

SARS-CoV-2 support and solutions

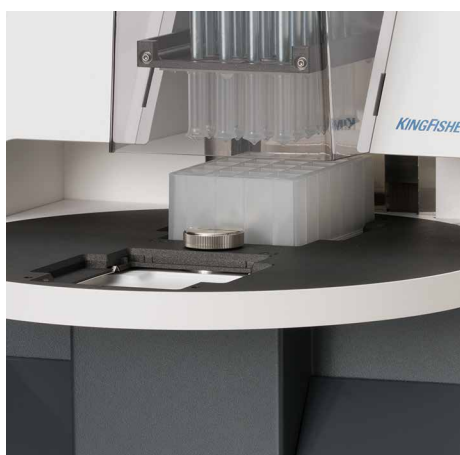
KingFisher instruments and MagMAX isolation kits

Automated nucleic acid extraction

In response to global events related to SARS-CoV-2, Thermo Fisher Scientific has worked rapidly to develop protocols for the Applied Biosystems™ MagMAX™ Viral/Pathogen and Viral/Pathogen II Nucleic Acid Isolation Kits coupled with Thermo Scientific™ KingFisher™ instruments to support increased SARS-CoV-2 testing throughput.

For the most up-to-date information on SARS-CoV-2, go to the [WHO](#) and [CDC](#) websites.

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KingFisher instrument recommendations

KingFisher instruments reduce sample loss and user processing errors while increasing the reproducibility and quality of your results. The Thermo Scientific™ KingFisher™ Flex, Duo Prime, and Presto instruments support a range of throughput options for nucleic acid extraction (Table 1).

Table 1. KingFisher instrument selection guide.

| | KingFisher instrument | | |
|--------------------------------|---|--|---|
| | Duo Prime | Flex | Presto |
| Throughput level | Low to medium | Medium to high | Ultrahigh—integrates with robotic liquid handler |
| Processing volume range | <ul style="list-style-type: none"> • 50–1,000 µL: 12-pin magnet head • 200–5,000 µL: 6-pin magnet head | <ul style="list-style-type: none"> • 20–200 µL: 96-well plate • 50–1,000 µL: 96 deep-well plate* | <ul style="list-style-type: none"> • 50–150 µL: KingFisher 96 plate • 50–1,000 µL: 96 deep-well plate |
| Customizable protocols | Yes, with PC software | Yes, with PC software | Yes, with PC software |
| Samples per run | 6 or 12 | 24 or 96 | 24 or 96 |
| Heating/cooling | <ul style="list-style-type: none"> • 10°C to 75°C (plate row block A) • 4°C to 75°C (elution strip block) | From 5°C above ambient temperature to 115°C | From 5°C above ambient temperature to 115°C |
| Ultraviolet lamp | 8 W (up to 16 hr) | No lamp | No lamp |

* Other plate options available at thermofisher.com/kingfisherplastics

Learn more at thermofisher.com/kingfisher

Medium to high throughput: KingFisher Flex instrument

The KingFisher Flex instrument can process 96 samples per run when paired with 96 deep-well plastics and the 96 deep-well magnet head and heating block configuration (Cat. No. 24074431).

Features of this system include:

- High-throughput processing of up to 96 samples per run
- Easy to install and run (ready to run in 10 min or less)
- Choose from two plate formats for a wide volume range (20–1,000 μL)
- Download existing protocols from library, or easily customize protocols using Thermo Scientific™ BindIt™ Software

Learn more at thermofisher.com/kingfisherflex

Low throughput: KingFisher Duo Prime instrument

The KingFisher Duo Prime instrument (Cat. No. 5400110) can process 6 to 12 samples per run and is best suited for a small to intermediate number of samples.

Features of this system include:

- Low- to medium-throughput processing of 6 to 12 samples per run
- Easy to install and run (ready to run in 10 min or less)
- Choose from two plate formats for a wide volume range (20–5,000 μL)
- Download existing protocols from library, or easily customize protocols using BindIt Software

Learn more at thermofisher.com/kingfisherduoprime

Ultrahigh throughput: KingFisher Presto instrument

The KingFisher Presto instrument processes up to 96 samples per run. This instrument is best suited for a high number of samples per run and is specifically designed to be paired with your liquid handler of choice for fully automated nucleic acid isolation.

Features of this system include:

- Fully automated purification of up to 96 samples at a time
- Designed to easily integrate with several liquid handling instruments
- Volume range of 50–1,000 μL

Learn more at thermofisher.com/kingfisherpresto

Quick tip

If purchased separately, the KingFisher Flex 96-well plate configuration requires:

- KingFisher 96 Tip Comb for Deep-Well Magnets, 100/box (Cat. No. 97002534)
- KingFisher 96 Elution Plate (200 μL), 48 plates/box (Cat. No. 97002540)
- KingFisher 96 Deep-Well Plate, 50/box (Cat. No. 95040450)
- KingFisher 96 Deep-Well Magnetic Head (Cat. No. 24074430)



Customize your KingFisher instrument

BindIt Software

The KingFisher Flex and Duo Prime instruments are programmed to run using BindIt Software. This software allows you to easily create, modify, and store your protocols.

- Included with purchase of your KingFisher instrument
- Modify prewritten protocols, or create your own to handle more applications
- Add sample IDs for full traceability from the run report

Search our extensive library of automated protocols at thermofisher.com/kingfisherprotocols that can be tailored to your research needs.

KingFisher magnetic heads

KingFisher instruments have interchangeable magnetic heads for flexibility in sample volume.

- Can be easily switched without tools, depending on your plate setup, allowing you to run large or small volumes
- Magnet strong enough to attract magnetic beads contained in MagMAX or Thermo Scientific™ Dynabeads™ kits through the plastic tip comb

KingFisher plastics

Thermo Scientific™ KingFisher™ plastics were specifically designed for use with the KingFisher instruments. Both the yield and quality of isolated nucleic acid are significantly improved with these specialized plates and tip combs.

- Made of polypropylene
- Low binding affinity for biomolecules, ideal for magnetic particle processing

For SARS-CoV-2 nucleic acid extraction, the 96 deep-well plate (Cat. No. 95040450) is recommended for use on the KingFisher Flex instrument. Only approved KingFisher plastics should be used for optimal performance and to eliminate risk of damaging the instrument. See all KingFisher plastics products at thermofisher.com/kingfisherplastics.

Temporary changes to conserve plastics usage

Our R&D scientists have created temporary procedural changes related to the 96 deep-well plates to help customers efficiently complete SARS-CoV-2 testing. To conserve plastics and alleviate plastics shortages, the following temporary changes are recommended:

- Reduction from 3 wash steps to 2 wash steps for the MagMAX Viral/Pathogen kit and MagMAX Viral/Pathogen II kit
- Use of alternative plastic plates and tip combs for KingFisher instruments

Samples can be processed using an input volume of either 400 µL or 200 µL. The 200 µL input protocol requires half the amounts of nucleic acid isolation reagents per prep—see page 10 for details.

Reduction from 3 wash steps to 2 wash steps

Currently, the MagMAX Viral/Pathogen kit (Cat. No. A48310) and MagMAX Viral/Pathogen II kit (Cat. No. A48383) protocols for SARS-CoV-2 testing using the KingFisher Flex Purification System with 96 Deep-Well Head stipulate 3 wash steps and plates as shown in Table 2. Researchers can reduce the number of washes from 3 to 2, which will help reduce plastics usage as shown in Table 3.

Table 2. Protocol for 400 µL sample input with 3 wash steps (script name: MVP_Flex_400ul.bdz).

| Plate ID | Plate position | Plate type | Reagent | Volume per well |
|---------------|----------------|--|------------------|-----------------|
| Wash 1 plate | 2 | KingFisher deep-well 96 plate | Wash buffer | 1,000 µL |
| Wash 2 plate | 3 | | 80% ethanol | 1,000 µL |
| Wash 3 plate | 4 | | 80% ethanol | 500 µL |
| Elution plate | 5 | | Elution solution | 50 µL |
| Tip comb | 6 | Place a KingFisher 96 tip comb for deep-well magnets in a KingFisher 96 microplate | | |

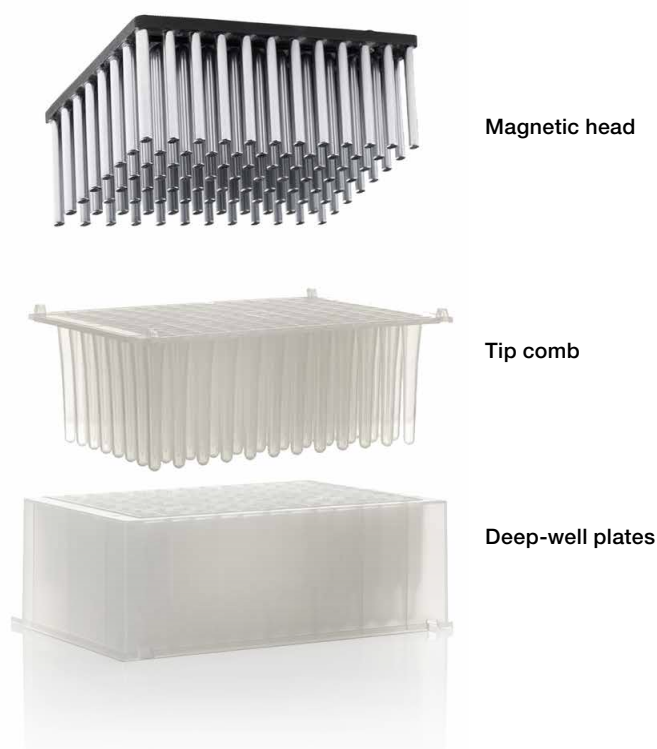
Table 3. Protocol for 400 µL sample input with 2 wash steps (script name: MVP_2Wash_400_Flex.bdz).

| Plate ID | Plate position | Plate type | Reagent | Volume per well |
|---------------|----------------|--|------------------|-----------------|
| Wash 1 plate | 2 | KingFisher deep-well 96 plate | Wash buffer | 1,000 µL |
| Wash 2 plate | 3 | | 80% ethanol | 1,000 µL |
| Elution plate | 4 | | Elution solution | 50 µL |
| Tip comb | 5 | Place a KingFisher 96 tip comb for deep-well magnets in a KingFisher 96 microplate | | |

Updated scripts may be obtained at thermofisher.com/magmaxviralpathogen or by editing the existing scripts according to Table 3.

96 deep-well configuration

50–1,000 µL



Alternative plastics for KingFisher instruments

The products in Table 4 can be used as alternatives for the existing Thermo Scientific™ KingFisher™ 96 deep-well, V-bottom plate (Cat. No. 95040450).

Table 4. Alternative deep-well plates for KingFisher instruments.

| Plate description | KingFisher instrument compatibility | Quantity | Cat. No. |
|-----------------------------------|-------------------------------------|--------------------|----------|
| New KingFisher 96 deep-well plate | Flex, Duo Prime | 50 plates per case | 95040455 |
| New KingFisher 96 deep-well plate | | | A48424* |
| New KingFisher 96 deep-well plate | Flex, Duo Prime, Presto | | A48305 |

* Not available in all regions.

The products in Table 5 can be used as alternatives for the existing Thermo Scientific™ KingFisher™ 96 tip comb for deep-well magnets (Cat. No. 97002534).

Table 5. Alternative 96 deep-well tip comb plastics for KingFisher instruments.

| Tip comb description | KingFisher instrument compatibility | Quantity | Cat. No. |
|---|-------------------------------------|------------------------|----------|
| New KingFisher 96 tip comb for deep-well plates | Flex, Presto | 100 tip combs per case | A48438 |
| New KingFisher 96 tip comb for deep-well plates | | | A48414* |

* Not available in all regions.

Ordering information

| Product | Quantity | Cat. No. |
|---|----------|----------|
| New KingFisher 96 deep-well plate, V-bottom, polypropylene | 50/box | A48305 |
| New KingFisher 96 deep-well plate (for Flex and Duo Prime instruments only) | 50/box | 95040455 |
| New KingFisher 96 deep-well plate (for Flex and Duo Prime instruments only) | 50/box | A48424* |
| New KingFisher 96 tip comb for deep-well plates | 100/box | A48438 |
| New KingFisher 96 tip comb for deep-well plates | 50/box | A48414* |
| KingFisher 96 tip comb presenting plate, Flex only (not for wash/elution steps) | 50/box | 267600 |

* Not available in all regions.

Find out more about KingFisher plastics at thermofisher.com/kingfisherplastics

MagMAX isolation kit recommendations

Customers already using the MagMAX Viral/Pathogen Nucleic Acid Isolation Kit for SARS-CoV-2 can continue to use this kit and apply the new protocols and procedures referenced throughout this guide. Customers who are new or switching from another kit should use the MagMAX Viral/Pathogen II Nucleic Acid Isolation Kit. Both kits contain the same buffers and reagents; however, there has been a raw material change in the brand of magnetic bead used for the MagMAX Viral/Pathogen II kit. The nucleic acid binding capacity of each bead type used in both kits provides equivalent results. These kits pair uniform, monosized superparamagnetic bead technology with optimized buffers and reagents to help ensure the highest reproducibility and binding efficiency, for greater viral nucleic acid capture. MagMAX Viral/Pathogen kits were specifically designed to be used with KingFisher instruments and plastics but can also be used manually with the Invitrogen™ Magnetic-Ring Stand (Cat. No. AM10050).



MagMAX Viral/Pathogen Nucleic Acid Isolation Kits

Features of these kits:

- Up to 2,000 preps
- Compatible with multiple sample types, including BD™ universal viral transport media, whole blood, serum, plasma, urine, nasal aspirates, and sputum (requires bead beating)
- Elution volumes ranging from 50 to 100 μ L
- Fast procedure allows for 96 samples to be processed in <40 min
- Optimized buffers for the highest binding efficiency
- Isolate RNA from SARS-CoV-2 quickly and efficiently using these kits on KingFisher instruments
- Buffers and reagents available for purchase in bulk formats for up to 2,000 reactions when using the 200 μ L input protocol—see page 10 for details

Ordering information*

| Product | Quantity | Cat. No. |
|---|-------------------|----------|
| MagMAX Viral/Pathogen Nucleic Acid Isolation Kit** | Up to 200 preps | A42352 |
| | Up to 2,000 preps | A48310 |
| MagMAX Viral/Pathogen II Nucleic Acid Isolation Kit | Up to 2,000 preps | A48383 |

* In order to support the unprecedented demand for the MagMAX Viral/Pathogen Nucleic Acid Isolation Kit for SARS-CoV-2 testing, we have created a new kit, the MagMAX Viral/Pathogen II Nucleic Acid Isolation Kit. This new kit contains the same buffers and reagents as the MagMAX Viral/Pathogen Nucleic Acid Isolation Kit. The only difference is a raw material change in the magnetic bead; however, the nucleic acid binding capacity of each bead type provides equivalent results between the two products.

** Due to high demand, we have instituted a temporary packaging change for the 100 prep kit to support rapid packing and shipping to labs.

SARS-CoV-2 virus inactivation and protocols

Guidelines

Various domestic and international public health organizations have published guidelines on sample handling for viral detection, particularly with respect to SARS-CoV-2. These guidelines generally agree that non-inactivated viral samples can be handled in a common Biosafety Level 2 (BSL-2) laboratory and that sample collection tubes should be uncapped inside a biosafety cabinet (BSC) prior to processing. Please visit [thermofisher.com/viralinactivation](https://www.thermofisher.com/viralinactivation) for more information on viral handling and inactivation guidelines.

SARS-CoV-2 research protocols

A new temporary protocol has been developed by our R&D staff that reduces sample input to help conserve precious viral samples for SARS-CoV-2 testing. Using the MagMAX Viral/Pathogen kit (Cat. No. A48310) and MagMAX Viral/Pathogen II kit (Cat. No. A48383), researchers can now perform viral RNA extraction with a sample input volume of 200 μ L rather than 400 μ L without compromising the quality or yield of extracted viral RNA.

The new protocol option:

- Reduces sample input volume from 400 μ L to 200 μ L
- Enables greater flexibility and testing capacity
- Doubles the amount of purified nucleic acid added into RT-qPCR without doubling the quantity of KingFisher extraction plates used

Inactivation of SARS-CoV-2

Viral inactivation will depend on how the sample is collected and stored. After collection, swab samples are generally stored in either a viral transport medium (VTM) meant to inactivate the virus or a VTM meant to preserve the sample but not inactivate the virus. In either case, the binding buffer present in the MagMAX Viral/Pathogen kits can be used for nucleic acid isolation and contains guanidine thiocyanate, which has been documented as an inactivation agent for many potential pathogens.*

Suggested protocol for viral inactivation in swab VTM:

1. Using a BSC hood, add MagMAX Viral/Pathogen Binding Solution to VTM and incubate for 15 min at room temperature.
 - For the 400 μ L input protocol, use 530 mL of MagMAX Viral/Pathogen Binding Solution and 400 μ L of VTM.
 - For the 200 μ L input protocol, use 265 mL of MagMAX Viral/Pathogen Binding Solution and 200 μ L of VTM. See Table 6 (page 10) for volumes of other reagents.
2. Prepare wash, elution, and tip comb plates. Add Proteinase K and beads to sample plate.
3. Run samples on KingFisher instrument.

Use your mobile phone's camera app to scan the QR code for immediate access to the user manual for viral nucleic acid isolation for 200 μ L or 400 μ L of sample.



Updated scripts that can be used on the KingFisher Flex instrument may be obtained at [thermofisher.com/magmaxviralpathogen](https://www.thermofisher.com/magmaxviralpathogen). See Figures 1 and 2 (page 10) for performance data and plastics usage for the new protocol option.

* The MagMAX buffers and reagents are specifically designed to be used together throughout the entirety of the extraction process. The MagMAX binding buffer used to inactivate viral samples is not optimally designed to work with buffers and reagents from other kits.

Table 6. Sample prep protocol for MagMAX Viral/Pathogen kits.

| | 400 μ L sample input | 200 μ L sample input |
|--|--|--|
| Component | Volume per well | |
| Proteinase K | 10 μ L | 5 μ L |
| Sample (or nuclease-free water for negative control) | 400 μ L | 200 μ L |
| Binding bead mix (binding solution + beads) | 550 μ L (530 μ L + 20 μ L) | 275 μ L (265 μ L + 10 μ L) |
| MS2 phage control | 10 μ L | 5 μ L |

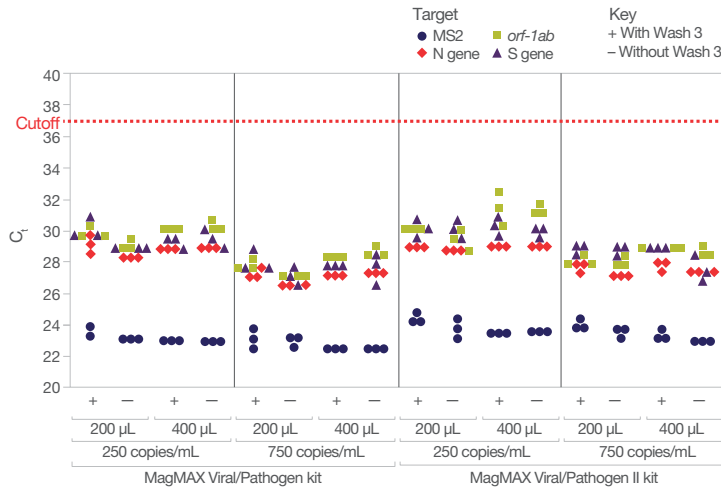


Figure 1. Equivalent performance demonstrated by measuring C_t values of spiked SARS-CoV-2 RNA.

The protocols for the MagMAX Viral/Pathogen kit and MagMAX Viral/Pathogen II kit result in equivalent RNA purification efficiency whether using 400 μ L or 200 μ L of sample input (and normalized going into the RT-qPCR reaction). Samples were processed on the KingFisher Flex Purification System with 96 Deep-Well Head (Cat. No. 5400630).

A. Plastics and reagents for 400 μ L input protocol

| I want to run this many samples | I need this many units | Description | No. of reactions | Quantity | Cat. No. |
|---------------------------------|------------------------|---|------------------|-------------|----------|
| 9,600 | 10 | KingFisher 96 deep-well plate | 960 | 50 pieces | 95040450 |
| | 3 | KingFisher 96 microplate (200 μ L) | 4,608 | 48 pieces | 97002540 |
| | 1 | KingFisher 96 tip comb for deep-well magnets | 9,600 | 100 pieces | 97002534 |
| Choose either: | | | | | |
| 9,600 | 10 | MagMAX Viral/Pathogen Nucleic Acid Isolation Kit | 1,000 | 1,000 preps | A48310 |
| | 10 | MagMAX Viral/Pathogen II Nucleic Acid Isolation Kit | 1,000 | 1,000 preps | A48383 |

B. Plastics and reagents for 200 μ L input protocol

| I want to run this many samples | I need this many units | Description | No. of reactions | Quantity | Cat. No. |
|---------------------------------|------------------------|---|------------------|-------------|----------|
| 9,600 | 10 | KingFisher 96 deep-well plate | 960 | 50 pieces | 95040450 |
| | 3 | KingFisher 96 microplate (200 μ L) | 4,608 | 48 pieces | 97002540 |
| | 1 | KingFisher 96 tip comb for deep-well magnets | 9,600 | 100 pieces | 97002534 |
| Choose either: | | | | | |
| 9,600 | 5 | MagMAX Viral/Pathogen Nucleic Acid Isolation Kit | 2,000 | 2,000 preps | A48310 |
| | 5 | MagMAX Viral/Pathogen II Nucleic Acid Isolation Kit | 2,000 | 2,000 preps | A48383 |

Figure 2. Plastics usage for 400 μ L input vs. 200 μ L input. Using this new protocol, researchers are able to process twice the number of samples with the same amount of plastics when reducing the amount of input from (A) 400 μ L to (B) 200 μ L per prep.

Pro tip

Utilize the new protocol with fewer wash steps as outlined on page 6 with this new protocol with a reduction in input sample volume from 400 μL to 200 μL to simultaneously reduce plastics usage and conserve viral samples. Use your mobile phone's camera app to scan the QR code for more information.



Supplemental information for inactivation binding solution

For more information on virus inactivation, see the following resources:

- Journal article: Ngo KA et al. (2017) Unreliable inactivation of viruses by commonly used lysis buffers. *Journal of ABSA International* 22:56–59.
– <https://journals.sagepub.com/doi/pdf/10.1177/1535676017703383>
- Journal article: Wang Y et al. (2004) Low stability of nucleocapsid protein in SARS virus. *Biochemistry* 43:11103–11108.
– <https://pubmed.ncbi.nlm.nih.gov/15323569/>
- Product page: eNAT™ specimen collection and transport device
– Basic composition from MSDS: guanidine thiocyanate (40–50%); N-lauryl sarcosine (0.1–0.25%)
– <https://www.copanusa.com/sample-collection-transport-processing/enat/>
- Product page: OMNIgene™ collection kits
– Basic composition from MSDS: sodium dodecyl sulfate (1–5%); glycine, N,N'-trans-1,2-cyclohexanediybis[N-(carboxymethyl)-, hydrate (1–5%); lithium chloride (1–5%)
– <https://www.dnagenotek.com/us/products/collection-microbiome/index.html> (relevant products are OMR-130, OMR-120, or OMR-110)
- Product information pages: PrimeStore™ Molecular Transport Medium
– Basic composition from MSDS: guanidine thiocyanate (0–50%); 96.5–99% ethanol (0–23%)
– <https://www.lhnvd.com/primestore-mtm>
– <https://www.lhnvd.com/coronavirus>

Liquid handling solutions and protocols

The MagMAX kit reagents can be dispensed into plastics manually or using fully automated systems. Thermo Scientific™ E1-ClipTip™ multichannel electronic pipettes are recommended for customers using manual techniques, and the Thermo Scientific™ Multidrop™ Combi Reagent Dispenser is recommended for customers who require higher-throughput solutions and less manual preparation time.

Manual liquid handling

The E1-ClipTip multichannel electronic pipettes can be used for rapid, accurate, and consistent filling to help save time and increase reproducibility when paired with the MagMAX Viral/Pathogen Nucleic Acid Isolation Kits.

Product features:

- Adjustable tip spacing to greatly facilitate the transfer of liquids from tubes to plates
- Can be programmed with the steps in the protocol to reduce errors and increase productivity
- Patented ClipTip™ technology to ensure consistent tip sealing for superior pipetting performance
- Unique design offers a highly ergonomic solution to help reduce strain and increase pipetting efficiency

For more information on ClipTip electronic and manual pipettes, go to [thermofisher.com/cliptip](https://www.thermofisher.com/cliptip)

Automated liquid handling

The Multidrop Combi Reagent Dispenser handles a wide selection of plates and volume ranges and provides fast dispensing and high-throughput operation. The instrument can be used for rapid, accurate, and consistent filling of the KingFisher wash and elution plates, which can then be stored at room temperature for 4 hr with an adhesive cover before use.*

Product features:

- Can dispense 100 µL into a full 96-well plate in 10 sec
- Dispense volumes range from 0.5 µL to 2.5 mL per well
- Can dispense 1 mL of solution into a full KingFisher 96 deep-well plate in under 2 min
- Dispenses with minimal dead volume, and back-flushing mechanism helps reduce reagent costs

For more information on the Multidrop reagent dispensers, go to [thermofisher.com/multidrop](https://www.thermofisher.com/multidrop)

* The dispensing cassettes are not RNase free, so it is important to run Invitrogen™ RNase AWAY™ Decontamination Reagent (Cat. No. 10328011) through the instrument, followed by nuclease-free water, before dispensing.

Lab decontamination solutions

Eliminating RNase and DNA contamination is imperative to avoiding false positives in downstream analysis. The following lab stabilization and decontamination products can be used in tandem with other products being used for SARS-CoV-2 research.

Invitrogen™ Nuclease-Free Water

- Endonuclease-, exonuclease-, DNase-, and RNase-free water that has been filtered, autoclaved, and rigorously tested according to ISO 9001 specifications
- DEPC-treated and non-DEPC-treated options available
- Compatible with products used for SARS-CoV-2 sample prep and analysis



Invitrogen™ RNAlater™ Solution for RNA storage and stabilization

- Aqueous, nontoxic tissue storage reagent that eliminates RNases and rapidly permeates tissue to stabilize and protect cellular RNA
- Room temperature–stable solution to store RNA at the bench, in the field, or at different time points, without the need for liquid nitrogen
- Compatible with products used for SARS-CoV-2 sample prep and analysis



Invitrogen™ nuclease-free buffers and reagents

- Use in your experiments involving RNA and DNA to prevent unwanted nuclease activity
- Quality checked for nonspecific endonuclease, exonuclease, and RNase activities
- Our selection includes Tris buffer, TE buffer, PBS, glycogen, Proteinase K solution, and more



Invitrogen™ RNaseZap™ Solution for surface decontamination

- RNase decontamination wipes or spray solution to rid pipettes, instruments, and hard-to-reach surfaces of RNases
- Invitrogen™ RNase AWAY™ Decontamination Reagent (Cat. No. 10328011), RNase-free tips (Cat. No. AM12650), and RNase-free tubes (Cat. No. AM12300) are also available
- Compatible with products used for SARS-CoV-2 sample prep and analysis



Invitrogen™ nuclease-free tips and tubes

- Autoclave-safe, nuclease-free tips and tubes that are compatible with other pipettor brands
- PCR, microcentrifuge, and conical tubes available
- Compatible with products used for SARS-CoV-2 sample prep and analysis

For more information on our RNA essentials products, go to [thermofisher.com/rnaessential](https://www.thermofisher.com/rnaessential)

Find out more at [thermofisher.com/coronavirus](https://www.thermofisher.com/coronavirus)

ThermoFisher
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