



Promega

Technical Bulletin

Maxwell[®] 16 Cell LEV Total RNA Purification Kit

INSTRUCTIONS FOR USE OF PRODUCT AS1225.

Upon receipt: Store the tube of RNasin[®] Plus RNase Inhibitor (Cat.# AS1232) at -20°C. Store the remaining kit components (Cat.# AS1222) at room temperature (22-25°C).

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Part# TB368

Maxwell® 16 Cell LEV Total RNA Purification Kit

All technical literature is available on the Internet at: www.promega.com/tbs/
 Please visit the web site to verify that you are using the most current version of this Technical Bulletin. Please contact Promega Technical Services if you have questions on use of this system. E-mail: techserv@promega.com

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I. Description

The Maxwell® 16 Cell LEV Total RNA Purification Kit^(a) is used with the Maxwell® 16 Instrument configured with the Low Elution Volume (LEV) hardware. This RNA purification procedure provides an easy method for efficient, automated purification of total RNA from the cytoplasm of eukaryotic cultured cells. The low elution volume of 30–100µl is used to generate more concentrated purified RNA for downstream applications such as qRT-PCR, RT-PCR and cDNA synthesis. The Maxwell® 16 Instrument is supplied with preprogrammed purification procedures and is designed for use with the pre-dispensed reagent cartridges, maximizing simplicity and convenience. After cytosol processing, the instrument can process up to 16 samples in approximately 30 minutes.

II. Product Components and Storage Conditions

Product	Size	Cat.#
Maxwell® 16 Cell LEV Total RNA Purification Kit	48 preps	AS1225

For Laboratory Use. Cat.# AS1225 includes AS1232 and AS1222. Each system contains sufficient reagents for 48 purifications. Includes:

Cat.# AS1222 includes:

- 48 Maxwell® 16 LEV Total RNA Cartridges
- 50ml RNA Lysis Buffer (RLA)
- 44ml RNA Dilution Buffer (RDB)
- 0.9ml 97.4% β -mercaptoethanol (BME)
- 10ml CytoSol Buffer
- 25ml Nuclease-Free Water
- 50 LEV Plungers
- 50 Elution Tubes (0.5ml)
- 1 Protocol

Cat.# AS1232 includes:

- 0.25ml RNasin® Plus RNase Inhibitor

Storage Conditions: Upon receipt, remove Cat.# 1232, RNasin® Plus RNase Inhibitor, and store at -20°C . Store the remaining kit components at room temperature ($22\text{--}25^{\circ}\text{C}$).

Safety Information: The reagent cartridges contain ethanol, which is flammable, and guanidine thiocyanate, which is an irritant. β -mercaptoethanol and guanidine thiocyanate are toxic. Wear gloves and follow standard safety procedures while working with these substances.

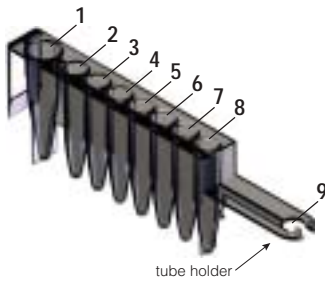


The Maxwell® 16 reagent cartridges are designed to be used with potentially infectious substances. Users should wear the appropriate protection (e.g., gloves and goggles) when handling infectious substances. Users should adhere to their institutional guidelines for the handling and disposal of all infectious substances when used with this system.

Note: Bleach reacts with guanidine thiocyanate and should not be added to any sample waste containing the lysate solution.

Notes:

1. The RNA Dilution Buffer is colored blue so that it can be distinguished easily from the other solutions.
2. Due to the toxicity of the chemicals used in the RNA purification procedure and the prevalence of RNases, you should wear gloves throughout the sample and cartridge preparation procedures.



Well	Contents	User Adds:
1.	RNA Lysis Buffer (RLA)	Sample
2.	MagneSil® PMPs	
3.	RNA Lysis Buffer (RLA)	
4.	Yellow Core Wash Solution	
5.	RNA Alcohol Wash B	
6.	RNA Alcohol Wash B	
7.	RNA Alcohol Wash B	
8.	Empty	Plunger
9.	Tube holder	0.5ml tube in tube holder slot

Figure 1. Maxwell® 16 Cell LEV Total RNA Cartridges.

III. Before You Begin

III.A. Maxwell® 16 Instrument Hardware Setup

To use the Maxwell® 16 Cell LEV Total RNA Purification Kit, the Maxwell® 16 Instrument must be configured with LEV instrument hardware. Users with a standard Maxwell® 16 Instrument (Cat.# AS1000) will need to reconfigure their instrument using the LEV Conversion Kit for Maxwell® 16 (Cat.# AS1250; see Figure 2). Reconfiguring the instrument is simple and easy. Please refer to your *Maxwell® 16 Instrument Technical Manual #TM274* for directions. Alternatively, a Maxwell® 16 Instrument can be purchased with LEV hardware already installed (Cat.# AS1002).



Figure 2. Maxwell® 16 Instrument hardware set to LEV configuration. Refer to the *Maxwell® 16 Instrument Technical Manual #TM274* to reconfigure your instrument to the LEV hardware configuration.

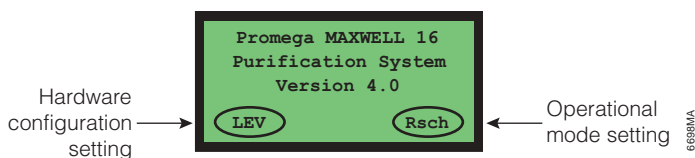
- ❗ Failure to change a Maxwell® 16 Instrument's hardware to the LEV hardware configuration could result in instrument damage. Use of the standard elution volume (SEV) hardware configuration with LEV configured reagent products will cause damage to the instrument.

III.B. Maxwell® 16 Instrument Firmware Setup

The Maxwell® 16 Instrument firmware needs to be set to match the LEV hardware configuration. Also, the firmware operational mode setting needs be in research mode ("Rsch") for proper use of the Maxwell® 16 Cell LEV Total RNA Purification Kit.

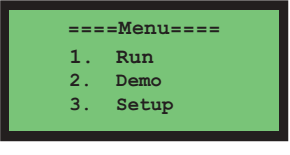
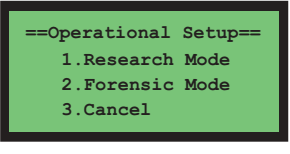


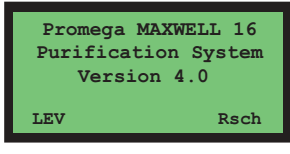
- ❗ Failure to change the Maxwell® 16 Instrument firmware settings to LEV could result in instrument damage.

1. Turn the instrument off and then on again.
2. The first screen displayed on the LCD panel will show the firmware version currently installed on the instrument. Verify that firmware version 4.0 (or higher) is loaded on your instrument. If a version lower than 4.0 is loaded on your instrument, please contact Promega Technical Services for a firmware upgrade.
3. The current hardware configuration and operational mode settings are also displayed on this screen.



4. Verify that the hardware configuration setting is "LEV" and the operational mode is "Rsch".
5. If the hardware configuration and operational mode are not set to "LEV" and "Rsch", change the instrument firmware settings as indicated in Table 1.
6. Press the up/down button to make selections.

Table 1. Changing the Maxwell® 16 Instrument Firmware Settings.

Menu screen: Select “Setup”.	 <pre> ====Menu==== 1. Run 2. Demo 3. Setup </pre>
Operational mode setup screen: Select “Research Mode”.	 <pre> ==Operational Setup== 1. Research Mode 2. Forensic Mode 3. Cancel </pre>
Hardware setup screen: Select “LEV Hardware”.	 <pre> ==Hardware Setup== 1. SEV Hardware 2. LEV Hardware </pre>
Confirm the instrument’s firmware settings and cycle the instrument’s power by turning the instrument off and then on again.	 <pre> ==Setup Verification== LEV Hardware Research Mode Set Please Cycle Power </pre>
Correct instrument firmware setup.	 <pre> Promega MAXWELL 16 Purification System Version 4.0 LEV Rsch </pre>

IV. Processing Capacity of the Maxwell® 16 Cell LEV Total RNA Purification Kit

The Maxwell® 16 Cell LEV Total RNA Purification Kit is designed to optimize purification of concentrated total RNA at a high quality for downstream applications. The capacity of the system can be exceeded by using too many cells. The processing capacity of the system depends on a variety of factors such as cell type and cell number, etc. Table 2 and Figure 3 recommend and describe the general processing capacity of the system. The specific processing capacity for your sample type may need to be determined. For purification of stabilized white blood cells or tissue, please see the Maxwell® 16 Tissue LEV Total RNA Purification Kit (Cat.# AS1220).

IV. Processing Capacity of the Maxwell® 16 Cell LEV Total RNA Purification Kit (continued)

Table 2. Recommended Sample Amounts.

Sample Type	Processing Capacity
Cultured Cells	1×10^4 – 2×10^6 cells

*Sample sizes 1×10^4 cells and below may not be quantifiable by spectrophotometry but may be amplifiable by qRT-PCR.

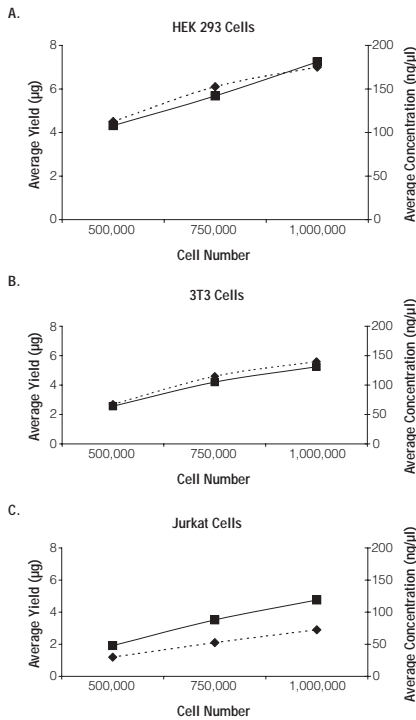


Figure 3. Maxwell® 16 Cell LEV Total RNA Purification Kit processing capacity will depend on cell type and sample size used. Total RNA was purified from either 5×10^5 , 7.5×10^5 , or 1×10^6 HEK 293, 3T3, or Jurkat cells and eluted in 50µl of Nuclease-Free Water. The Average Yield (µg) of purified total RNA is shown as a dotted line. The Average Concentration (ng/µl) of purified total RNA is shown as a solid line of purified total RNA. The yield and concentration of the purified total RNA depends on the starting cell type and other factors. **Panel A.** HEK 293 cells. **Panel B.** 3T3 cells. **Panel C.** Jurkat cells.

The elution volume of your purified sample may need to be optimized for your downstream applications. The recommended range of elution volumes for the Maxwell® 16 Cell LEV Total RNA Purification Kit is 30–100µl of Nuclease-Free Water. An elution volume of 50µl is recommended. Elution volumes less than 50µl may result in lower yield. For more concentrated RNA, an elution volume of 30µl may be used, but the total yield may be affected. Do not use elution volumes less than 30µl (Figure 4). Elution volumes of greater than 100µl may result in purified sample too dilute for some downstream applications. Varying the sample size or elution volumes does not effect the total RNA purity (Figure 5).

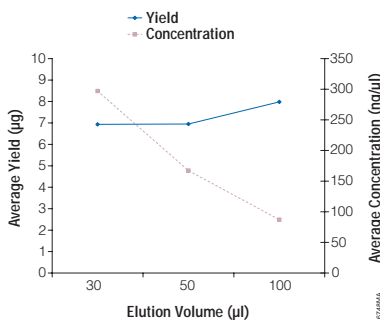


Figure 4. Effect of different elution volumes on purified total RNA yield and concentration. Total RNA was purified from 1×10^6 HEK 293 cells and eluted in 30, 50 or 100µl of Nuclease-Free Water. The Average Yield (µg) of purified total RNA is shown as a dotted line. The Average Concentration (ng/µl) of purified total RNA is shown as a solid line. Both Yield and Concentration are plotted as a function of the elution volume used. Elution with 30µl of Nuclease-Free Water will result in the greatest **concentration** of purified total RNA, while elution with 100µl of Nuclease-Free Water will result in a higher yield of purified total RNA. To maximize both yield and concentration, elute purified RNA with 50µl of Nuclease-Free Water.

IV. Processing Capacity of the Maxwell® 16 Cell LEV Total RNA Purification Kit (continued)

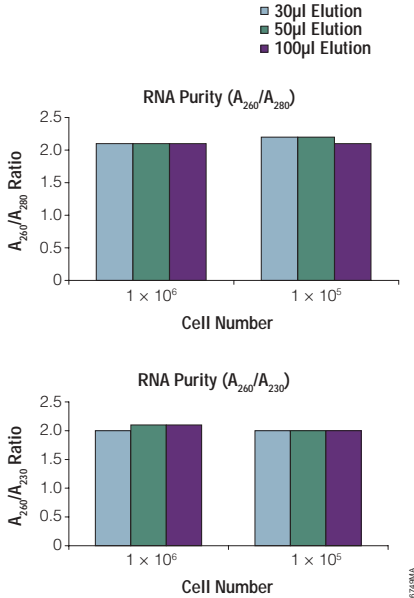


Figure 5. Effect of different elution volumes on purified total RNA. Total RNA was purified from 1×10^6 or 1×10^5 HEK 293 cells and eluted in 30, 50 or 100µl of Nuclease-Free Water. The average purity of the RNA was measured using either the A_{260}/A_{280} ratio or the A_{260}/A_{230} ratio.

V. RNA Isolation and Purification Procedures

Always use RNase-free pipettes and wear gloves to reduce the chance of RNase contamination.

V.A. Purification of Total RNA from Cultured Cells

Materials to Be Supplied by the User

- 1.5ml microcentrifuge tubes, nuclease free
 - microcentrifuge (at 4°C) capable of 14,000 × *g*
 - trypsin-EDTA for adherent cells
1. Prepare a CytoSol Working Solution (Table 3). For each sample you are processing combine in a tube 200μl of CytoSol Buffer and 2μl of RNasin® Plus RNase Inhibitor. If you are processing multiple tubes, make a master from which you can remove aliquots. Prepare a fresh master mix for each batch of samples.

After preparation, keep prepared CytoSol Working Solution on ice.

Table 3. Preparation of CytoSol Working Solution.

Reagent	Volume for One Sample	Volume for × N Samples
CytoSol Buffer	200μl	(N + 1) × 200μl
RNasin® Plus RNase Inhibitor	2μl	(N + 1) × 2μl

2. Prepare RNA Lysis/Dilution Working Solution (Table 4). For each sample you are processing, combine in a tube 250μl of RNA Lysis Buffer, 150μl of RNA Dilution Buffer and 4μl of β-mercaptoethanol (BME). If you are processing multiple tubes, make a master mix from which you can remove aliquots.

The RNA Lysis/ Dilution Working Solution should be made fresh for each batch of samples.

Table 4. Preparation of RNA Lysis/Dilution Working Solution.

Reagent	Volume for One Sample	Volume for × N Samples
RNA Lysis Buffer	250μl	(N + 1) × 250μl
RNA Dilution Buffer	150μl	(N + 1) × 150μl
β-mercaptoethanol (BME)	4μl	(N + 1) × 4μl

V.A. Purification of total RNA from Cultured Cells (continued)

Prepare Cell Lysates

3. If you working with adherent cells, scrape or trypsinize cells to detach them from the bottom of the culture plate or flask. If you are working with suspension cells, proceed to Step 4.



Note: Process the cells immediately after harvesting.

4. Transfer up to 2×10^6 cells into a nuclease-free tube. Pellet the cells by centrifugation at $300 \times g$ for 5 minutes at 4°C . Remove the supernatant.
5. Immediately add 200 μl of chilled CytoSol Working Solution (CytoSol Buffer with RNasin[®] Plus added) to the cell pellet and pipet to mix.
6. Vortex cells in CytoSol Working Solution for 10 seconds.
7. Incubate on ice for 10 minutes.

Note: During this incubation, aliquot 400 μl of the RNA Lysis/Dilution Working Solution into a new, clean, 1.5ml microcentrifuge tube.

8. Centrifuge the cells + CytoSol Solution sample at the centrifuge's highest speed (at least $14,000 \times g$) for 10 minutes at 4°C .
9. After centrifugation, transfer the sample supernatant to a microcentrifuge tube containing 400 μl of the RNA Lysis/Dilution Working solution.



Note: Be careful to avoid the pelleted cell debris and nuclei at the bottom of the tube.

10. Vortex to mix.
11. Proceed to Section VI.A to transfer the sample to the cartridge.

VI. Automated Total RNA Purification on the Maxwell® 16 Instrument

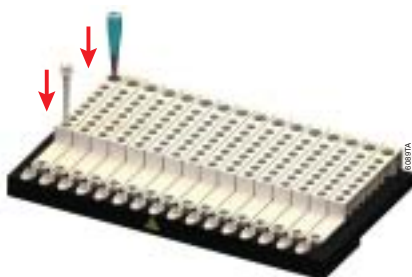
VI.A. Cartridge Preparation



1. Place the number of cartridges to be used into the Maxwell® 16 LEV Cartridge Rack (Cat.# AS1251). Place each cartridge into the rack with the tube holder (Figure 1) facing towards the numbered side of the rack. Slowly remove the seal starting at the elution tube. Then press down the back of the cartridge to snap it into position

Notes:

- It is easiest to insert the cartridge by inserting the tube holder side first and then gently pressing down on the back of the cartridge to snap it into place.
- If you are processing fewer than 16 samples, center the reagent cartridges on the platform.



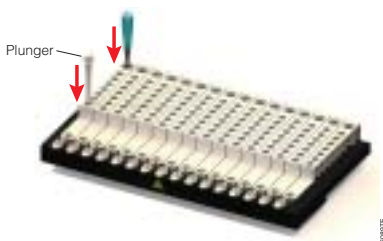
2. Place a plunger into Well #8 of each cartridge with the tabs sticking up. (Well #8 is the well closest to the tube holder).

Note: The plunger will fit loosely in the cartridge.

3. Transfer the sample into Well #1. (Well #1 is the well closest to the cartridge label and furthest from the user).



VI.A. Cartridge Preparation (continued)



4. Place 0.5ml Elution Tubes into the elution tube holder at the front of the each cartridge.

! **Remember** to put the plunger in Well #8.

5. Add 50 μ l of Nuclease-Free Water to the bottom of each elution tube.

Note: If the Nuclease-Free Water is on the side of the tube, the elution may be suboptimal.

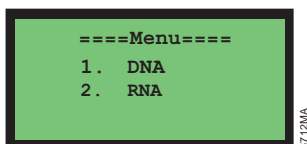
VI.B. Instrument Run

1. Turn the Maxwell[®] 16 Instrument on. The instrument will power up, display the firmware version number, proceed through a self-check and home all moving parts.
2. Verify that the instrument settings indicate an “LEV” hardware configuration and a “Rsch”, operational mode setting (Section III.B). If the instrument firmware is not set for “LEV” and “Rsch” go to Section III and reset the instrument.

3. Select "Run" on the Menu screen and press the "Run/Stop" button to start the method.



4. Select "RNA" at the Menu screen and then select "OK" at the Verification screen.



5. Open the door when prompted to do so on the LCD display. Press the "Run/Stop" button to extend the platform.



Warning. Pinch point hazard.

6. Transfer the Maxwell® 16 LEV Cartridge Rack, containing the prepared LEV total RNA purification cartridges, onto the Maxwell® 16 Instrument platform. Ensure that the rack is placed into the Maxwell® 16 Instrument with the tube holders of the cartridges closest to the door. The rack will only fit into the instrument in this orientation. If you have difficulty fitting the rack onto the platform, check that the rack is in the correct orientation.
Note: Hold the Maxwell® 16 LEV Cartridge Rack by the sides to avoid dislodging the cartridge from the rack.
7. Ensure that the cartridge rack is level on the instrument platform.
8. Verify that you have added: samples to Well #1; plungers to Well #8; and Nuclease-Free Water to the 0.5ml elution tubes.
9. Press the "Run/Stop" button. The platform will retract. Close the door.



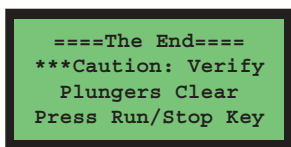
Warning. Pinch point hazard

VI.B. Instrument Run (continued)

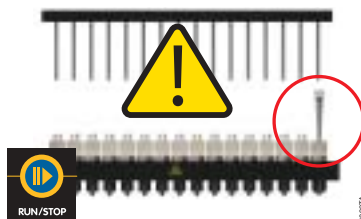
10. The Maxwell® 16 Instrument will immediately begin the purification run. The LCD screen will display the steps performed and the approximate time remaining in the run.

Notes:

- If any problems are encountered, turn the instrument off and on to restart the sequence (Section VI.B).
 - Pressing the “Run/Stop” button or opening the door will pause the run.
 - If the program is terminated before completion, the instrument will wash the particles off the plungers and eject the plungers into Well #8 of the cartridge. The sample will be lost.
11. When the automated purification run is complete, the LCD screen will display a message that the method has ended. Upon method completion, open the instrument door. The plungers should be located in Well #8 of the cartridge at the end of the run. Check to make sure that all of the plungers have been removed from the plunger bar. If the plungers have not been removed, push them down gently by hand to remove them from the plunger bar.



5318MA



6026TA

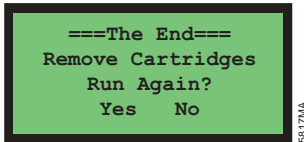
12. Press the “Run/Stop” button to extend the platform out of the instrument.
13. Remove the Elution Tubes containing eluted purified total RNA from the purification cartridges, and cap the tubes. Store the purified sample at -20°C or below for use in downstream analysis applications.

Notes:

- Some MagneSil® PMPs may be present in the elution tube. This should not affect downstream applications.
- If desired, place the tubes containing purified total RNA sample into a magnetic elution rack (e.g., Cat.# Z5314) to do another magnetic capture of remaining MagneSil® PMPs along the side of the tube.
- Leaving the tube in the magnetic elution rack, carefully aspirate by pipetting the purified sample to a new storage tube, being careful not to disturb any MagneSil® PMPs captured on the side of the tube.



14. Remove the cartridges and plungers from the cartridge rack and discard. Do not reuse Reagent Cartridges, Plungers, or Elution Tubes.



15. Use the scroll up or down buttons to move the cursor to select “Yes” or “No” to run the purification method again.
If “Yes” is selected, the Menu screen will appear.
If “No” is selected, the platform will retract into the instrument and you will be prompted to close the instrument door.
16. A diagnostic axis check is automatically performed whether another run is chosen or not. If the check is successful, the LCD screen will display a message indicating so. If the check is unsuccessful, an error message will appear. See Section VIII for further information about resolving instrument diagnostic errors.

VII. Determining RNA Yield and Quality

The most common method to determine the yield and purity of RNA is spectrophotometry. The yield of total RNA is determined by measuring the sample absorbance at 260nm. According to Beer's Law, an absorbance unit ($A_{260} = 1.0$) equals $\sim 40\mu\text{g/ml}$ of single-stranded RNA in a 1cm pathlength cuvette. The yield of purified total RNA will vary depending on the type of starting material and physiological activity of the sample.

The A_{260}/A_{280} ratio is an indicator of protein contamination. Pure RNA will exhibit an A_{260}/A_{280} ratio greater than 1.8. If the sample is contaminated with protein, the ratio will be lower due to an increased absorbance of protein at 280nm.

The integrity of purified total RNA may be determined by denaturing agarose gel or Agilent Bioanalyzer analysis. RNA integrity may be reflected by the RNA integrity number (RIN) from the Agilent Bioanalyzer, which integrates several quality assessments.

VIII. Troubleshooting

For questions not addressed here, please contact your local Promega Branch Office or Distributor. Contact information available at: www.promega.com. E-mail: techserv@promega.com

Symptoms	Causes and Comments
Low RNA yield, RNA degradation or poor reproducibility between samples	Sample mixing may be incomplete. Incomplete permeabilization of samples may lower RNA yield. Incubate sample on ice for 10 minutes.
	RNA may have been degraded during sample preparation. It is essential to work quickly during sample preparation. Maintain the sample at 4°C during preparation.
	Sample contains a low amount of RNA. The amount of RNA present in a sample depends on the metabolic state, stage of growth, cell type, and growth conditions. Cell lines vary in the amount of total RNA (Figure 3).
	RNase was introduced by handling. Use sterile, disposable plasticware or baked glassware when handling RNA. Wear clean gloves at all times. Mishandling of kit plastics and introduction of RNases during or after the purification will degrade the RNA. See Section IX.A.
	RNasin® Plus was not added to the CytoSol Working Solution. RNasin® Plus inhibits RNases during sample processing.
BME was not added to the RNA Lysis/Dilution working solution. BME inactivates RNases during sample processing.	

IX. Appendix

IX.A. Creating a Ribonuclease-Free Environment

Ribonucleases are extremely difficult to inactivate. Take care to avoid introducing RNase activity into your RNA samples during and after isolation. This is especially important if the starting material was difficult to obtain or is irreplaceable. The following notes may help prevent accidental RNase contamination of your samples.

1. Two of the most common sources of RNase contamination are the user's hands and bacteria or molds that may be present on airborne dust particles. To prevent contamination from these sources, use sterile technique when handling the reagents supplied with this system. Wear gloves at all times. Change gloves whenever ribonucleases may have been contacted.
2. Whenever possible, sterile, disposable plasticware should be used for handling RNA. These materials are generally RNase-free and do not require pretreatment to inactivate RNase.
3. Treat nonsterile glassware, plasticware and electrophoresis chambers before use to ensure that they are RNase-free. Bake glassware at 200°C overnight, and thoroughly rinse plasticware with 0.1N NaOH, 1mM EDTA, followed by RNase-free water. Commercially available RNase removal products may also be used, following the manufacturer's instructions.

Note: Electrophoresis chambers may be contaminated with ribonucleases, particularly RNase A, from analysis of DNA samples. Whenever possible, set aside a new or decontaminated apparatus for RNA analysis only.

4. Treat solutions not supplied with the system by adding diethyl pyrocarbonate (DEPC) to 0.1% in a fume hood. Incubate overnight at room temperature in the hood. Autoclave for 30 minutes to remove any trace of DEPC.

Caution: DEPC is a suspected carcinogen and should only be used in a chemical fume hood. DEPC reacts rapidly with amines and cannot be used to treat Tris buffers.

IX.B. Downstream Applications

Total RNA purified with the Maxwell® 16 Cell LEV Total RNA Purification Kit is suitable for molecular biology applications, such as RT-PCR, real-time qRT-PCR, microarrays and Northern blot analysis. For more information on downstream applications, see the Promega *Protocols and Applications Guide* (1) and the *RNA Applications Guide* (2).

Note: For all downstream applications, it is essential that you continue to protect your RNA samples from RNases. Continue to wear clean gloves and use solutions and centrifuge tubes that are RNase-free.

IX.C. References

1. *Protocols and Applications Guide*, Online Edition (2004) Promega Corporation.
2. *RNA Applications Guide* (2003) Promega Corporation.

IX.D. Related Products

Instrument/ Instrument Accessories	Size	Cat.#
Maxwell® 16 Instrument*	1 each	AS1000
Maxwell® 16 LEV Instrument*	1 each	AS1002
LEV Conversion Kit for Maxwell® 16**	1 each	AS1250
Maxwell® LEV Cartridge Rack	1 each	AS1251

Standard Reagent Kits	Size	Cat.#
Maxwell® 16 Blood DNA Purification Kit*	48 preps	AS1010
Maxwell® 16 Cell DNA Purification Kit*	48 preps	AS1020
Maxwell® 16 Tissue DNA Purification Kit*	48 preps	AS1030
DNA IQ™ Reference Sample Kit for Maxwell® 16**	48 preps	AS1040
Maxwell® 16 Total RNA Purification Kit*	48 preps	AS1050
Maxwell® 16 Polyhistidine Protein Purification Kit	48 preps	AS1060

LEV Reagent Kits	Size	Cat.#
Maxwell® 16 Tissue LEV Total RNA Purification Kit*	48 preps	AS1220
DNA IQ™ Casework Sample Kit for Maxwell® 16**	48 preps	AS1210

Accessory Products	Size	Cat.#
MagenSphere® Technology Magnetic Separation Stand	1 each	Z5341

* For Laboratory Use.

** For Research Use Only. Not for use in diagnostic procedures.

⁽⁴⁾U.S. Pat. Nos. 6,027,945, 6,368,800 and 6,673,631, Australian Pat. No. 732756, European Pat. No. 1 204 741 and Mexican Pat. No. 209436 have been issued to Promega Corporation for methods of isolating biological target materials using silica magnetic particles and simultaneous isolation and quantitation of DNA. Other patents are pending.

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All prices and specifications are subject to change without prior notice.

Product claims are subject to change. Please contact Promega Technical Services or access the Promega online catalog for the most up-to-date information on Promega products.