschen.*
- P 304+340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.  
*BEI EINATMEN: Die Person an die frische Luft bringen und für ungehinderte Atmung sorgen.*
- P 330 Rinse mouth.  
*Mund ausspülen.*
- P 333+313 If skin irritation or rash occurs: Get medical advice/attention.  
*Bei Hautreizung oder -ausschlag: Ärztlichen Rat einholen/ärztliche Hilfe hinzuziehen.*
- P 342+311 If experiencing respiratory symptoms: Call a POISON CENTER / doctor / ...  
*Bei Symptomen der Atemwege: GIFTINFORMATIONSZENTRUM/Arzt / ... anrufen.*
- P 363 Wash contaminated clothing before reuse.  
*Kontaminierte Kleidung vor erneutem Tragen waschen.*
- P 370+378 In case of fire: Use ... to extinguish.  
*Bei Brand: ... zum Löschen verwenden.*
- P 403+235 Store in a well-ventilated place. Keep cool.  
*An einem gut belüfteten Ort aufbewahren. Kühl halten.*

For further information please see Material Safety Data Sheets ([www.mn-net.com](http://www.mn-net.com)).  
Weiterführende Informationen finden Sie in den Sicherheitsdatenblättern ([www.mn-net.com](http://www.mn-net.com)).



The symbol shown on labels refers to further safety information in this section.  
Das auf Etiketten dargestellte Symbol weist auf weitere Sicherheitsinformationen dieses Kapitels hin.

## 5 Protocols

### 5.1 NucleoSpin® 8 RNA – vacuum processing

- For hardware requirements, refer to section 2.4.
- For detailed information regarding the vacuum manifold setup, see page 20.
- For detailed information about each step, see page 21.
- For use of the NucleoSpin® 8 RNA Core Kit (REF 740465.4), refer to section 2.5 regarding recommended accessories.

#### Before starting the preparation:

- Check if Buffer RA3, Buffer RA4, and rDNase reaction mixture were prepared according to section 3.

#### Protocol at a glance

|                                |                                                                                                                                                                                                                                       |                                                                                                                                       |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>                       | <b>Harvest cells</b>                                                                                                                                                                                                                  | <b>500 x g,<br/>5 min</b>                                                                                                             |
| <b>2</b>                       | <b>Lyse cells or tissue</b><br><br><i>Optional: If using tissue samples or large number of cells, clearing of lysate with the NucleoSpin® RNA Filter Strips is recommended</i><br><br>Transfer cleared lysate to MN Square-well Block | <b>300 µL RA1 (cells, tissue)<br/>(+ 3 µL β-ME)</b><br><br><b>or</b><br><br><b>130 µL RA1 (cells)<sup>1</sup><br/>(+ 1.3 µL β-ME)</b> |
| <b>3</b>                       | <b>Prepare binding</b><br><br>Mix by pipetting up and down at least 10–15 times                                                                                                                                                       | <b>300 µL RA4 (cells, tissue)</b><br><br><b>or</b><br><br><b>130 µL RA4 (cells)<sup>1</sup></b>                                       |
| <b>Prepare vacuum manifold</b> |                                                                                                                                                                                                                                       |                                                                                                                                       |
| <b>4</b>                       | <b>Transfer</b> crude lysates to NucleoSpin® RNA Binding Strips                                                                                                                                                                       |                                                                                                                                       |
| <b>5</b>                       | <b>Bind</b> RNA to silica membrane of the NucleoSpin® RNA Binding Strips                                                                                                                                                              | <b>-0.2 bar*,<br/>1 min</b>                                                                                                           |
| <b>6</b>                       | <b>Desalt</b> silica membrane by washing                                                                                                                                                                                              | <b>500 µL RA3<br/><br/>-0.2 bar*,<br/>3 min</b>                                                                                       |

<sup>1</sup> Cell grown in 96-well plates only

\* Reduction of atmospheric pressure

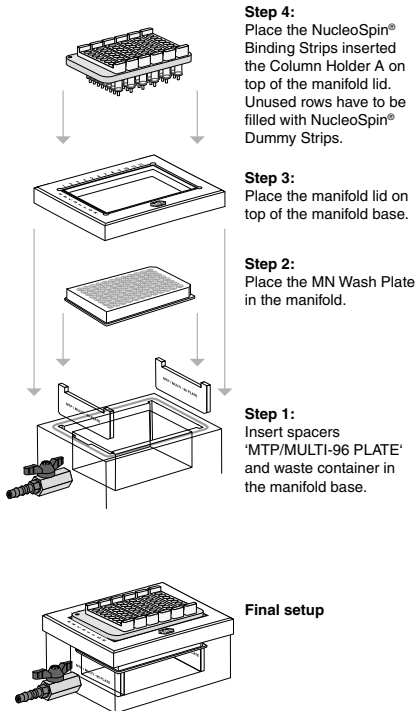
|           |                                                                                                                                                                                                             |                                                                                                                  |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>7</b>  | <b>Digest DNA</b>                                                                                                                                                                                           | <b>95 µL rDNase<br/>reaction mixture</b><br><br><b>Room temperature,<br/>15 min</b>                              |
| <b>8</b>  | <b>Wash</b> silica membrane                                                                                                                                                                                 | <b>500 µL RA2</b><br><br><b>800 µL RA3</b><br><br><b>500 µL RA4</b><br><br><b>-0.2 bar*,<br/>1 min each step</b> |
|           |                                                                                                                                                                                                             | <b>Remove<br/>MN Wash Plate</b>                                                                                  |
| <b>9</b>  | <b>Dry</b> NucleoSpin® RNA Binding Strips by<br>applying vacuum<br><br><i>Optional: Dry the outlets of the NucleoSpin®<br/>RNA Binding Strips by placing it on a Paper<br/>Sheet before applying vacuum</i> | <b>Maximum vacuum<br/>(-0.6 bar*),<br/>10 min</b>                                                                |
| <b>10</b> | <b>Elute</b> RNA                                                                                                                                                                                            | <b>75 µL RNase-free H2O</b><br><br><b>Incubate 2 min</b><br><br><b>-0.5 bar*,<br/>1 min</b>                      |

---

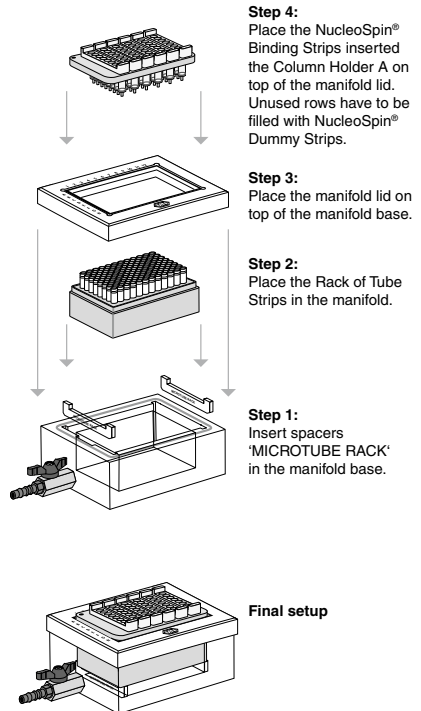
\* Reduction of atmospheric pressure

## Setup of vacuum manifold:

### Binding / Washing steps



### Elution step



## Detailed protocol

- For hardware requirements, refer to section 2.4.
- For detailed information regarding the vacuum manifold setup, see page 20.
- For use of the NucleoSpin® 8 RNA Core Kit (REF 740465.4), refer to section 2.5 regarding recommended accessories.

### Before starting the preparation:

- Check if Buffer RA3, Buffer RA4, and rDNase reaction mixture were prepared according to section 3.
- 

#### 1 Harvest cells

If cells have been grown in suspension, aliquots of up to  $2 \times 10^6$  cells can be transferred into wells of a MN Square-well Block (included in the kit) or another suitable deep-well plate or reaction tube (e.g., Round-well Block, Rack of Tube Strips; see ordering information). Pellet cells by centrifugation (**5 min, 500 x g**), and remove the supernatant by pipetting.

---

#### 2 Lyse cells or tissue

##### Cells, tissue samples

Add **300 µL Buffer RA1 / 1% β-mercaptoethanol [vol/vol]** to each sample. Cells can be lysed by repeated pipetting up and down or vigorous shaking of the sealed/closed plate or reaction tube. For homogenization of tissue samples, please refer to section 2.7.

*Note:* As alternative to β-ME, the reducing agent DTT or TCEP may be used. Use a final concentration of 10–20 mM DTT or TCEP within the Lysis Buffer RA1.

*Optional:* It is recommended using the **NucleoSpin® RNA Filter Strips** (see ordering information) for the clarification of tissue lysates.

##### Cells cultures grown in 96-well platesss

Discard culture medium and if necessary, wash cells with PBS buffer once. Add **130 µL Buffer RA1 / 1% β-mercaptoethanol [vol/vol]** to the cells in each well of the cell-culture plate. Cells can be lysed by repeated pipetting up and down or vigorous shaking of the sealed plate.

*Note:* Use of β-mercaptoethanol is recommended, but not essential for most cell types (also see section 2.7).

---

### 3 Prepare binding

Depending on the volume of Buffer RA1 used in the lysis step, add 300 µL or 130 µL Buffer RA4 (for lysates from cells grown in 96-well plates) to each well of the lysis plate or tube. Mix by pipetting up and down at least 10–15 times.

*Note: Buffer RA1 and Buffer RA4 have to be used in the same volume ratio.*

---

#### Prepare NucleoVac 96 Vacuum Manifold

Insert appropriate number of NucleoSpin® RNA Binding Strips into a Column Holder A. Close any unused openings of the Column Holder A with NucleoSpin® Dummy Strips.

*Note: Make sure that the NucleoSpin® RNA Binding Strips are inserted tightly into the Column Holder A. Not properly inserted strips may prevent sealing when vacuum is applied to the manifold.*

Insert spacers (MTP/MULTI-96 PLATE), notched side up, into the grooves located on the short sides of the manifold. Insert the waste container into the center of the manifold. Place the MN Wash Plate on top of the spacers in the manifold base. Insert Column Holder A with inserted NucleoSpin® RNA Binding Strips into the manifold lid and place lid on the manifold base.

---

### 4 Transfer crude lysates to NucleoSpin® RNA Binding Strips

Apply the samples to the wells of the NucleoSpin® RNA Binding Strips.

---

### 5 Bind RNA to silica membrane

Apply vacuum until all lysates have passed through the wells (**-0.2 bar\***; **1 min**). Release the vacuum.

---

### 6 Desalt silica membrane

Desalt the membrane by adding **500 µL Buffer RA3** to each well and apply vacuum (**-0.2 bar\***; **3 min**) until all buffer has passed through the wells. Release the vacuum.

---

### 7 Digest DNA

Prepare rDNase reaction mixture as described in section 3:

Pipette **95 µL rDNase reaction mixture** directly to the bottom of each well of the NucleoSpin® RNA Binding Strips. Do not touch the silica membrane with the pipette tips. Incubate at **room temperature** for **15 min**.

Be sure that all of the rDNase reaction mixture gets into contact with the silica membrane, and that the membrane is completely wetted.

---

\* Reduction of atmospheric pressure

**8 Wash silica membrane****1<sup>st</sup> wash**

Add **500 µL Buffer RA2** to each well of the NucleoSpin® RNA Binding Strips. Apply vacuum (**-0.2 bar\***; **1 min**) until all buffer has passed through the wells. Release the vacuum.

**2<sup>nd</sup> wash**

Add **800 µL Buffer RA3** to each well of the NucleoSpin® RNA Binding Strips. Apply vacuum (**-0.2 bar\***; **1 min**) until all buffer has passed through the wells. Release the vacuum.

**3<sup>rd</sup> wash**

Add **500 µL Buffer RA4** to each well of the NucleoSpin® RNA Binding Strips. Apply vacuum (**-0.2 bar\***; **1 min**) until all buffer has passed through the wells. Release the vacuum.

---

**Remove MN Wash Plate**

After the final wash step, close the valve, release the vacuum and remove the Column Holder A with inserted NucleoSpin® RNA Binding Strips from the vacuum manifold. Put it on a clean paper towel to remove residual EtOH-containing wash buffer. Remove manifold lid, MN Wash Plate, and waste container from the vacuum manifold.

---

**9 Dry NucleoSpin® RNA Binding Strips**

Remove any residual wash buffer from the NucleoSpin® RNA Binding Strips. If necessary, tap the outlets of the NucleoSpin® RNA Binding Strips onto a clean Paper Sheet (supplied with the MN Wash Plate) or soft tissue until no further drops come out.

Insert the Column Holder A with inserted NucleoSpin® RNA Binding Strips into the manifold lid and close the manifold. Build up the vacuum with the valve closed. Once the **maximum vacuum (-0.6 bar\*)** is achieved, open the valve and apply vacuum for at least **10 min** to dry the membrane completely. This step is necessary to eliminate traces of ethanol.

*Note: The ethanol in Buffer RA4 inhibits enzymatic reactions and has to be removed completely before eluting DNA.*

Finally, release the vacuum.

---

\* Reduction of atmospheric pressure

## 10 Elute RNA

Place the Elution Plate U-bottom onto the spacers 'MTP/MULTI-96 PLATE' of the vacuum manifold. Pipette **75 µL RNase-free H<sub>2</sub>O** directly to the bottom of each well (75 µL are recommended, 50–130 µL are possible, see section 2.8). Incubate for **2 min** at **room temperature**. Build up the vacuum with the valve closed. Once the **maximum vacuum** (-0.5 bar\*) is achieved, open the valve and apply vacuum for 1 min.

Alternatively, elution into Tube Strips (included in the kit) or standard PCR plates is possible. For elution in Tube Strips, place the Rack of Tube Strips on the spacers 'MICROTUBE STRIPS' inside the manifold. Elution into PCR plates can be performed by placing a PCR plate onto a MN Square-well Block placed on the spacers 'SQUARE-WELL BLOCK' in the manifold.

---

## 5.2 NucleoSpin® 8 RNA – centrifuge processing

- For hardware requirements, refer to section 2.4.
- For detailed information on each step, see page 27.
- For use of the NucleoSpin® 8 RNA Core Kit (REF 740465.4), refer to section 2.5 regarding recommended accessories.

### Before starting the preparation:

- Check if Buffer RA3, Buffer RA4, and rDNase reaction mixture were prepared according to section 3.

### Protocol at a glance

|          |                                                                                                                                                                                                                          |                                                                                                                               |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b>Harvest cells</b>                                                                                                                                                                                                     | <b>500 x g,<br/>5 min,</b>                                                                                                    |
| <b>2</b> | <b>Lyse cells or tissue</b><br><i>Optional: If using tissue samples or large number of cells, clearing of lysate with the NucleoSpin® RNA Filter Strips is recommended</i><br><i>Centrifuge 5,600–6,00 x g for 5 min</i> | <b>300 µL RA1 (cells, tissue)<br/>(+ 3 µL β-ME)</b><br><b>or</b><br><b>130 µL RA1 (cells)<sup>1</sup><br/>(+ 1.3 µL β-ME)</b> |
| <b>3</b> | <b>Prepare binding</b><br>Mix by pipetting up and down at least 10–15 times                                                                                                                                              | <b>300 µL RA4 (cells, tissue)</b><br><b>or</b><br><b>130 µL RA4 (cells)<sup>1</sup></b>                                       |
| <b>4</b> | <b>Transfer</b> crude lysates to NucleoSpin® RNA Binding Strips                                                                                                                                                          |                                                                                                                               |
| <b>5</b> | <b>Bind</b> RNA to silica membrane of the NucleoSpin® RNA Binding Strips                                                                                                                                                 | <b>5,600–6,000 x g,<br/>2 min</b>                                                                                             |
| <b>6</b> | <b>Desalt</b> silica membrane by washing                                                                                                                                                                                 | <b>500 µL RA3</b><br><b>5,600–6,000 x g,<br/>2 min</b>                                                                        |
| <b>7</b> | <b>Digest</b> DNA                                                                                                                                                                                                        | <b>95 µL rDNase<br/>reaction mixture</b><br><b>Room temperature,<br/>15 min</b>                                               |

<sup>1</sup> Cell grown in 96-well plates only

|           |                                          |                                                                                                 |
|-----------|------------------------------------------|-------------------------------------------------------------------------------------------------|
| <b>8</b>  | <b>Wash</b> silica membrane              | <b>500 µL RA2</b><br><b>5,600–6,000 x g,</b><br><b>2 min</b>                                    |
|           |                                          | <b>800 µL RA3</b><br><b>5,600–6,000 x g,</b><br><b>2 min</b>                                    |
|           |                                          | <b>500 µL RA4</b><br><b>5,600–6,000 x g,</b><br><b>10 min1</b>                                  |
| <b>9</b>  | <b>Dry</b> NucleoSpin® RNA Binding Plate | <b>Not necessary</b>                                                                            |
| <b>10</b> | <b>Elute</b> RNA                         | <b>75 µL RNase-free H2O</b><br><b>Incubate 2 min</b><br><b>5,600–6,000 x g,</b><br><b>2 min</b> |

---

## Detailed protocol

- For hardware requirements, refer to section 2.4.
- For use of the NucleoSpin® 8 RNA Core Kit (REF 740465.4), refer to section 2.5 regarding recommended accessories.

### Before starting the preparation:

- Check if Buffer RA3, Buffer RA4, and rDNase reaction mixture were prepared according to section 3.
- 

#### 1 Harvest cells

If cells have been grown in suspension, aliquots of up to  $1 \times 10^7$  cells can be transferred into the wells of a MN Square-well Block (included in the kit) or into the wells of another suitable deep-well plate or reaction tube (e.g., Round-well Block, Tube Strips; see ordering information). Pellet cells by centrifugation (5 min, 500 x g), and remove the supernatant by pipetting.

---

#### 2 Lyse cells or tissue

##### Cells, tissue samples

Add 300 µL Buffer RA1 / 1 % β-mercaptoethanol [vol/vol] to each sample. Cells can be lysed by pipetting up and down repeatedly or vigorous shaking of the sealed/closed plate or reaction tube. For homogenization of tissue samples please refer to section 2.7.

*Note:* As alternative to β-ME, the reducing agent DTT or TCEP may be used. Use a final concentration of 10–20 mM DTT or TCEP within the Lysis Buffer RA1.

*Optional:* It is recommended using the **NucleoSpin® RNA Filter Strips** (see ordering information, section 6.2) for the clarification of tissue lysates.

##### Cells cultures grown in 96-well plates

Discard culture medium and if necessary wash cells with PBS buffer once. Add **130 µL Buffer RA1 / 1 % β-mercaptoethanol [vol/vol]** to the cells in each well of the cell-culture plate. Cells can be lysed by pipetting up and down repeatedly or vigorous shaking of the sealed plate.

*Note:* Use of β-mercaptoethanol is recommended, but not essential for most cell types (also see section 2.7).

---

#### 3 Prepare binding

Depending on the volume of Buffer RA1 used in the lysis step, add **300 µL Buffer RA4** or **130 µL Buffer RA4** (for lysates from cells grown in 96-well plates), to each well of the lysis plate or tube. Mix by pipetting up and down at least 10–15 times.

*Note:* Buffer RA1 and Buffer RA4 have to be used in the same volume ratio.

---

---

**4 Transfer crude lysates to NucleoSpin® RNA Binding Strips**

Insert desired number of NucleoSpin® RNA Binding Strips into the Column Holder C and place on it a MN Square-well Block for collection of flowthrough. If using more than one block, label the column holders for later identification. Transfer lysates to the wells of the NucleoSpin® RNA Binding Strips.

---

**5 Bind RNA to silica membrane**

Centrifuge for **2 min** at **5,600–6,000 x g**.

---

**6 Desalt silica membrane**

Desalt the membrane by adding **500 µL Buffer RA3** to each well and centrifuge for **2 min** at **5,600–6,000 x g**. Empty MN Square-well Block.

---

**7 Digest DNA**

Prepare rDNase reaction mixture as described in section 3:

Place Column Holder C with the NucleoSpin® RNA Binding Strips on the MN Square-well Block. Pipette 95 µL rDNase reaction mixture directly to the bottom of each well of the NucleoSpin® RNA Binding Strips. Do not touch the silica membrane with the pipette tips. Incubate at room temperature for 15 min.

Be sure that all of the rDNase reaction mixture gets into contact with the silica membrane, and that the membrane is completely wetted.

---

**8 Wash silica membrane**

**1<sup>st</sup> wash**

Add **500 µL Buffer RA2** to each well of the NucleoSpin® RNA Binding Strips. Place the Column Holder C with the NucleoSpin® RNA Binding Strips on the MN Square-well Block into the rotor bucket and centrifuge for **2 min** at **5,600–6,000 x g**. Empty MN Square-well Block.

**2<sup>nd</sup> wash**

Add **800 µL Buffer RA3** to each well of the NucleoSpin® RNA Binding Strips and centrifuge for or **2 min** at **5,600–6,000 x g**. Empty MN Square-well Block.

**3<sup>rd</sup> wash**

Add **500 µL Buffer RA4** to each well of the NucleoSpin® RNA Binding Strips and centrifuge for or **10 min** at **5,600–6,000 x g**. Empty MN Square-well Block.

---

## 9 Dry NucleoSpin® RNA Binding Strips

Residual wash buffer from the NucleoSpin® RNA Binding Strips is removed by the prolonged centrifugation time of **10 min** after adding Wash Buffer RA4 as described in step 8. This prolonged time is necessary to eliminate traces of ethanol.

*Note: The ethanol in Buffer RA4 inhibits enzymatic reactions and has to be removed completely before eluting DNA.*

---

## 10 Elute RNA

For elution, place Column Holder C with the NucleoSpin® RNA Binding Strips onto the Rack of Tube Strips and pipette **75 µL RNase-free H<sub>2</sub>O** directly to the bottom of each well (75 µL are recommended, 50–130 µL are possible, see section 2.8). Make sure that all of the water gets into contact with the silica membrane and that the membrane is completely wetted. Incubate for **2 min** at **room temperature** and for **3 min** at **5,600–6,000 x g**.

Alternatively, elution in a MN Square-well Block or Round-well Block (see ordering information, section 6.2) is possible.

*Note: The Elution Plate U-bottom is not suitable for use in a centrifuge.*

---

## 5.3 Automated purification using common laboratory automation workstations

### Before starting the preparation:

- Check if Wash Buffer RA3, Wash Buffer RA4, and rDNase reaction mixture were prepared according to section 3.

*Note: For ready-to-run robot scripts and general information about automation, please contact your local distributor or MN directly.*

---

- 1 Place the plastic equipment like plates and the assembled vacuum manifold at the locations of the robotic platforms as specified in the individual robotic programs.
- 

- 2 Add sufficient buffer to the reservoirs or place the buffer bottles at the corresponding positions on the robot worktable.

Calculate the required buffer volumes and pour an additional amount of 10 % into the reservoirs. Buffers are delivered in sufficient, but limited amounts and should not be wasted. Do not fill back unused buffer into the bottle.

---

- 3 Harvest cells: If cells have been grown in suspension, aliquots of up to  $2 \times 10^6$  cells can be transferred into the wells of a deep-well plate. Pellet cells by centrifugation for 5 min at 500 x g).

Tissue samples: For harvesting and homogenization of tissue samples, please refer to section 2.7.

---

- 4 Place the samples at the appropriate position of the robot worktable.
- 

- 5 Select method for total RNA purification and start the run. Seal unused wells with Self adhering PE Foil (see ordering information, section 6.2).

Use disposable tips with filter for the transfer of sample to the NucleoSpin® RNA Binding Strips. All other steps may be processed with needles. Adjust vacuum times and strength, if necessary. Take care that the volume of the rDNase reaction mixture is pipetted to the middle of the well.

---

- 6 For increased RNA concentration, dispense at least 75 µL of RNase-free H<sub>2</sub>O to the membrane. Lower volumes of elution buffer will cause inhomogeneous results. By using higher volumes of dispensed water, the concentration of eluted RNA will decrease, but the efficiency of elution will increase.

Alternatively, the elution can be performed in a centrifuge to reduce the volume of water needed for elution thus increasing the concentration of the RNA:

Stop the protocol after the vacuum drying step. Remove the NucleoSpin® RNA Binding Strips and tap it on a sheet of filter paper to remove residual wash buffer.

Place the NucleoSpin® RNA Binding Strips on top of a Rack of Tube Strips.

---

## 5.4 Clean up of total RNA

This support protocol is designed for clean up of prepurified RNA samples (e.g., from extractions using phenol/chloroform based purification procedures, precipitation protocols or following enzymatic reactions). The NucleoSpin® 8 RNA clean up procedure will eliminate traces of organic solvents, salts, or enzymes.

### Before starting the preparation:

Check if Wash Buffer RA3, Wash Buffer RA4, and rDNase reaction mixture were prepared according to section 3.

- 
- 1 For each **50 µL (1 volume) sample**, add **160 µL (3.2 volumes) Buffer RA1** and **110 µL (2.2 volumes) ethanol (96–100 %)** to adjust conditions under which the RNA binds to the silica membrane.

It is possible to scale up the volumes. The total volume of Buffer RA1 supplied in the kit is sufficient for a maximum of 300 µL Buffer RA1 per well. See ordering information if additional buffer is required.

*Note: Do not exceed a total volume of 1.400 µL as this is the maximum capacity of the individual wells.*

- 
- 2 Mix by pipetting up and down at least 15 times and transfer samples to the wells of the NucleoSpin® RNA Binding Plate.

Proceed with step 5 of the standard procedure (Bind RNA to the silica membrane, section 5.1 or 5.2).

*Note: rDNase treatment may not be necessary, depending on starting material and upstream application.*

---

## 6 Appendix

### 6.1 Troubleshooting

| Problem                           | Possible cause and suggestions                                                                                                                                                                                                                                                                                   |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RNA is degraded / no RNA obtained | <i>RNase contamination</i>                                                                                                                                                                                                                                                                                       |
|                                   | <ul style="list-style-type: none"> <li>Create an RNase-free environment on the worktable. Clean trough reservoirs with appropriate solutions. Wear gloves during all steps of the procedure. Change gloves frequently. Use of sterile, disposable polypropylene tubes is recommended.</li> </ul>                 |
|                                   | <ul style="list-style-type: none"> <li>Do not fill back unused buffer from the trough reservoir into the bottle.</li> <li>Use sterile tips with filter.</li> <li>Add 1% <math>\beta</math>-mercaptoethanol to Buffer RA1.</li> </ul>                                                                             |
|                                   | <i>Sample material</i>                                                                                                                                                                                                                                                                                           |
|                                   | <ul style="list-style-type: none"> <li>Sample material not fresh. Whenever possible, use fresh material</li> </ul>                                                                                                                                                                                               |
| Poor RNA quality or yield         | <i>Reagents not applied or prepared properly</i>                                                                                                                                                                                                                                                                 |
|                                   | <ul style="list-style-type: none"> <li>Reagents not properly prepared. Add the indicated volume of RNase-free H<sub>2</sub>O to the DNase vial and 96–100 % ethanol to Buffer RA3 and Buffer RA4 Concentrate and mix.</li> <li>Add 1% <math>\beta</math>-mercaptoethanol to Buffer RA1.</li> </ul>               |
|                                   | <i>Kit storage</i>                                                                                                                                                                                                                                                                                               |
|                                   | <ul style="list-style-type: none"> <li>Store aliquots of the reconstituted DNase at -20 °C.</li> <li>Store other kit components at room temperature. Storage at low temperatures may cause salt precipitation.</li> <li>Keep bottles tightly closed in order to prevent evaporation or contamination.</li> </ul> |
|                                   | <i>Sample material</i>                                                                                                                                                                                                                                                                                           |
|                                   | <ul style="list-style-type: none"> <li>If using more than 10<sup>6</sup> cells, use a shaker or a commercial homogenizer for optimal homogenization of the starting material.</li> </ul>                                                                                                                         |

| Problem                               | Possible cause and suggestions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Poor RNA quality or yield (continued) | <p><i>Elution</i></p> <ul style="list-style-type: none"> <li>Be sure that all of the water gets into contact with the silica membrane. No water drops should stick to the walls of the columns. The membrane has to be wetted completely.</li> </ul> <p><i>Clogging of the NucleoSpin® RNA Binding Strips</i></p> <ul style="list-style-type: none"> <li>If using too much sample or if tissue lysate has not been successfully cleared, clogging of the NucleoSpin® RNA Binding Strips may appear. Reduce sample amount and raise time for vacuum filtration or centrifugation steps to prevent this. If clogging happens during the run, take the remaining lysate off the NucleoSpin® RNA Binding Strips, discard it, and proceed with the desalting step (Buffer RA3). The use of the NucleoSpin® RNA Filter Strips is recommended to clear the lysate.</li> </ul> |
|                                       | <p><i>rDNase not Active</i></p> <ul style="list-style-type: none"> <li>Reconstitute and store lyophilized rDNase according to instructions in section 3.</li> </ul> <p><i>Too much material used</i></p> <ul style="list-style-type: none"> <li>Reduce quantity of tissue.</li> <li>Increase mixing cycles after adding Buffer RA4 to the lysate.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                       | <p><i>Carry-over of ethanol</i></p> <ul style="list-style-type: none"> <li>Be sure to remove all of ethanolic Buffer RA4 after the final washing step. Dry the NucleoSpin® RNA Binding Strips for at least 10 min with maximum vacuum or by 10 min centrifugation.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Insufficient vacuum pressure          | <p><i>Vacuum pressure is not sufficient</i></p> <ul style="list-style-type: none"> <li>Check if the vacuum manifold lid fits tightly on the manifold base while vacuum is applied.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Insufficient buffer volumes           | <p><i>Buffer volumes are not enough</i></p> <ul style="list-style-type: none"> <li>Buffers are delivered in sufficient, but limited amounts. Calculate the required buffer volumes and pour an additional amount of 10% into the reservoirs if using a robotic platform.</li> <li>Do not fill back unused buffer from reservoir into the bottle to avoid contaminations. Ask technical service for extended buffer volumes.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Problem             | Possible cause and suggestions                                                                                                                                                                                                                                                             |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cross-contamination | <i>Splattering of eluate</i>                                                                                                                                                                                                                                                               |
|                     | <ul style="list-style-type: none"> <li>Reduce the vacuum strength during the elution step. Alternatively a Round-well Block or Rack of Tube Strips (see ordering information) can be used for collecting the eluate if a higher vacuum strength is required during the elution.</li> </ul> |
|                     | <i>Transfer of sample solution to the NucleoSpin® RNA Binding Strips</i>                                                                                                                                                                                                                   |
|                     | <ul style="list-style-type: none"> <li>Be sure that no liquid drops out of the tips while moving the tips above the binding plate.</li> </ul>                                                                                                                                              |

## 6.2 Ordering information

| Product                                                                                                                 | REF        | Pack of      |
|-------------------------------------------------------------------------------------------------------------------------|------------|--------------|
| NucleoSpin® 8 RNA                                                                                                       | 740698     | 12 x 8 preps |
|                                                                                                                         | 740698.5   | 60 x 8 preps |
| NucleoSpin® 8 RNA Core Kit                                                                                              | 740465.4   | 48 x 8 preps |
| NucleoSpin® 96 RNA                                                                                                      | 740709.2   | 2 x 96 preps |
|                                                                                                                         | 740709.4   | 4 x 96 preps |
|                                                                                                                         | 740709.24  | 24 x 96      |
| NucleoSpin® 96 RNA Core Kit                                                                                             | 740466.4   | 4 x 96       |
| NucleoSpin® RNA Filter Strips                                                                                           | 740699.12F | 12           |
|                                                                                                                         | 740699.60F | 60           |
| Buffer RA1                                                                                                              | 740961.55  | 500 mL       |
| Buffer RA4 Concentrate<br>(for 1 L Buffer RA4)                                                                          | 740960     | 300 mL       |
| TCEP                                                                                                                    | 740395.107 | 107 g        |
| MN Square-well Block                                                                                                    | 740476     | 4            |
|                                                                                                                         | 740476.24  | 24           |
| Round-well Block Low<br>(set consists of 1 Round-well Block Low and Self<br>adhering PE Foil)                           | 740487     | 4            |
|                                                                                                                         | 740487.24  | 24           |
| Round-well Block with Cap Strips<br>(set consists of 1 Round-well Block 12 Cap Strips)                                  | 740475     | 4 sets       |
|                                                                                                                         | 740475.24  | 24 sets      |
| Rack of Tube Strips with Cap Strips<br>(set consists of 1 Rack, 12 Tube Strips with 8 tubes<br>each, and 12 Cap Strips) | 740477     | 4 sets       |
|                                                                                                                         | 740477.24  | 24 sets      |

| Product                                                                                         | REF                 | Pack of   |
|-------------------------------------------------------------------------------------------------|---------------------|-----------|
| Elution Plate U-bottom<br>(set consists of Elution Plate U-bottom and Self<br>adhering PE Foil) | 740486.24           | 24 sets   |
| Cap Strips                                                                                      | 740478<br>740478.24 | 48<br>288 |
| MN Wash Plate                                                                                   | 740479<br>740479.24 | 4<br>24   |
| Self adhering PE Foil                                                                           | 740676              | 50        |
| NucleoVac 96 Vacuum Manifold                                                                    | 740681              | 1         |
| NucleoVac Vacuum Regulator                                                                      | 740641              | 1         |
| Starter Set A<br>(for processing NucleoSpin® 8-well strips on<br>NucleoVac 96 Vacuum Manifold)  | 740682              | 1         |
| Starter Set C<br>(for processing NucleoSpin® 8-well strips under<br>centrifugation)             | 740684              | 1         |
| MN Frame                                                                                        | 740680              | 1         |

Visit [www.mn-net.com](http://www.mn-net.com) for more detailed product information.

### 6.3 Product use restriction / warranty

**NucleoSpin® 8 RNA (Core 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.

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

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