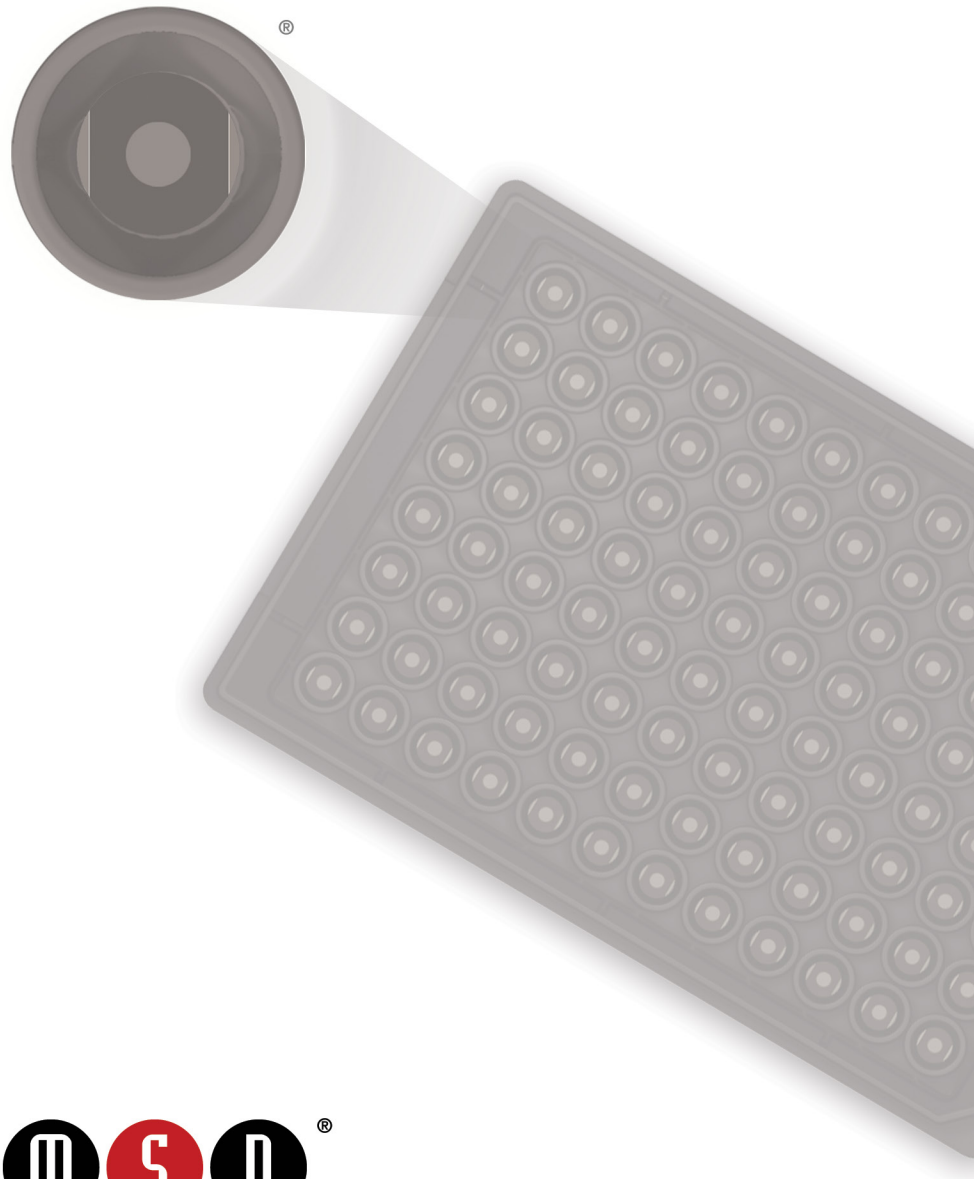
# MSD® S-PLEX Platform

## SARS-CoV-2 Spike Kit

S-PLEX® TrueSensitivity™



| | S-PLEX® |
|---|---|
| SARS-CoV-2 Spike Kit | K150ADJS |

# MSD S-PLEX Platform

## S-PLEX SARS-CoV-2 Spike Kit

**For the detection of Severe Acute Respiratory Syndrome Coronavirus 2 Spike protein (SARS-CoV-2 Spike) in human serum, EDTA plasma, saliva, and nasopharyngeal swab (upper respiratory) samples.**

**Instruments Supported:**

SECTOR™ plates for use on MESO® SECTOR S 600, MESO SECTOR® S 600MM, MESO QuickPlex® SQ 120, and MESO QuickPlex SQ 120MM instrument

QuickPlex® plates for use on MESO QuickPlex Q 60MM instrument

**FOR RESEARCH USE ONLY.**

**NOT FOR USE IN DIAGNOSTIC PROCEDURES.**

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# Table of Contents



# Contact Information

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# Introduction

The **S-PLEX SARS-CoV-2 Spike Kit** is an ultra-sensitive immunoassay developed using the S-PLEX platform. The assay measures Severe Acute Respiratory Syndrome Coronavirus 2 Spike protein (SARS-CoV-2 Spike) in human serum, EDTA plasma, saliva, and nasopharyngeal swab (upper respiratory) samples.

S-PLEX is MSD's ultra-sensitive assay platform. It can dramatically improve the sensitivity of immunoassays, thus reducing the lower limit of detection (LLOD) by 10- to 1000-fold over other assay methods. Results vary from assay to assay, but detection limits in the low femtogram/mL range are common. These low detection limits enable the measurement of analytes at lower concentrations, reduce required sample volumes, and reduce the use of critical reagents.

S-PLEX uses electrochemiluminescence (ECL) technology, retaining its well-known advantages and superior analytical performance. The improved sensitivity of S-PLEX is due, in part, to the new TURBO-TAG™ and TURBO-BOOST™ reagents. When TURBO-TAG is combined with an antibody labeled with TURBO-BOOST, more signal is generated than with other ECL formats that use SULFO-TAG™ as the detection label. The S-PLEX platform uses the same robust MSD® instruments as other MSD assays.

# Principle of the Assay

S-PLEX Assays use either S-PLEX 96-Well SECTOR or QuickPlex plates (Figure 1) that are coated with streptavidin. These plates provide high sensitivity, consistent performance, and excellent inter- and intralot precision. S-PLEX Kits are supplied with a biotinylated capture antibody, a TURBO-BOOST conjugated detection antibody, a calibrator, assay and antibody diluents, and S-PLEX specific reagents.

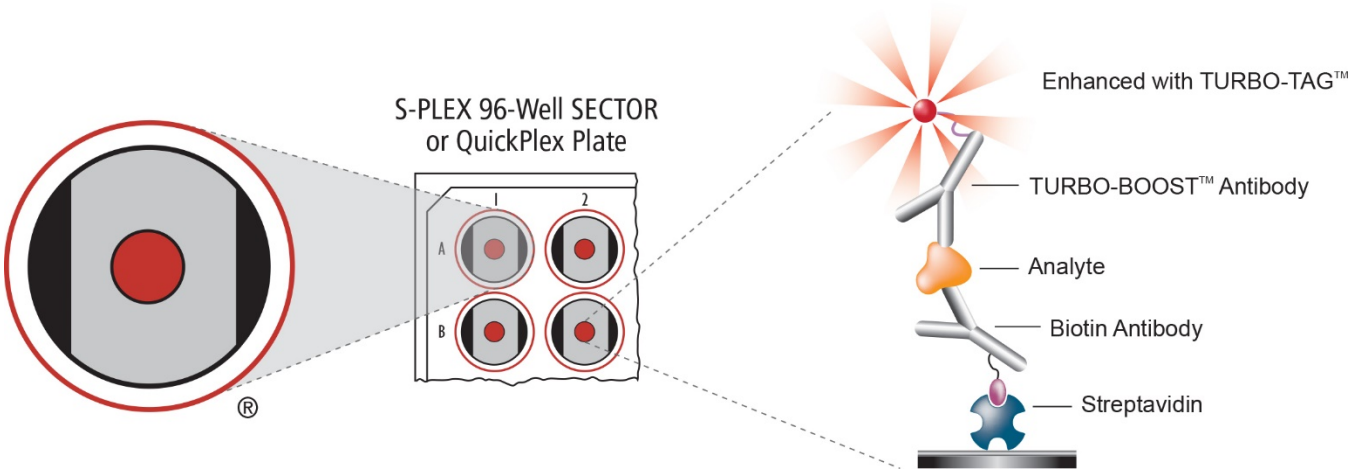


*Figure 1. S-PLEX Singleplex Assay on an S-PLEX 96-well SECTOR or QuickPlex plate.*

Performing an S-PLEX Assay is similar to other MSD assays. The protocol is simple, robust, and uses common laboratory techniques. A graphical representation of the protocol is shown in Figure 2. The steps are outlined below:

## ASSEMBLE

- ❑ Prepare coating solution containing biotin-conjugated capture antibody and S-PLEX Coating Reagent C1.
- ❑ Coat S-PLEX Plate.
- ❑ Add samples and calibrators.
- ❑ Add TURBO-BOOST detection antibody.

## ENHANCE

- ❑ Add S-PLEX enhance solution.
- ❑ Add S-PLEX detection solution. This detection solution includes the TURBO-TAG label that is required for the ECL signal. During this step, TURBO-TAG binds to the enhanced TURBO-BOOST. TURBO-BOOST or TURBO-TAG alone will not generate any signal.

## READ

- ❑ Add MSD Read Buffer and read on an MSD instrument.

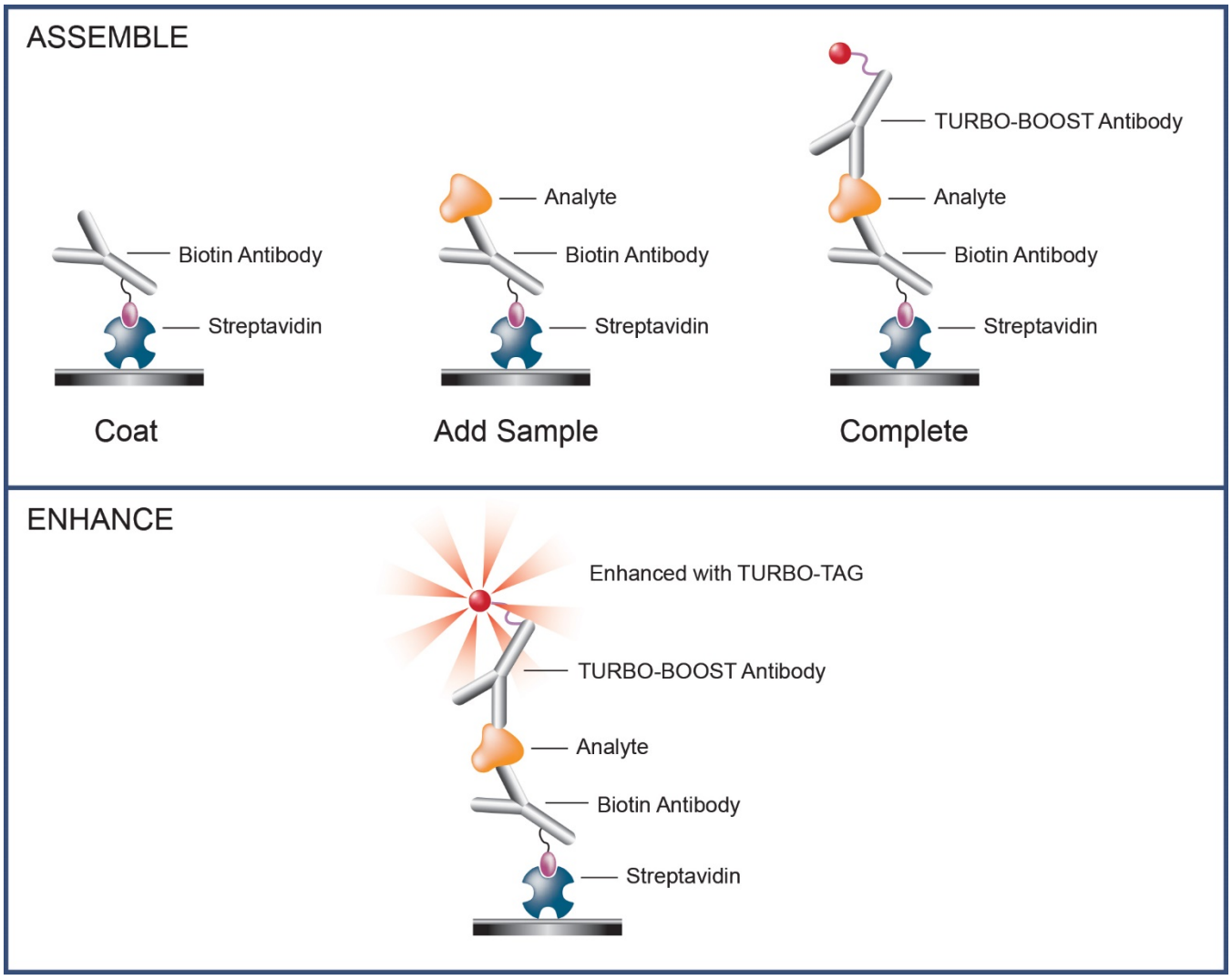


*Figure 2. S-PLEX Assay format on an S-PLEX 96-well SECTOR or QuickPlex plate.*

# Kit Components

S-PLEX Assay Kits are available as singleplex assays in 1-, 5-, and 25- plate sizes. S-PLEX Assay Kits include kit lot-specific (Table 1) and non-kit lot-specific reagents (Table 2). Assay kits are available in two plate formats compatible with either SECTOR or QuickPlex instruments (Table 3).

See the Catalog Numbers section (Table 11) for complete kit information.

**Note:**

Components will be packaged by storage conditions for ease of storage and shipping.

## Kit Lot-Specific Reagents and Components

*Table 1. Kit lot-specific reagents and components supplied with the S-PLEX SARS-CoV-2 Spike Kit*

| Reagent | Cap color | Storage | Catalog No. | Size | Quantity Supplied | | | Description |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1 Plate | 5 Plates | 25 Plates | |
| Biotin SARS-CoV-2 Spike Antibody‡ | ○ | 2–8 °C | C20ADJ-2 | 170 µL | 1 | — | — | Assay-specific biotinylated capture antibody |
| | | | C20ADJ-3 | 850 µL | — | 1 | 5 | |
| TURBO-BOOST SARS-CoV-2 Spike Antibody‡ | ● | 2–8 °C | D20ADJ-2 | 45 µL | 1 | — | — | TURBO-BOOST conjugated detection antibody |
| | | | D20ADJ-3 | 225 µL | — | 1 | 5 | |
| SARS-CoV-2 Spike Calibrator | — | ≤-70 °C | C00ADJ-2 | 1vial | 1 vial | 5 vials | 25 vials | Contains analyte of known concentration, used for creating the standard curve for each assay |
| S-PLEX Coating Reagent C1 (200X) | ● | ≤-70 °C | C20H0-3 | 300 µL | 1 | 1 | 5 | Reagent mixed with capture antibody for plate coating, enhances assay signals |
| Blocker S1 (100X) | ● | ≤-10 °C | R93AG-1 | 500 µL | 1 | 1 | 5 | Added to assay diluent, reduces nonspecific signals |
| S-PLEX Enhance E1 (4X) | ● | ≤-10 °C | R82AA-1 | 1.7 mL | 1 | 5 | 25 | Reagent 1 of 3 for Enhance Step |
| S-PLEX Enhance E2 (4X) | ● | ≤-10 °C | R82AB-1 | 1.7 mL | 1 | 5 | 25 | Reagent 2 of 3 for Enhance Step |
| S-PLEX Enhance E3 (200X) | ● | ≤-70 °C | R82AC-1 | 50 µL | 1 | 5 | 25 | Reagent 3 of 3 for Enhance Step |
| S-PLEX Detect D1 (4X) | ● | ≤-70 °C | D20K0-2 | 1.7 mL | 1 | 5 | 25 | Reagent 1 of 2 for detection step (contains TURBO-TAG label) |
| S-PLEX Detect D2 (200X) | ● | ≤-70 °C | D20J0-2 | 50 µL | 1 | 5 | 25 | Reagent 2 of 2 for detection step |
| Diluent 61 | — | ≤-10 °C | R50CD-1 | 8 mL | 1 bottle | — | — | Assay diluent for samples and calibrator |
| | | | R50CD-2 | 40 mL | — | 1 bottle | 5 bottles | |

All reagents listed above are kit lot specific. Lot-specific information for each assay can be found in the certificate of analysis (COA).
Dash (—) = not applicable
‡=Biotin and TURBO-BOOST antibodies are shipped as an Antibody Set (Catalog Nos. B20ADJ-2 for 1-plate and B20ADJ-3 for 5- and 25-plate sizes)

## Reagents Supplied with All Kits

*Table 2. Non-kit lot-specific reagents supplied with the S-PLEX SARS-CoV-2 Spike Kit*

| Reagent | Storage | Catalog No. | Size | Quantity Supplied | | | Description |
|---|---|---|---|---|---|---|---|
| | | | | 1 Plate | 5 Plates | 25 Plates | |
| Diluent 100 | 2–8 °C | R50AA-4 | 50 mL | 1 bottle | 1 bottle | 5 bottles | Coating buffer for capture antibody and S-PLEX Coating Reagent C1 |
| Diluent 59 | 2–8 °C | R50CB-2 | 8 mL | 1 bottle | — | — | Antibody diluent for diluting the TURBO-BOOST antibody |
| | | R50CB-4 | 40 mL | — | 1 bottle | 5 bottles | |
| MSD GOLD™ Read Buffer B | RT | R60AM-1 | 18 mL | 1 bottle | — | — | Buffer to catalyze the electrochemiluminescent reaction |
| | | R60AM-2 | 90 mL | — | 1 bottle | 5 bottles | |

RT = room temperature.
Dash (—) = not applicable

*Table 3. Plates supplied with the S-PLEX Kit and instrument compatibility*

| Reagent | Storage | Catalog No. | Quantity Supplied | | | Instrument Compatibility | Description |
|---|---|---|---|---|---|---|---|
| | | | 1 Plate | 5 Plates | 25 Plates | | |
| S-PLEX 96-Well SECTOR Plate | 2–8 °C | L45KA-1 | 1 plate | 5 plates | 25 plates | MESO SECTOR S 600<br>MESO SECTOR S 600MM<br>MESO QuickPlex SQ 120<br>MESO QuickPlex SQ 120MM | Plates for coating with capture antibodies |
| S-PLEX 96-Well QuickPlex Plate | 2–8 °C | L4BNA-1 | 1 plate | 5 plates | 25 plates | MESO QuickPlex Q 60MM | |

# Additional Materials and Equipment

## Materials

- ❑ Adhesive plate seals
- ❑ Micropipettes with filtered tips
- ❑ Tubes (polypropylene microcentrifuge tubes, conical tubes, library tubes)
- ❑ Serological pipettes and pipette controller
- ❑ Reagent reservoir
- ❑ Plastic bottles
- ❑ Wet ice and ice bucket
- ❑ Deionized water
- ❑ Molecular biology grade water
- ❑ MSD Wash Buffer (catalog no. R61AA-1) diluted to 1X
- ❑ Phosphate-buffered saline (PBS) plus 0.05% Tween-20 (PBS-T)

## Equipment

- ❑ Microtiter plate shaker capable of shaking at 500–1,000 rpm
- ❑ Microtiter plate shaker capable of shaking at 500–1,000 rpm and maintaining a controlled temperature of 27 °C (e.g., a Kisker heated plate shaker)
- ❑ Plate washing equipment (automated plate washer or multichannel pipette)
- ❑ Vortex mixer
- ❑ Water bath
- ❑ Microcentrifuge

# Safety

Use safe laboratory practices: wear gloves, safety glasses, and lab coats when handling assay components. Handle and dispose of all hazardous samples properly in accordance with local, state, and federal guidelines.

Additional product-specific safety information is available in the applicable safety data sheet(s), which can be obtained from MSD Customer Service or at the www.mesoscale.com® website.

# Best Practices

- Mixing or substituting reagents from different sources or different kit lots is not recommended. Lot information is provided in the lot-specific COA.
- Bring frozen diluents to room temperature in a 22–25 °C water bath before use. If a controlled water bath is not available, thaw at room temperature. Ensure that diluents are fully thawed and equilibrated to room temperature before use. Mix well after thawing and before use.
- To avoid cross-contamination between vials, open vials for one protocol step at a time (vial caps are color-coded). Close the cap after use. Use filtered pipette tips, and use a fresh pipette tip for each reagent addition.
- Prepare calibrators and samples in polypropylene microcentrifuge tubes. Use a fresh pipette tip for each dilution and mix by vortexing after each dilution.
- Avoid bubbles in wells during all pipetting steps as they may lead to variable results. Bubbles introduced when adding read buffer may interfere with signal detection.
- Use reverse pipetting when necessary to avoid the introduction of bubbles. For empty wells, pipette gently to the bottom corner. Do not touch the pipette tip on the bottom of the wells when pipetting into the MSD plate.
- Plate shaking should be vigorous, with a rotary motion between 500 – 1,000 rpm. Binding reactions may reach equilibrium sooner if shaken in the middle of this range (~700 rpm) or above.
- Use a new adhesive plate seal for all incubation steps.
- When using an automated plate washer, use individual wash cycles, and rotate the plate 180 degrees between wash steps to improve assay precision and reduce potential assay issues due to washing.
- When performing manual plate washing using a multichannel pipette, plates should be washed using at least 150 µL of wash buffer per well.
- Gently tap the plate on a paper towel to remove residual fluid after washing.
- Avoid excessive drying of the plate during washing steps. Add solutions to the plate immediately after washing.
- Remove the plate seal before reading the plate.
- Make sure that the read buffer is at room temperature when adding to the plate.
- Do not shake the plate after adding read buffer.
- To improve interplate precision, keep time intervals consistent between adding read buffer and reading the plate. Unless otherwise directed, read the plate as soon as possible after adding read buffer.
- If the sample results are above the top of the calibration curve, dilute the samples and repeat the assay.
- If the sample requires higher dilutions, Diluent 100 may be used in place of assay diluent.
- When running a partial plate, seal the unused sectors to avoid contaminating unused wells. Remove all seals before reading. Partially used plates may be stored up to 30 days at 2–8 °C in the original foil pouch with desiccant. You may adjust volumes proportionally when preparing reagents.
- Avoid prolonged exposure of the S-PLEX Detect D1 reagent and detection solutions to light. Keep stocks of S-PLEX Detect D1 reagent in the dark. During the detection incubation step, plates do not need to be shielded from light except for direct sunlight.
- When washing S-PLEX Assays, the best results are obtained by using a low dispense flow rate and by positioning dispenser tips at the outer edge of the well (e.g., horizontal dispense offset towards the left side of the well). This is most important after the detection solution incubation step. See **Appendix A** for more information on plate washing recommendations.

# Recommended Protocol

Bring all reagents to room temperature and refer to the **Best Practices** section (above) before beginning the protocol.

**Important**: Upon the first thaw, aliquot Diluent 61 into suitable volumes before refreezing.

Reagents prepared at each step are sufficient for a one-plate experiment.

*CAUTION: Concentrations of SARS-CoV-2 protein in some clinical sample types have a wide range and can be orders of magnitude above the upper end of the assay range. To avoid inaccurate results due to cross-contamination of samples, it is very important to change pipette tips between each set of sample replicates at both the sample addition and TURBO-BOOST reagent addition steps.*

A sample plate layout is shown in Figure 6 (last page).

## STEP 1: ASSEMBLE

### Prepare Coating Solution

Biotinylated capture antibody is provided as a 40X stock solution and S-PLEX Coating Reagent C1 as a 200X stock solution. Thaw the frozen vials and bring all reagents to room temperature. Vortex each vial to mix, and spin down briefly before use.

Prepare the coating solution immediately before use by combining the following reagents. Vortex briefly to mix.

- ❑ 5,820 µL Diluent 100
- ❑ 150 µL of Biotin SARS-CoV-2 Spike Antibody ○
- ❑ 30 µL of 200X S-PLEX Coating Reagent C1 ●

**Notes:**

- CRITICAL: Failure to add S-PLEX Coating Reagent C1 in the coating solution will drastically reduce the assay signal.
- The unused S-PLEX Coating Reagent C1 should be frozen immediately after use. The reagent is stable through 5 freeze-thaw cycles.

### Coat the Plate

- ❑ Wash the uncoated plates 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T. Prewashing the plate has been shown to increase signals and improve sensitivity in many assays.
- ❑ Add 50 µL of the coating solution to each well. Tap the plate gently on all sides. Seal the plate with an adhesive plate seal and incubate with shaking (~700 rpm) at room temperature for 1 hour or overnight at 2–8 °C. Shaking is not required for the overnight coating incubation step.

**Note:** While the coated plate is incubating, prepare the blocking solution, calibrators, and diluted samples.

### Prepare Blocking Solution

Blocking solution is the assay diluent supplemented with Blocker S1, and it is designed to reduce nonspecific binding in the sample matrix. Blocker S1 is provided as a 100X stock solution. Thaw the frozen vials and bring all reagents to room temperature. Vortex each vial to mix and spin down briefly before use.

Prepare the blocking solution by combining the following reagents. Vortex briefly to mix.

- ❑ 3,465 µL of Diluent 61
- ❑ 35 µL of 100X Blocker S1 ◍

Notes:

- One vial of Blocker S1 is sufficient for blocking 5 plates. If fewer than 5 plates are run, the unused Blocker S1 should be frozen immediately after use. The reagent is stable through 5 freeze-thaw cycles.
- The blocking solution should be added to the plate before sample addition.

## Prepare Calibrator Dilutions

MSD supplies a stock liquid calibrator at a concentration that is 20-fold higher than the recommended highest standard. We recommend a 7-point calibration curve with 4-fold serial dilution steps and a zero calibrator blank (Figure 3). Thaw the stock calibrator and keep on ice, then add to Diluent 61 at room temperature to make the calibration curve solutions.

**Note:** Discard any unused, diluted calibrator solutions. For the lot-specific concentration of the calibrator, refer to the COA supplied with the kit. You can also find the COA at www.mesoscale.com.

Prepare the seven standard solutions plus a zero standard for up to 4 replicates (Figure 3):

- ❑ Prepare Standard 1 by adding 15 µL of stock calibrator to 285 µL of Diluent 61. Mix by vortexing.
- ❑ Prepare the next standard solution (Standard 2) by transferring 50 µL of Standard 1 to 150 µL of Diluent 61. Mix by vortexing. Repeat 4-fold serial dilution 5 times to generate Standards 3-7. Mix by vortexing between each serial dilution.
- ❑ Use Diluent 61 as Standard 8 (zero standard).

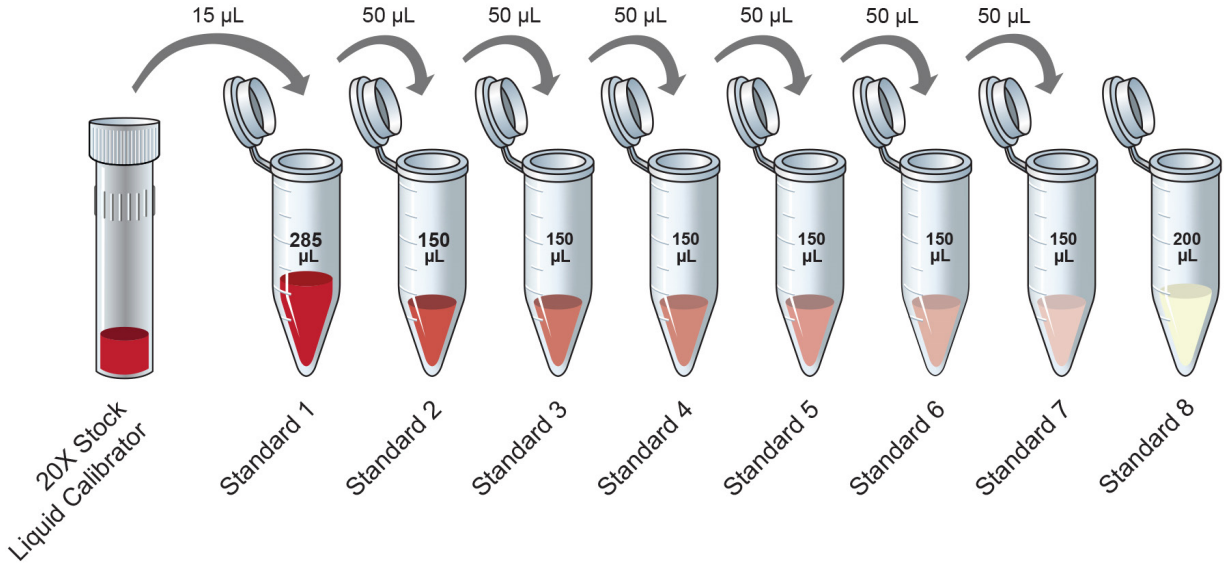


*Figure 3. Dilution schema for preparation of calibrator standards.*

## Sample Collection and Handling

The stability of SARS-CoV-2 Spike in clinical samples has not been established. General guidelines are presented below for sample collection, storage, and handling. If possible, use published guidelines.[1-5] Evaluate sample stability under the selected method as needed.

**Serum and plasma**: When preparing serum, allow samples to clot for 2 hours at room temperature. If there are visible particulates, centrifuge for 20 minutes at 2,000 × *g* before using or freezing. Collect plasma using EDTA, heparin, or citrate as an anticoagulant. Centrifuge for 20 minutes at 2,000 × *g* within 30 minutes of collection. Use immediately or freeze.

**Respiratory Swabs**: Swab samples should be collected in a non-denaturing transport media such as viral transport medium. Avoid the use of extraction buffers that include protein denaturants that could interfere with antibody recognition of the analyte. Most viral transport media (e.g., UTM) should provide acceptable performance. Other buffers may need to be evaluated for potential interference.

**Saliva**: Saliva samples may be tested undiluted, however, if saliva samples tend to be nonhomogeneous consider diluting 1:4 in Diluent 61 and centrifuging to remove particulates before testing.

**Other samples**: Use immediately or freeze.

Freeze all samples in suitably sized aliquots; they may be stored at ≤-10 °C until needed. Repeated freeze-thaw of samples is not recommended. After thawing, centrifuge samples at 2,000 × *g* for 3 minutes to remove particulates before sample preparation. Hold on wet ice or at 2–8 °C until used in the assay.

## Dilute Samples

Samples were tested neat for measuring SARS-CoV-2 Spike. The assay requires 25 µL/well of sample. You may conserve sample by using a higher dilution. The dilution factor for other sample types will need to be optimized. Additional diluent can be purchased at www.mesoscale.com.

## Add Calibrators and Sample

**Note**: To prevent cross-contamination of samples, replace pipette tips between wells containing different samples.

- ❑ After coating incubation completion, wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 25 µL of blocking solution to each well. Tap the plate gently on all sides.
- ❑ Add 25 µL of calibrator or sample to each well.
- ❑ Seal the plate with an adhesive plate seal and incubate with shaking (~700 rpm) at room temperature for 1.5 hours.

## Prepare TURBO-BOOST Antibody Solution

TURBO-BOOST detection antibody is provided as a 200X stock solution. The working solution is 1X. Prepare the detection antibody solution immediately before use. Bring all reagents to room temperature. Spin down the vial before use.

Prepare the TURBO-BOOST antibody solution by combining the following reagents. Vortex briefly to mix.

- ❑ 5,970 µL of Diluent 59
- ❑ 30 µL of TURBO-BOOST SARS-CoV-2 Spike Antibody 

## Add TURBO-BOOST Antibody Solution

**Note**: To prevent cross-contamination of samples, replace pipette tips between wells containing different samples.

- ❑ After calibrator and sample incubation, wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of TURBO-BOOST antibody solution to each well.
- ❑ Seal the plate with an adhesive plate seal and incubate with shaking (~700 rpm) at room temperature for 1 hour.

**Note:** While the TURBO-BOOST antibody solution is incubating, thaw 1 vial each of S-PLEX Enhance E1, E2, and E3 reagents at room temperature.

# STEP 2: ENHANCE

## Prepare Enhance Solution

Prepare enhance solution up to 30 minutes before use. Thaw the frozen vials and bring all reagents to room temperature. Vortex each vial to mix and spin down briefly before use.

Prepare enhance solution by combining the following reagents. Vortex briefly to mix.

- ❑ 2,970 µL Molecular Biology Grade water
- ❑ 1,500 µL of 4X S-PLEX Enhance E1
- ❑ 1,500 µL of 4X S-PLEX Enhance E2
- ❑ 30 µL of 200X S-PLEX Enhance E3

**Note:** S-PLEX Enhance E3 stock solution is viscous. Pipette slowly to avoid bubble formation in the pipette tip and to ensure accurate pipetting volume.

## Add Enhance Solution

- ❑ After TURBO-BOOST antibody incubation, wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of enhance solution to each well.
- ❑ Seal the plate with an adhesive plate seal and incubate with shaking (~700 rpm) at room temperature for **30 minutes**.

**Note:** While the enhance solution is incubating, thaw 1 vial each of S-PLEX D1 and D2 reagents at room temperature.

## Prepare TURBO-TAG Detection Solution

Prepare the TURBO-TAG detection solution up to 30 minutes before use. Thaw the frozen vials and bring all reagents to room temperature. Vortex each vial to mix and spin down briefly before use.

Prepare TURBO-TAG detection solution by combining the following reagents. Vortex briefly to mix.

- ❑ 4,470 µL Molecular Biology Grade water
- ❑ 1,500 µL of 4X S-PLEX Detect D1
- ❑ 30 µL of 200X S-PLEX Detect D2

**Notes:**

- **CRITICAL:** Avoid prolonged exposure of the S-PLEX Detect D1 reagent and detection solution to light.
- S-PLEX Detect D2 solution is viscous. Pipette slowly to avoid bubble formation in the tip and to ensure accurate pipetting volume.
- **CRITICAL:** The TURBO-TAG detection incubation (next step) requires incubation at 27 °C. Upon completion of the enhance solution incubation, prepare a shaker at 27 °C.

### Add TURBO-TAG Detection Solution

- ❑ After the enhance solution incubation, wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of TURBO-TAG detection solution to each well.
- ❑ Seal the plate with an adhesive plate seal and incubate with shaking (~700 rpm) at 27 °C for 1 hour.

Note: CRITICAL: The incubation temperature for this step can affect the background and assay signals, thereby affecting the assay sensitivity. It is highly recommended that TURBO-TAG detection be performed at 27 °C. If you do not have access to a temperature-controlled shaker, a plate shaker can be placed inside an incubator maintaining 27 °C.

## STEP 3: READ

MSD provides MSD GOLD Read Buffer B ready for use. Do not dilute.

### Add Read Buffer

- ❑ After TURBO-TAG detection incubation, wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T using a gentle wash step.

Note: CRITICAL: For this final wash step, the best results are obtained by using a low dispense flow rate and by positioning dispense tips at the outer edge of the well (e.g., horizontal dispense offset towards the left side of the wall). See Appendix A for more information on plate washing recommendations if using an automated plate washer.

- ❑ Add 150 µL of MSD GOLD Read Buffer B to each well and read on an MSD reader. Incubation in MSD GOLD Read Buffer B is not required before reading the plate.

Note: CRITICAL: Refer to the plate-instrument compatibility table (Table 3) to ensure the correct plate is read on the compatible instrument. SECTOR plates are compatible with SECTOR and QuickPlex SQ instruments. QuickPlex plates are ONLY compatible with the QuickPlex Q 60MM instrument.

# Assay Performance

A representative data set for the S-PLEX SARS-CoV-2 Spike assay is presented below (Figure 4) and is also available at www.mesoscale.com. The data represent the performance of the assay tested in singleplex format. The data were generated during the development of the assay and do not represent the product specifications. Under your experimental conditions, the assay may perform differently than the representative data shown.

## Representative Calibrator Curve and Sensitivity

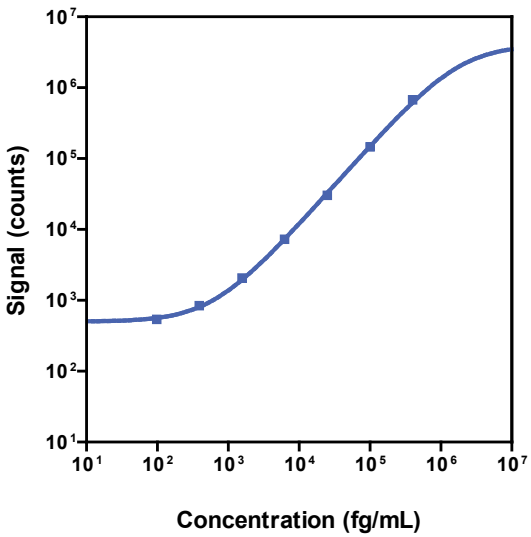


*Figure 4. Typical calibrator curve for the S-PLEX SARS-CoV-2 Spike Kit.*

*Table 4. LLOD, LLOQ, and ULOQ for the S-PLEX SARS-CoV-2 Spike Kit*

| Dilution from Stock Liquid Calibrator to Standard 1 (top of curve) | 20X |
|---|---|
| Tested Sample Dilution | Neat |
| LLOD (fg/mL) | 95 |
| LLOQ (fg/mL) | 350 |
| ULOQ (fg/mL) | 260,000 |

The calibration curves used to calculate analyte concentrations were established by fitting the signals from the calibrators using a 4-parameter logistic (or sigmoidal dose-response) model with a $1/Y^2$ weighting. The lower limit of detection (LLOD; Table 4) is a calculated concentration corresponding to the signal 2.5 standard deviations above the background (zero Standard). The upper limit of quantification (ULOQ; Table 4) is the highest concentration at which the CV of calculated concentration is <25% and the recovery of each analyte is within 75% to 125% of the known value. The lower limit of quantification (LLOQ; Table 4) is the lowest concentration at which the CV of calculated concentration is <25% and the recovery of each analyte is within 75% to 125% of the known value. Analyte concentrations were determined from the ECL signals by back-fitting to the calibration curve.

# Tested Samples

Normal human serum, EDTA plasma, and saliva samples were tested without dilution (Table 5). COVID-19 positive and negative human nasopharyngeal swab (upper respiratory) samples in transport medium were also tested without dilution.

*Table 5. Samples tested in the S-PLEX SARS-CoV-2 Spike Kit*

| Statistics | Nasopharyngeal Swab (Positive) (N = 12) | Nasopharyngeal Swab (Negative) (N = 6) | Saliva (N = 6) | Serum (N = 6) | EDTA Plasma (N =6) |
|---|---|---|---|---|---|
| Median (fg/mL) | 41,000 | ND | ND | ND | 93 |
| Range (fg/mL) | ND–AS | ND | ND | ND | ND–140 |

AS = above Standard 1
ND = not detectable (<LLOD)

# Dilution Linearity

Normal human serum, EDTA plasma, saliva, and COVID-19 negative human nasopharyngeal swab (upper respiratory) samples were spiked with calibrator and tested at different dilutions (Table 6). Percent recovery at each dilution level was normalized to the dilution-adjusted, neat concentration. Samples may require additional dilution with assay diluent to reduce matrix effects.

$$\%\, recovery = \frac{measured\ concentration}{expected\ concentration} \times 100$$

*Table 6. Analyte percent recovery at various fold dilutions for each sample type*

| Fold Dilution | Nasopharyngeal Swab | | Saliva | | Serum | | EDTA Plasma | |
|---|---|---|---|---|---|---|---|---|
| | Average % Recovery | % Recovery Range | Average % Recovery | % Recovery Range | Average % Recovery | % Recovery Range | Average % Recovery | % Recovery Range |
| Neat | 100 | — | 100 | — | 100 | — | 100 | — |
| 2 | 105 | 99–115 | 102 | 92–108 | 101 | 96–108 | 100 | 93–111 |
| 4 | 107 | 98–120 | 105 | 94–113 | 102 | 94–117 | 100 | 92–114 |
| 8 | 113 | 98–124 | 112 | 107–124 | 107 | 95–132 | 100 | 92–118 |

Dash (—) = not applicable

# Spike Recovery

Normal human serum, EDTA plasma, saliva, and COVID-19 negative human nasopharyngeal swab (upper respiratory) samples were spiked with calibrator at 3 levels (Table 7). Spiked samples were tested without dilution. Samples may require additional dilution with assay diluent to reduce matrix effects.

$$\%\ recovery = \frac{measured\ concentration}{expected\ concentration} \times 100$$

*Table 7. Recovery of different sample types at three spiked levels*

| Spike Level | Nasopharyngeal Swab | | Saliva | | Serum | | EDTA Plasma | |
|---|---|---|---|---|---|---|---|---|
| | Average % Recovery | % Recovery Range | Average % Recovery | % Recovery Range | Average % Recovery | % Recovery Range | Average % Recovery | % Recovery Range |
| High | 93 | 84–99 | 99 | 86–115 | 106 | 89–114 | 132 | 99–153 |
| Mid | 93 | 82–108 | 98 | 83–118 | 102 | 94–108 | 136 | 102–152 |
| Low | 98 | 92–104 | 101 | 89–113 | 105 | 90–115 | 142 | 108–165 |

# Assay Components

## Calibrators

The assay calibrator (Table 8) uses the recombinant SARS-CoV-2 Spike protein.

*Table 8. Recombinant protein used in the calibrator*

| Calibrator | Expression System |
|---|---|
| SARS-CoV-2 Spike | *Human cell line* |

The antibody source species are described in Table 9.

## Antibodies

*Table 9. Antibody source species*

| Analyte | MSD Capture Antibody | MSD Detection Antibody | Assay Generation |
|---|---|---|---|
| SARS-CoV-2 Spike | Mouse Monoclonal | Mouse Monoclonal | A |

# References


1. Bowen RA, et al. Impact of blood collection devices on clinical chemistry assays. Clin Biochem. 2010;43:4-25.
2. Zhou H, et al. Collection, storage, preservation, and normalization of human urinary exosomes for biomarker discovery. Kidney. 2006;69:1471-6.
3. Thomas CE, et al. Urine collection and processing for protein biomarker discovery and quantification. Cancer Epidemiol Biomarkers & Prevention. 2010;19:953-9.
4. Schoonenboom NS, et al. Effects of processing and storage conditions on amyloid beta (1-42) and tau concentrations in cerebrospinal fluid: implications for use in clinical practice. Clin Chem. 2005;51:189-95.
5. Girgrah N, et al. Purification and characterization of the P-80 glycoprotein from human brain. Biochem J. 1988;256:351-6.

# Appendix A: Recommended Plate Washer Parameters

When using an automated plate washer for S-PLEX Assays, best results are obtained by using a low dispense flow rate and by positioning dispense tips at the outer edge of the well (e.g., horizontal dispense offset towards the left side of the well). This low flow rate dispense program is recommended for washing after the detection step in S-PLEX Assays; all other steps can use default wash programs. However, for convenience, plates can be washed using the low dispense flow rate program for all S-PLEX Assay wash steps.

We recommend creating a new program for your automated plate washer with the optimal settings before starting your S-PLEX Assay. Example settings for a typical (MSD-recommended) wash program and the S-PLEX program are shown below (Table 10) for a common plate washer (Biotek Model 405 LS). The only difference from typical wash program settings are the Dispense Rate and Dispense X-Position.

*Table 10. Parameters for customized programs on the Biotek 405 LS microplate washer*

| Wash Program Parameters | Typical Wash Program Settings | Recommended S-PLEX Wash Program Settings |
|---|---|---|
| Plate type | 96 | 96 |
| CYCLES | | |
| Wash cycles | 3 | 3 |
| ASPIRATION | | |
| Aspirate Type | TOP | TOP |
| Travel Rate | 1 (4.1% 1.0 mm/second) | 1 (4.1% 1.0 mm/second) |
| Aspirate Delay | 0500 milliseconds | 0500 milliseconds |
| Aspirate X-Position | -35 (1.600 mm) | -35 (1.600 mm) |
| Aspirate Y-Position | -35 (1.600 mm) | -35 (1.600 mm) |
| Aspirate Height | 22 | 22 |
| Secondary Aspirate? | NO | NO |
| DISPENSE | | |
| Dispense Rate | 05 | 02 |
| Dispense Volume | 0300 µL/well | 0300 µL/well |
| Vacuum Delay Volume | 0300 µL/well | 0300 µL/well |
| Dispense X-Position | 00 (0.000 mm) | -35 (1.600 mm) |
| Dispense Y-Position | 00 (0.000 mm) | 00 (0.000 mm) |
| Dispense Height | 120 (15.245 mm) | 120 (15.245 mm) |
| OPTS | | |
| PRE | | |
| Wash Pre dispense? | NO | NO |
| Bottom Wash? | NO | NO |
| MIDCYC | | |
| Wash Shake? | NO | NO |
| Wash Soak? | NO | NO |
| Home Carrier? | NO | NO |
| Between Cycle Pre Dispense? | NO | NO |
| POST | | |
| Final Aspirate? | YES | YES |
| Aspirate Type | TOP | TOP |
| Travel Rate | 3 | 3 |
| Final Aspirate Delay | 0500 milliseconds | 0500 milliseconds |
| Final Aspirate X-Position | -35 (1.600 mm) | -35 (1.600 mm) |
| Final Aspirate Y-Position | -35 (1.600 mm) | -35 (1.600 mm) |
| Final Aspirate Height | 22 | 22 |
| Secondary Aspirate? | YES | YES |
| Final Aspirate Secondary X-Position | 35 (1.600 mm) | 35 (1.600 mm) |
| Final Aspirate Secondary Y-Position | 35 (1.600 mm) | 35 (1.600 mm) |
| Final Aspirate Secondary Height | 22 | 22 |

# Appendix B: Frequently Asked Questions

- **Can I use a 1-step dilution to make the top standard instead of using a 2-step or 3-step dilution?**

  You can perform dilutions with volumes other than defined in the protocol. We recommend not to pipette volumes less than 10 µL. If using volumes less than 10 µL, ensure that pipettes are appropriately calibrated to accurately dispense small volumes.

  Make sure you prepare ~150 µL of Standard 1 after performing intermediate dilutions.

  However, for consistent and reproducible performance, we recommend following the instructions as outlined in the protocol.

- **Can I extend capture, sample, and detection antibody incubation times?**

  The best practice is to follow the S-PLEX protocol as outlined in this product insert. The plate coating step can be extended overnight, however. Once coating solution is added, store the plate overnight at 2–8 ºC without shaking. Equilibrate the plate to room temperature before proceeding with the next step.

- **Can all plate incubation steps be performed at 27 °C?**

  Yes. In our study, no changes in sensitivity and minimal signal differences were observed when all incubations were conducted at 27 °C.

- **Can the recommended plate washer program be used throughout the entire protocol?**

  Yes. However, the recommended washing program is most important after the TURBO-TAG incubation step.

- **Is it possible to store any of the working solutions after the components are mixed? If so, for how long and at what temperatures?**

  All working solutions are stable at room temperature for 30 minutes. For longer periods, they should be stored on ice. They can be stored at 2–8 °C for up to 4 hours. Equilibrate each solution to room temperature 10–15 minutes before use.

- **When should I thaw my reagents?**

  **Enhance Solution**: Start thawing E1, E2, and E3 at room temperature 30 minutes after the start of TURBO-BOOST antibody incubation.

  **TURBO-TAG Detection Solution**: Start thawing D1 and D2 at room temperature, right after the start of the incubation in enhance solution.

- **Which reagents are recommended to be stored on ice? What stocks should be stored in the dark?**

  If either E3 or D2 needs to be used repeatedly, we recommend storing them on ice (they rapidly thaw completely on ice). D1 should be treated similarly to SULFO-TAG conjugated antibodies, and prolonged light exposures should be avoided.

- **For which assay steps is molecular-grade water essential? Must it be used to prepare wash buffer?**

  Wash buffer can be prepared using deionized water. Use molecular-grade water to prepare the enhance/detect reagents.

- **Can Milli-Q water be used instead of molecular-grade water in the enhance/detect steps?**

  We recommend molecular-grade water because of its known qualities and rigorous testing. If the Milli-Q water is known to be of high quality and not contaminated, Milli-Q water can be used.

- **What volume of wash buffer is needed during plate washing?**

  We recommend at least 150 µL of wash buffer per well for each washing step. However, if an automated plate washer is used adjust the volume as per the guidance in **Appendix A**.

# Summary Protocol

## STEP 1: ASSEMBLE

### Coat Plate with Biotin Antibody

- ❑ Prewash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of coating solution containing biotinylated capture antibody and Coating Reagent C1 to each well. Tap the plate gently on all sides. Seal the plate with an adhesive plate seal.
- ❑ Incubate at room temperature with shaking (700 rpm) for 1 hour, or overnight without shaking at 2–8 °C.

### Add Samples and Calibrators

- ❑ Wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 25 µL of blocking solution to each well. Tap the plate gently on all sides.
- ❑ Add 25 µL of calibrator or sample to each well. Seal the plate with an adhesive plate seal.
- ❑ Incubate at room temperature with shaking (700 rpm) for 1.5 hours.

### Add TURBO-BOOST Antibody Solution

- ❑ Wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of TURBO-BOOST antibody solution to each well. Seal the plate with an adhesive plate seal.
- ❑ Incubate at room temperature with shaking (700 rpm) for 1 hour.

## STEP 2: ENHANCE

### Add Enhance Solution

- ❑ Wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of enhance solution to each well. Seal the plate with an adhesive plate seal.
- ❑ Incubate at room temperature with shaking (700 rpm) for 30 minutes.

### Add TURBO-TAG Detection Solution

- ❑ Wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T.
- ❑ Add 50 µL of TURBO-TAG detection solution to each well. Seal the plate with an adhesive plate seal.
- ❑ Incubate at 27 °C in a temperature-controlled shaker with shaking (700 rpm) for 1 hour.

## STEP 3: READ

### Add Read Buffer

- ❑ Wash the plate 3 times with at least 150 µL/well of 1X MSD Wash Buffer or PBS-T using a washer program with low dispense speed. See **Appendix A** for more details.
- ❑ Add 150 µL of MSD GOLD Read Buffer B to each well. Read the plate on an MSD instrument. Incubation in MSD GOLD Read Buffer B is not required before reading the plate.

# Catalog Numbers

*Table 11. Catalog numbers for the S-PLEX SARS-CoV-2 Spike Kits*

| Kit Name | SECTOR Plate | | | QuickPlex Plate | | |
|---|---|---|---|---|---|---|
| | 1-Plate Kit | 5-Plate Kit | 25-Plate Kit | 1-Plate Kit | 5-Plate Kit | 25-Plate Kit |
| S-PLEX SARS-CoV-2 Spike | K150ADJS-1 | K150ADJS-2 | K150ADJS-4 | K150ADJS-21 | K150ADJS-22 | K150ADJS-24 |

# Plate Diagram

Figure 5 and Figure 6 are provided for illustration.

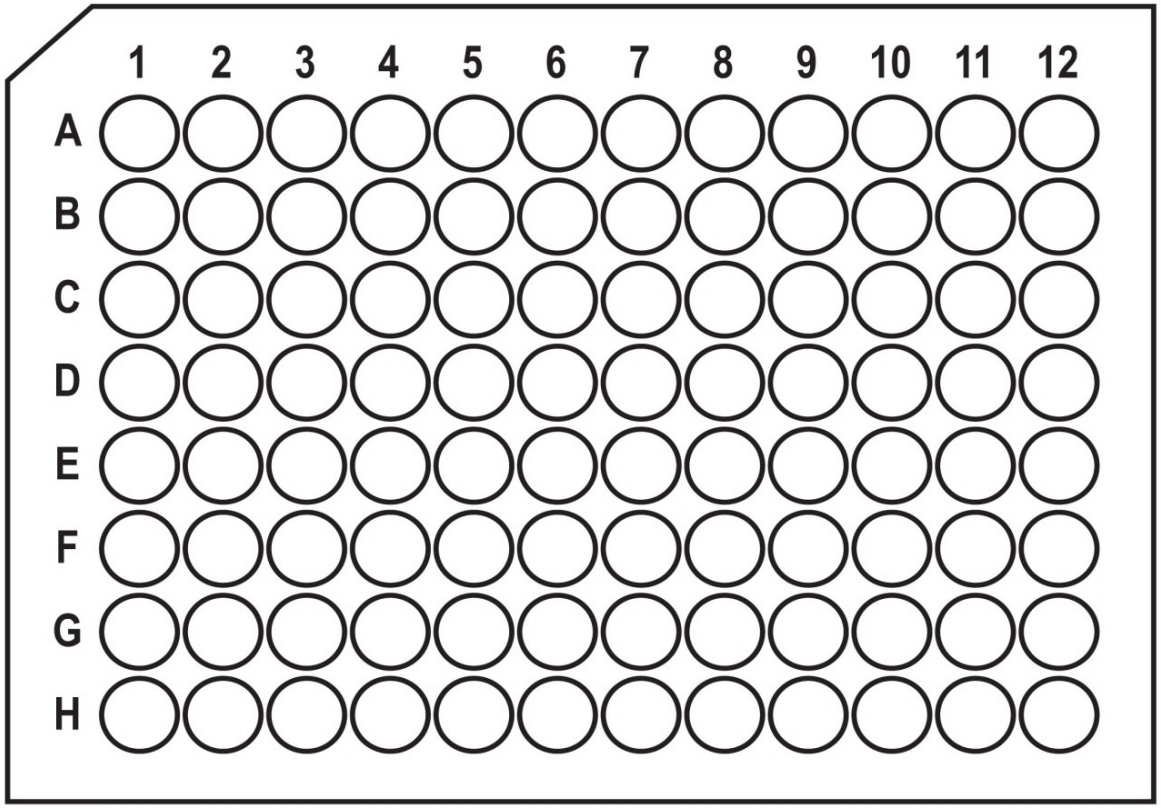


*Figure 5. Plate diagram.*

# Plate Layout

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | CAL-01 | | Sample-01 | | Sample-09 | | Sample-17 | | Sample-25 | | Sample-33 | |
| B | CAL-02 | | Sample-02 | | Sample-10 | | Sample-18 | | Sample-26 | | Sample-34 | |
| C | CAL-03 | | Sample-03 | | Sample-11 | | Sample-19 | | Sample-27 | | Sample-35 | |
| D | CAL-04 | | Sample-04 | | Sample-12 | | Sample-20 | | Sample-28 | | Sample-36 | |
| E | CAL-05 | | Sample-05 | | Sample-13 | | Sample-21 | | Sample-29 | | Sample-37 | |
| F | CAL-06 | | Sample-06 | | Sample-14 | | Sample-22 | | Sample-30 | | Sample-38 | |
| G | CAL-07 | | Sample-07 | | Sample-15 | | Sample-23 | | Sample-31 | | Sample-39 | |
| H | CAL-08 | | Sample-08 | | Sample-16 | | Sample-24 | | Sample-32 | | Sample-40 | |

*Figure 6. Sample plate layout that can be used for the assay. Each sample and calibrator is measured in duplicate in side-by-side wells.*