

## Plasma/Serum Cell-Free Circulating and Viral Nucleic Acid Purification Kit Product # 56300 Product Insert

Cell-free circulating (cfc) Nucleic Acids such as DNA and RNA in plasma or serum, including exosomal RNA, has the potential to provide biomarkers for certain cancers and disease states as well as fetal DNA in maternal blood. Moreover, plasma and serum has been widely used for the detection of viral infections, including HIV, HCV and HBV. Currently, significant advancements are being made in utilizing cfc-DNA as well as free circulating RNA as biomarkers for the early diagnosis, prognosis and monitoring of therapy for several cancer types and autoimmune diseases, as well as for gene expression analysis. Exosomes are 40 - 100 nm membrane vesicles, which are secreted by most cell types. Exosomes can be found in saliva, blood, urine, amniotic fluid and malignant ascitic fluids, among other biological fluids. Evidence has been accumulating recently that these vesicles act as cellular messengers, conveying information to distant cells and tissues within the body. The exosomes contain cell-specific proteins, lipids and RNAs, which are transported to other cells, where they can alter function and/or physiology. These exosomes may play a functional role in mediating adaptive immune responses to infectious agents and tumours, tissue repair, neural communication and transfer of pathogenic proteins. Recent work has demonstrated the presence of distinct subsets of microRNAs within exosomes which depend upon the tumour cell type from which they are secreted. For this reason exosomal RNAs may serve as biomarkers for various diseases including cancer. Cell-free mitochondrial DNA (cfmtDNA) is also under investigation for its clinical significance. In addition, cell-free fetal DNA has been widely used as a non-invasive method for prenatal diagnosis including early identification of fetal sex, genetic studies for families at high risk for inherited genetic disorders, screening for Rhesus factor, screening for aneuploidy and identification of preeclampsia.

Norgen's Plasma/Serum Cell-Free Circulating and Viral Nucleic Acid Purification Kits provides a fast, reliable reproducible and simple procedure for isolating total circulating Nucleic Acid (DNA and RNA) from various amounts of plasma/serum inputs ranging from 50  $\mu$ L up to 5 mL, with various kit formats address different plasma/serum input volumes. Purification is based on spin column chromatography that uses Norgen's proprietary resin separation matrix. The kit is designed to isolate all sizes of cfc-DNA and circulating RNA, including microRNA, as well as all sizes of exosomal RNA. Norgen's Plasma/Serum Cell-Free Circulating and Viral Nucleic Acid Purification Kits provide a clear advantage over other available kits in that they do not require phenol/chloroform or any protease treatments. Nucleic Acids can be isolated from either fresh or frozen samples using this kit. Moreover, the kit allows the user to elute into a flexible elution volume ranging from 25  $\mu$ L to 100  $\mu$ L. ***This kit is suitable for the isolation of total nucleic acid (RNA and DNA) from fresh or frozen serum or plasma prepared from blood collected on either EDTA or Citrate. Plasma samples prepared from blood collected on heparin should not be used, especially if the primary interest is purifying RNA, as heparin can significantly interfere with many downstream applications such as RT-PCR. If the main interest is to purify DNA, then heparinised plasma can be used.***

## Kit Components

Component	Mini Kit Cat.# 56300
Number of Preps	50 preps
Lysis Buffer A	2 x 20 mL
Wash Solution A	18 mL*
Elution Buffer F	6 mL
Micro Spin Columns	50
Collection Tubes	50
Elution tubes (1.7 mL)	50
Product Insert	1

\* For the preparation of working solutions, please see Important Notes (Notes prior to use)

## Kit Specifications

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Sample Type	Plasma/Serum
Anti-coagulant (for Plasma) †	EDTA or Citrate
Sample volume Range	50 to 200 µL
Minimum Elution Volume	10 µL
Maximum Elution Volume	25 µL
Time to Complete 10 Purifications	15 - 20 minutes
Size of RNA Purified	All sizes, including miRNA and small RNA (<200 nt)
Size of DNA Purified	≥ 50 bp
Average Yields ‡	Variable depending on specimen

† This kit is suitable for the isolation of total nucleic acid (RNA and DNA) from fresh or frozen serum or plasma prepared from blood collected on either EDTA or Citrate. Plasma samples prepared from blood collected on heparin should not be used, especially if the primary interest is RNA, as heparin can significantly interfere with many downstream applications such as RT-PCR. If the main interest is DNA then heparinised plasma can be used.

‡ Please check page 6 for Average Plasma/Serum Yields and Common RNA/DNA Quantification Methods

### Storage Conditions and Product Stability

All solutions should be kept tightly sealed and stored at room temperature. This kit is stable for 2 years after the date of shipment. It is recommended to warm Lysis Buffer A for 20 minutes at 60°C if any salt precipitation is observed.

### Quality Control

In accordance with Norgen's Quality Management System, each lot of Norgen's Plasma/Serum Nucleic Acid Purification Kits are tested against predetermined specifications to ensure consistent product quality.

**Product Use Limitations**

Norgen's Plasma/Serum Nucleic Acid Purification Kits are designed for research purposes only. They are not intended for human or diagnostic use.

**Product Warranty and Satisfaction Guarantee**

NORGEN BIOTEK CORPORATION guarantees the performance of all products in the manner described in our product manual. The customer must determine the suitability of the product for its particular use.

**Safety Information**

Ensure that a suitable lab coat, disposable gloves and protective goggles are worn when working with chemicals. For more information, please consult the appropriate Material Safety Data Sheets (MSDSs). These are available as convenient PDF files online at [www.norgenbiotek.com](http://www.norgenbiotek.com).

**Lysis Buffer A** contain guanidinium salts, and should be handled with care. Guanidinium salts form highly reactive compounds when combined with bleach, thus care must be taken to properly dispose of any of these solutions. Plasma or serum of all human and animal subjects is considered potentially infectious. All necessary precautions recommended by the appropriate authorities in the country of use should be taken when working with plasma or serum.

**CAUTION: DO NOT add bleach or acidic solutions directly to the sample-preparation waste.**

**Customer-Supplied Reagents and Equipments**

- Benchtop microcentrifuge
- Swinging bucket centrifuges
- Vortexer
- Micropipettors
- 96 – 100% ethanol
- 100% Isopropanol
- $\beta$  - Mercaptoethanol

# Procedure

## Important Notes

### Working with RNA

RNases are very stable and robust enzymes that degrade RNA. Autoclaving solutions and glassware is not always sufficient to actively remove these enzymes. The first step when preparing to work with RNA is to create an RNase-free environment. The following precautions are recommended as your best defence against these enzymes.

- The RNA area should be located away from microbiological work stations
- Clean, disposable gloves should be worn at all times when handling reagents, samples, pipettes, disposable tubes, etc. It is recommended that gloves are changed frequently to avoid contamination
- There should be designated solutions, tips, tubes, lab coats, pipettes, etc. for RNA only
- All RNA solutions should be prepared using at least 0.05% DEPC-treated autoclaved water or molecular biology grade nuclease-free water
- Clean all surfaces with commercially available RNase decontamination solutions
- When working with purified RNA, ensure that they remain on ice during downstream applications

### Notes Prior to Use

- All centrifugation steps are performed at room temperature.
- Ensure that centrifuge tubes used are capable of withstanding the centrifugal forces required.
- The provided spin columns are optimized to be used with a benchtop centrifuges and not to be used on a vacuum apparatus
- Most standard benchtop microcentrifuges will accommodate Norgen's Micro and Mini Spin Columns.
- Most standard swinging bucket centrifuges will accommodate Norgen's Midi and Maxi Spin Columns. Do not use a fixed-angle rotor
- Norgen's Midi and Maxi Spin Columns are centrifuged in 15 mL and 50 mL centrifuge tubes, respectively.
- Centrifuging Norgen's Spin columns at a speed higher than recommended may affect RNA yield.
- Centrifuging Norgen's Spin columns at a speed lower than recommended will not affect RNA yield. However, centrifugation at a lower speed may require longer time for the solutions to pass through the spin column
- When placing Norgen's Midi and Maxi Spin Columns into the swinging bucket centrifuge make sure that lids of the tubes are not tightly closed. Tightly closed lids may cause back pressure which may cause column clogging or disintegration.
- Ensure that all solutions are at room temperature prior to use.
- It is highly recommended to warm up **Lysis Buffer A** at 60°C for 20 minutes and mix well until the solutions become clear again if precipitates are present.
- Prepare a working concentration of the **Wash Solution A**:
  - Add **42 mL** of 96 - 100% ethanol (provided by the user) to the supplied bottle containing **18 mL** of the concentrated Wash Solution A. This will give a final volume of **60 mL**.
  - Add **90 mL** of 96 - 100% ethanol (provided by the user) to the supplied bottle containing **38 mL** from the concentrated Wash Solution A. This will give a final volume of **128 mL**.
  - The labels on the bottles have a box that may be checked to indicate that the ethanol has been added.
- The use of  $\beta$ -mercaptoethanol in lysis is highly recommended to isolate RNA for sensitive downstream applications. Add 10  $\mu$ L of  $\beta$ -mercaptoethanol (provided by the user) to each 1 mL of **Lysis Buffer A**.

- Ensure that samples have not undergone more than one freeze-thaw cycle, as this may lead to RNA degradation.
- It is recommended to not work with samples that were hemolyzed as this will affect the nucleic acid profile outcome
- ***This kit is suitable for the isolation of total nucleic acids (RNA and DNA) from fresh or frozen serum or plasma prepared from blood collected on either EDTA or Citrate. Plasma samples prepared from blood collected on heparin should not be used, especially if the primary interest is RNA, as heparin can significantly interfere with many downstream applications such as RT-PCR. If the main interest is DNA then heparinised plasma can be used.***
- ***Frozen plasma or serum samples should be centrifuged for 2 minutes at 400 x g (~2,000 RPM) before processing. Only clear supernatant should be processed, as column clogging may be encountered if frozen samples are directly processed.***
- ***If any of the solutions do not go through the Spin Columns within the specified centrifugation time, spin for an additional 1-2 minutes until the solution completely passes through the Column. Do NOT exceed the centrifugation speed as this may affect DNA yield.***

**Note: The procedure outlined below is for 200  $\mu$ L inputs of Plasma/Serum. If processing a sample volume lower than 200  $\mu$ L Plasma/Serum, simply bring the volume of your samples up to 200  $\mu$ L using Nuclease-free water and proceed as outlined below.**

1. Place 200  $\mu$ L of plasma/serum sample in a 2 mL tube (provided by the user) and add 600  $\mu$ L of **Lysis Buffer A**. Mix well by vortexing for 10 seconds.
2. Add 800  $\mu$ L of 96-100% ethanol (provided by the user). Mix well by vortexing for 10 seconds.
3. Transfer 650  $\mu$ L of the mixture from **Step 2** into a Micro Spin Column. Centrifuge for **2 minutes at 3,300 x g (~6,000 RPM)**. Discard the flowthrough and reassemble the spin column with its collection tube.
4. Repeat **Step 3** two more times until all the mixture from **Step 2** has been transferred to the Micro Spin column.

**Optional Step: If only RNA is the primary interest, an optional On-Column DNA Removal Protocol is provided in Appendix A for the maximum removal of DNA that may affect sensitive downstream applications. This step should be performed at this point in the protocol**

5. Apply 400  $\mu$ L of **Wash Solution A** to the column and centrifuge for **30 seconds at 3,300 x g (~6,000 RPM)**. Discard the flowthrough and reassemble the spin column with its collection tube.
6. Repeat **step 5** two more times, for a total of three washes.
7. Spin the column, empty, for **2 minutes at 13,000 x g (~14,000 RPM)**. Discard the collection tube.
8. Transfer the spin column to a fresh 1.7 mL Elution tube. Apply from 10  $\mu$ L up to 25  $\mu$ L of **Elution Buffer F** to the column and let stand at room temperature for 2 minutes. Centrifuge for **1 minute at 400 x g (~2,000 RPM)**, followed by **2 minutes at 5,800 x g (~8,000 RPM)**.
9. For maximum recovery, transfer the eluted buffer back to the column and let stand at room temperature for 2 minutes. Centrifuge for **1 minute at 400 x g (~2,000 RPM)**, followed by **2 minutes at 5,800 x g (~8,000 RPM)**.

- ***Plasma/Serum nucleic acid is ready for the downstream application of your choice. For an explanation of expected yields and recommendations for quantification of the nucleic acids, please refer to Appendix B***

## Appendix A

### Protocol for Optional On-Column DNA Removal

Norgen's Plasma/Serum Cell-Free Circulating and Viral Nucleic Acid Purification Kits isolate total nucleic acid (RNA and DNA) in one elution. However, an optional protocol is provided below for the maximum removal of DNA that may affect sensitive downstream applications if your primary interest is cell-free circulating RNA. It is recommended that Norgen's RNase-Free DNase I Kit (Product # 25710) be used for this step.

1. For every on-column reaction to be performed, prepare a mix of 15  $\mu\text{L}$  of **DNase I** and 100  $\mu\text{L}$  of **Enzyme Incubation Buffer** using Norgen's RNase-Free DNase I Kit (Product # 25710). Mix gently by inverting the tube a few times. **DO NOT VORTEX**.  
**Note:** If using an alternative DNase I, prepare a working stock of 0.25 Kunitz unit/ $\mu\text{L}$  RNase-free DNase I solution according to the manufacturer's instructions. A 100  $\mu\text{L}$  aliquot is required for each column to be treated.
2. Perform the procedure up to **Step 4**.
3. Apply 400  $\mu\text{L}$  of **Wash Solution A** to the column and centrifuge for **30 seconds at 6,000 RPM**. Discard the flowthrough and reassemble the spin column with its collection tube.
4. Apply 50  $\mu\text{L}$  of the **RNase-free DNase I** solution prepared in **Step 1** to the column and centrifuge at **8,000 x g (~10,000 RPM)** for 1 minute.  
**Note:** Ensure that the entire DNase I solution passes through the column. If needed, spin at **13,000 x g (~14,000 RPM)** for an additional minute.
5. After the centrifugation in **Step 4**, pipette the flowthrough that is present in the collection tube back onto the top of the column.  
**Note:** Ensure **Step 5** is performed in order to ensure maximum DNase activity and to obtain maximum yields of RNA, in particular for small RNA species.
6. Incubate the column assembly at 25 - 30°C for 15 minutes.
7. Without any further centrifugation, proceed directly **to the second wash step** in **Step 6**.

## Appendix B

### Cell-Free Circulating Nucleic Acid Yield

Plasma/Serum total Nucleic Acid, like RNA and DNA in other cell-free bodily fluids, is normally found in very low amounts (1 - 100 pg/ $\mu\text{L}$ ), therefore measuring cell-free RNA or DNA concentration using common quantification methods is very difficult and challenging. Typical yields of plasma/serum Nucleic Acid vary significantly from sample to sample. Variability is also observed between samples collected from the same donor at different times during the day and therefore there is no absolute yield for RNA purified from bodily fluids including plasma or serum. Cell-free circulating RNA yield varies depending on a number of factors including age, sex, diet, exercise and most importantly the health status of the donor.

Below is a list of the most common RNA and DNA quantification methods, as well as the limit of detection for each of these methods. **Unfortunately, none of these methods can be used reliably for measuring the concentration of the purified nucleic acid from plasma or serum unless large plasma/serum volumes have been processed.** This would only be applicable if plasma/serum contains the maximum amount of nucleic acid that can fit within the specification range of these quantification tools. It should be noted that the specifications outlined below are based on measuring a pure RNA/DNA, which will not be the case for the nucleic acid purified from plasma or serum. Plasma/Serum nucleic acid is short and fragmented, and is usually present in less than 1000 bp. Purified plasma/serum nucleic acid usually contains traces of proteins which will interfere with most quantification methods, leading to the overestimation of the purified nucleic acid concentration. Therefore purified nucleic acid contaminated with more proteins will be presented at a higher concentration as compared to nucleic acid purified with less protein contaminants, which in this case will depend on the method used for plasma/serum

nucleic acid purification. *The only reliable method that can assess the quality and the relative quantity of the purified plasma/serum nucleic acid is RT-qPCR (RNA) or qPCR (DNA) amplification of a standard RNA or DNA using a small amplicon such as the 5S rRNA housekeeping gene.*

## Common Nucleic Acid Quantification Methods

### 1) Bioanalyzer RNA Quantification Kits

	RNA 6000 Nano Kit		RNA 6000 Pico Kit		Small RNA kit
	Total RNA	mRNA	Total RNA	mRNA	Total RNA
<b>Quantitative range</b>	25 - 500 ng/ $\mu$ L	25 - 250 ng/ $\mu$ L	----	----	50-2000 pg/ $\mu$ L
<b>Qualitative range</b>	5 - 500 ng/ $\mu$ L	5 - 250 ng/ $\mu$ L	50 - 5000 pg/ $\mu$ L	250 - 5000 pg/ $\mu$ L	50-2000 pg/ $\mu$ L
<b>Quantitation accuracy</b>	20% CV	20% CV	30% CV	----	-----

### 2) Bioanalyzer DNA Quantification Kits

	DNA 1000 Kit	DNA 7500 Kit	DNA 12000 Kit	High Sensitivity DNA Kit
<b>Size Range</b>	25–1000 bp	100–7500 bp	100–12000 bp	50-7000 bp
<b>Quantitation accuracy</b>	20% CV*	20% CV*	25% CV*	20% CV
<b>Quantitative range</b>	0.5-50 ng/ $\mu$ L	0.5-50 ng/ $\mu$ L	0.5-50 ng/ $\mu$ L	5-500 pg/ $\mu$ L

### 3) NanoDrop 2000

- Detection Limit: 2 ng/ $\mu$ l (dsDNA)

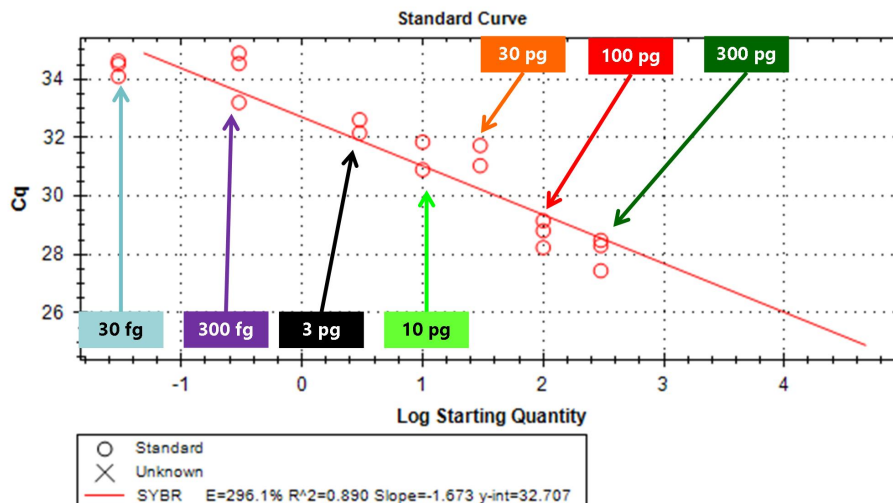
### 4) Quant-iT™ RiboGreen® RNA Assay Kit

- Quantitation Range: 1-200 ng

### 5) Quant-iT™ Pico Green® dsDNA Assay Kit

- Detection Limit: 25 pg/mL

### 6) qPCR Standard Curve (generated using Norgen's Low Abundance DNA Quantification Kit, Cat# 57200)



## Frequently Asked Questions

### 1. What if a variable speed centrifuge is not available?

- A fixed speed centrifuge can be used, however reduced yields may be observed.

### 2. At what temperature should I centrifuge my samples?

- All centrifugation steps are performed at room temperature. Centrifugation at 4 °C will not adversely affect kit performance.

### 3. What if I added more or less of the specified reagents' volume?

- Adding more or less than the specified volumes may reduce both the quality and the quantity of the purified nucleic acids. Eluting your nucleic acids in high volumes will increase the yield but will lower the concentration. Eluting in small volumes will increase the concentration but will lower the overall yield.

### 4. What if I forgot to do a dry spin before my final elution step?

- Your purified nucleic acids will be contaminated with the Wash Solution A. This may reduce the quality of your purified nucleic acid and will interfere with your downstream applications.

### 5. Can I perform a second elution?

- Yes, but it is recommended that the 2<sup>nd</sup> elution be in a smaller volume (50% of 1<sup>st</sup> Elution). It is also recommended to perform the 2<sup>nd</sup> elution into a separate elution tube to avoid diluting the 1<sup>st</sup> elution.

### 6. Why do my samples show low nucleic acid yield?

- Plasma/Serum samples contain very little nucleic acid. This varies from individual to individual based on numerous variables. In order to increase the yield, the amount of Plasma/Serum input could be increased.

### 7. Why do the A260:280 ratio of the purified nucleic acid is lower than 2.0?

- Most of the Free-Circulating Plasma/Serum nucleic acid is short nucleic acid fragments. The A260:280 ratio is normally between 1 – 1.6. This low A260:280 ratio will not affect any downstream application.

### 8. Why does my isolated RNA not perform well in downstream applications?

- If a different Elution Buffer was used other than the one provided in the kit, the buffer should be checked for any components that may interfere with the application. Common components that are known to interfere are high salts (including EDTA), detergents and other denaturants. Check the compatibility of your elution buffer with the intended use.

### 9. Do I need to do a DNase treatment for my nucleic acid Elution?

- You may need to do a DNase treatment to your isolated Plasma/Serum miRNA. It is recommended to use Norgen's RNase-Free DNase I Kit (Cat# 25710). Also please refer to the protocol for optional on-column DNA removal outlined in **Page 6**.

## Technical Support

Contact our Technical Support Team between the hours of 9:00 and 5:30 (Eastern Standard Time) at (905) 227-8848 or Toll Free at 1-866-667-4362.

Technical support can also be obtained from our website ([www.norgenbiotek.com](http://www.norgenbiotek.com)) or through email at [support@norgenbiotek.com](mailto:support@norgenbiotek.com).

Norgen's purification technology is patented and/or patent pending. See [www.norgenbiotek.com/patents](http://www.norgenbiotek.com/patents)

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