RAPID MAX™

SARS-CoV-2 Spike S1 Human IgG ELISA Kit

ELISA Kit for Accurate Quantitation of Spike S1 IgG in Human Serum, Plasma, and Other Biological Fluids

Cat. No. 447809

BioLegend®

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General Information

Important Information

It is highly recommended to read this manual in its entirety before using this product. Do not use this kit beyond the expiration date.

For Research Purposes Only. Not for use in diagnostic or therapeutic procedures. Purchase does not include or carry the right to resell or transfer this product either as a stand-alone product or as a component of another product. Any use of this product other than the permitted use without the express written authorization of BioLegend is strictly prohibited.

Warnings

This manual highlights particularly important remarks as follows:

WARNING	Indicates a risk of death or serious injury, or damage to property.
CAUTION	Indicates a risk of moderate or minor injury, or damage to property.
IMPORTANT	Indicates critical information that must be observed.

Introduction

SARS-CoV-2 is an enveloped non-segmented positive-sense RNA coronavirus that infects the human respiratory-epithelial cells, and is the cause of the coronavirus disease 2019 (COVID-19). One of its structural proteins includes the spike protein (S). The S protein consists of the S1 subunit which contains a receptor binding domain (RBD) that is capable of recognizing and binding with the cell surface receptor, and playing a key role in viral entry. Assays to detect virus-specific antibodies are important to understand the prevalence of infection and the course of the immune system.

Principle of the Assay

The BioLegend RAPID MAX™ SARS-CoV-2 Spike S1 Human IgG ELISA Kit is an indirect 85-minute enzyme-linked immunosorbent assay (ELISA) with a pre-coated, 96-well strip plate that immobilizes the biotinylated capture protein. Standards and samples are added into the wells with the biotinylated-capture protein and incubated. This is followed by an HRP-conjugated donkey polyclonal detection antibody. This kit is specifically designed for the accurate quantitation of SARS-CoV-2 Spike S1 Human IgG from cell culture supernatant, serum, plasma, and other biological fluids. This kit is analytically validated with ready-to-use reagents.

Materials Provided

Description	Quantity	Volume (per bottle)	Part No.
RAPID MAX™ Pre-coated 96-well Strip Microplate	1 plate		750001894
SARS-CoV-2 Spike S1 Human IgG Detection Antibody	1 bottle	12 mL	750002466
SARS-CoV-2 Spike S1 Human IgG Capture Protein	1 bottle	12 mL	750002470
Human SARS-CoV-2 Spike S1 IgG Lyophilized Standard	1 vial	lyophilized	750002201
Assay Buffer B	1 bottle	25 mL	79128
Wash Buffer (20X)	1 bottle	50 mL	78233
Substrate Solution D	1 bottle	12 mL	78115
Stop Solution	1 bottle	12 mL	79133
Plate Sealers	1 pack		78101

Materials to be Provided by the User

- Microplate reader able to measure absorbance at 450 nm
- Adjustable pipettes to measure volumes ranging from 1 µL to 1,000 µL
- Deionized water
- Wash bottle or automated microplate washer
- Log-Log graph paper or software for data analysis
- Tubes to prepare standard dilutions
- Timer
- Plate Shaker
- Polypropylene vials
- Phosphate-Buffered Saline (PBS): 8.0 g NaCl, 1.16 g Na2HPO4, 0.2 g KH2PO4, 0.2 g KCl, add deionized water to 1.0 L, pH to 7.4, 0.2 µm filtered.

Storage Information

Store unopened kit components between 2-8 °C. Do not use this kit beyond its expiration date.

Opened or Reconstituted Components	
Microplate wells	If not all microplate strips are used, remove the excess strips by pressing up from underneath each strip. Place excess strips back in the foil pouch with the included desiccant pack and reseal. Store between 2-8 °C for up to one month.

Opened or Reconstituted Components	
Standard	The remaining reconstituted standard stock solution can be aliquoted into polypropylene vials and stored at ≤ -70 °C for up to one month. Avoid repeated freeze-thaw cycles.
Capture Protein	Store opened reagents between 2-8 °C and use within one month.
Detection Antibody	
Assay Buffer B	
Wash Buffer (20X)	
Substrate Solution D	
Stop Solution	

Health Hazard Warnings

WARNING Observe the following precautions prior to use.

- Reagents that contain preservatives may be harmful if ingested, inhaled, or absorbed through the skin. Refer to the MSDS online at BioLegend's website for details: biolegend.com/msds
- Substrate Solution D is harmful if inhaled or ingested. Avoid contact with skin, eyes, and clothing.
- To reduce the likelihood of blood-borne transmission of infectious agents, handle all serum, plasma, and other biological fluids in accordance with NCCLS regulations.
- Stop Solution contains strong acid. Wear eye, hand, and face protection.
- Before disposing of the plate, rinse it with an excess amount of tap water.

Specimen Collection and Handling

Specimens should be clear and non-hemolyzed. If possible, run unknown samples at a number of dilutions to determine the optimal dilution factor that will ensure accurate quantitation.

Serum

Use a serum separator tube and allow clotting for at least 30 minutes, then centrifuge for 10 minutes at 1,000 x *g*. Remove serum layer and assay immediately or store serum samples at ≤ -70 °C. Avoid repeated freeze-thaw cycles.

Plasma

Collect blood samples in citrate, heparin, or EDTA containing tubes. Centrifuge for 10 minutes at 1,000 x *g* within 30 minutes of collection. Assay immediately or store plasma samples at ≤ -70 °C. Avoid repeated freeze-thaw cycles.

Reagent and Sample Preparation

IMPORTANT Dilute all reagents immediately prior to use.

1. Dilute the 20X Wash Buffer to 1X with deionized water. For example, make 1 L of 1X Wash Buffer by adding 50 mL of 20X Wash Buffer to 950 mL of deionized water. If crystals have formed in the 20X Wash Buffer, bring it to room temperature and vortex until dissolved.
2. Reconstitute the lyophilized SARS-CoV-2 Spike S1 Human IgG Standard by adding the volume of Assay Buffer B indicated on the kit CoA to make 240 ng/mL standard stock solution. Allow the reconstituted standard to sit at room temperature for 15-20 minutes, then briefly vortex to mix completely.
3. In general, serum and plasma samples are analyzed with a 1000-fold dilution. Use Assay Buffer B as the sample diluent.

Technical Hints

- Follow all instructions outlined in the Assay Procedure section with particular attention to incubation times.
- Avoid contamination between wells by changing pipette tips between the addition of each standard and between each addition of the capture protein. Use separate reservoirs for each reagent. Pipette against the well while avoiding dipping the pipette tip into the sample for best results.
- Reduce time between loading reagents by ensuring that addition is uninterrupted. Use of a multichannel pipette can also decrease differences in loading time between wells.

- Load Substrate Solution and Stop Solution in the same order on the plate.
- Ensure that all liquid is removed from the wells after washing by tapping them firmly on clean absorbent paper. Tap out liquid after every soaking step.

Assay Procedure

IMPORTANT	Do not mix reagents from different kits or lots. Reagents and/or antibodies from different manufacturers should not be used with this kit. To ensure correct incubation, use a multichannel pipette to load the antibody cocktail.

1. Bring all reagents to room temperature prior to use. It is strongly recommended that all standards and samples be run in duplicate or triplicate and loaded using a multichannel pipette. A standard curve is required for each assay.
2. If not all microplate strips will be used, remove the excess strips by pressing up from underneath each strip. Place excess strips back in the foil pouch with the included desiccant pack and reseal.
3. Prepare 500 µL of the 40 ng/mL top standard by diluting 83 µL of the standard stock solution in 417 µL of Assay Buffer B. Perform six two-fold serial dilutions of the 40 ng/mL top standard in separate tubes using Assay Buffer B as the diluent. Thus, the SARS-CoV-2 Spike S1 Human IgG standard concentrations in the tubes are 40, 20, 10, 5, 2.5 ,1.25, and 0.625 ng/mL, respectively. Assay Buffer B serves as the zero standard (0 ng/mL).

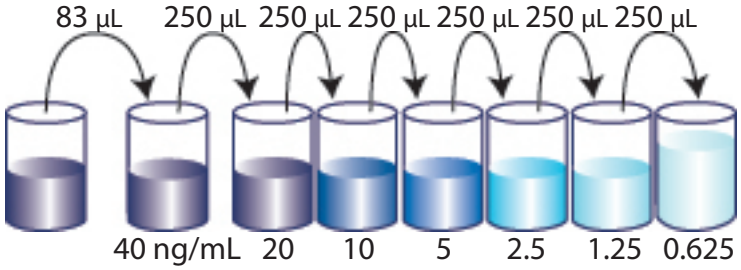

Figure 1. Illustration of dilution procedure.

4. Add 50 µL of standard dilutions or samples per wells.
5. Add 50 µL of the capture protein to each well.
6. Seal the plate with a Plate Sealer included in the kit and incubate the plate at room temperature, shaking at 500 rpm, for 30 minutes.
7. Discard the contents of the plate into a sink, then wash the plate five times by adding 300 µL 1X Wash Buffer per well. Blot any residual buffer by firmly tapping the plate upside down on absorbent paper after each wash.
8. Add 100 µL of the detection antibody to each well.
9. Seal the plate with a Plate Sealer included in the kit and incubate the plate at room temperature, shaking at 500 rpm, for 30 minutes.
10. Discard the contents of the plate into a sink, then wash the plate five times by adding 300 µL 1X Wash Buffer per well. Soak for 30 seconds to one minute per wash. Blot any residual buffer by firmly tapping the plate upside down on absorbent paper after each soak.
11. Add 100 µL of Substrate Solution D to each well and incubate the plate at room temperature for 15 minutes in the dark. Wells containing SARS-CoV-2 Spike S1 Human IgG should turn blue in color with an intensity proportional to its concentration. It is not necessary to seal the plate during this step.
12. Stop the reaction by adding 100 µL of Stop Solution to each well. The solution color should change from blue to yellow.
13. Read absorbance at 450 nm within 30 minutes. If the reader is capable of reading at 570 or 620 nm, the absorbance at 570 or 620 nm can be subtracted from the absorbance at 450 nm.

Assay Procedure

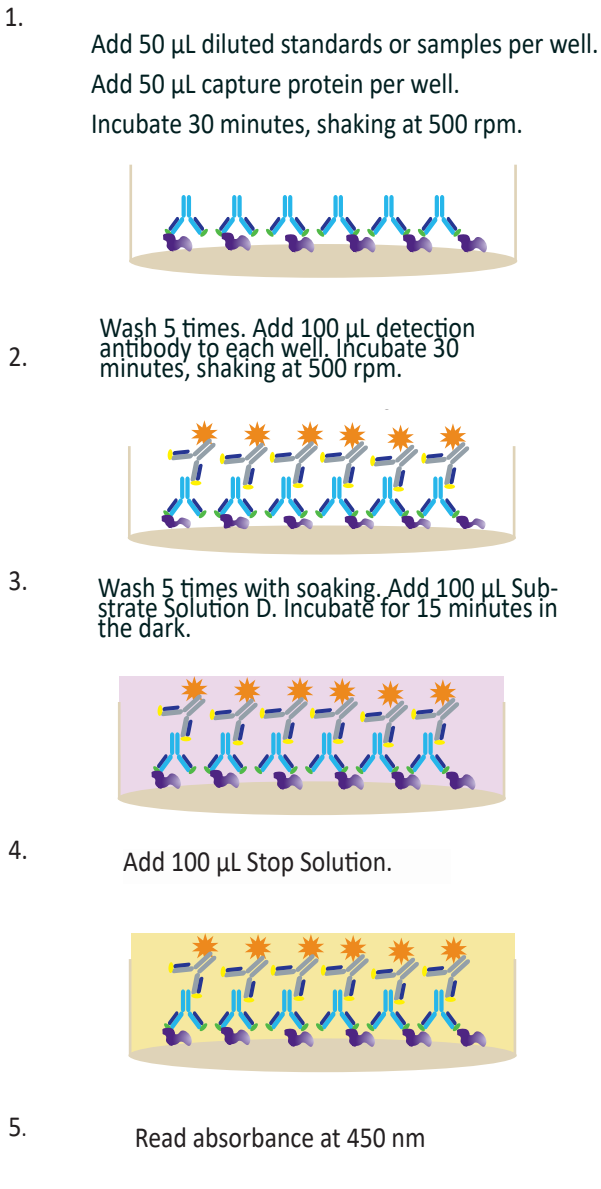

Figure 2. Illustration of assay procedure.

Calculation of Results

The data can be best calculated with computer-based curve-fitting software using a 5- or 4-parameter logistics curve-fitting algorithm. If an appropriate software is not available, use log-log graph paper to determine sample concentrations. Determine the mean absorbance for each set of duplicate or triplicate standards, controls, and samples. Plot the standard curve on log-log graph paper with antibody concentration on the X-axis and absorbance on the Y-axis. Draw a best fit line through the standard points. To determine the unknown antibody concentrations, find the mean absorbance value of the unknown concentration on the Y-axis and draw a horizontal line to the standard curve. At the point of intersection, draw a vertical line to the X-axis and read the antibody concentration.

If samples were diluted, multiply the concentration by the appropriate dilution factor. If a test sample's absorbance value falls outside the linear portion of the standard curve, the test sample needs to be reanalyzed at a higher (or lower) dilution as appropriate.

Typical Data

This standard curve was generated at BioLegend for demonstration purposes only.
A standard curve must be run with each assay.

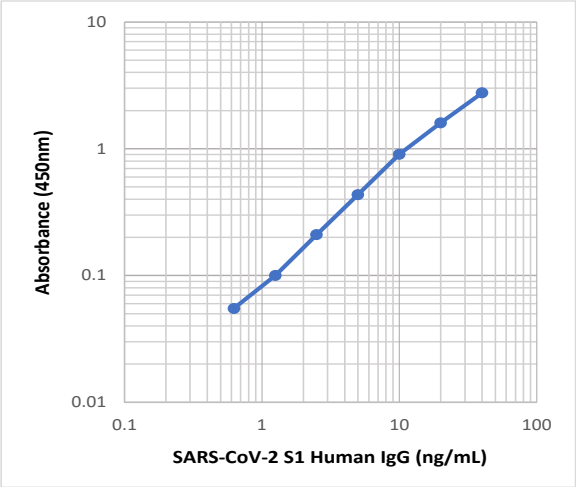

Figure 3. Graph of standard curve for demonstration purposes.

Performance Characteristics

Specificity

No cross-reactivity was observed when this kit was used to analyze the SARS-CoV-2 Nucleocapsid Human IgG at up to 400 ng/mL. The observed cross-reactivity did not exceed 6% when testing the assay with SARS-CoV-2 Human anti-Spike RBD IgA and IgM antibodies.

Sensitivity

The average minimum detectable concentration (minDC) of SARS-CoV-2 Spike S1 Human IgG is 0.17 ng/mL (n=6). The range of minDC was 0.03 - 0.43 ng/mL.

Recovery

Recombinant or natural SARS-CoV-2 Spike S1 Human IgG at three different concentrations was spiked into human samples of serum, EDTA plasma, citrate plasma, and heparin plasma, and then analyzed with the RAPID MAX™ SARS-CoV-2 Spike S1 Human IgG ELISA kit.

Sample Type	% Recovery, Average
Serum (n=5)	86.7
EDTA Plasma (n=5)	88.8
Citrate Plasma (n=5)	93.6
Heparin Plasma (n=5)	87.2

Linearity

Human samples were first diluted to the recommended dilution factor, spiked with high concentrations of SARS-CoV-2 Spike S1 Human IgG, then diluted 2-fold in serial with Assay Buffer B to produce samples with values within the dynamic range and assayed.

Sample Type	% Linearity, Average
Serum (n=6)	96.2
EDTA Plasma (n=6)	95.3
Citrate Plasma (n=5)	95.0
Heparin Plasma (n=5)	98.7

Intra-Assay Statistics

Ten replicates of each of two samples containing different SARS-CoV-2 Spike S1 Human IgG concentrations were tested in one assay.

Concentration	Sample 1	Sample 2
Number of Replicates	10	10
Mean Concentration (ng/mL)	17.78	2.35
Standard Deviation	0.87	0.19
% CV	4.9	8.1

Inter-Assay Statistics

Two samples containing different concentrations of SARS-CoV-2 Spike S1 Human IgG were tested in ten independent assays.

Concentration	Sample 1	Sample 2
Number of Assays	10	10
Mean Concentration (ng/mL)	16.54	2.23
Standard Deviation	1.62	0.28
% CV	9.8	12.6

Biological Samples

Serum samples were taken from 26 healthy donors before vaccination (BCV), 2 weeks after 1st dose vaccination (1CV), and 2 weeks after 2nd dose vaccination (2CV) with SARS-CoV-2 vaccine. These samples were diluted 1,000-fold in Assay Buffer B and assayed using the RAPID MAX™ SARS-CoV-2 Spike S1 Human IgG ELISA Kit.

Sample	Average Concentration (µg/mL), n=26
BCV	0.38
1CV	20.62
2CV	40.19

Troubleshooting

Problem	Probable Cause	Solution
High background	Background wells were contaminated	Avoid cross-well contamination by using the provided plate sealers. Use multichannel pipettes and change tips between pipetting samples and reagents. Do not agitate plate.
	Insufficient washes	Increase soaking time between washes prior to addition of substrate solution.
	Substrate Solution was contaminated	Substrate Solution should be clear and colorless prior to addition to wells. Use a clean container prior to pipetting substrate solution into wells.
No or poor signal	Detection Antibody, Capture Antibody, samples/ standard, or Substrate Solution were NOT added	Rerun the assay and follow the protocol.
	Wrong reagent or reagents were added in wrong sequential order	
	The wash buffer contains Sodium Azide (NaN3)	Avoid Sodium Azide contamination in the wash buffer as it inhibits HRP activity.
	Incubations were done at an inappropriate temperature, timing, or without agitation	Rerun the assay and follow the protocol.
Low or poor standard curve signal	The standard was incorrectly reconstituted or diluted	Adjust the calculations and follow the protocol.
	Standard was inappropriately stored	Store the reconstituted standard stock solution in polypropylene vials at ≤ -70 °C. Avoid repeated freeze-thaw cycles.
	Reagents added to wells with incorrect concentrations	Check for pipetting errors and the correct reagent volume.
Signal is high, standard curves have saturated signal	Standard reconstituted with less volume than required	Check calculation for reconstitution. If further dilution is required, dilute to the correct concentration and rerun the assay.
	Standards/samples, antibody cocktail, or substrate solution were incubated for too long	Rerun the assay and follow the protocol.
Sample readings are out of range	Samples contain no or below detectable levels of the analyte	If samples are below detectable levels, it may be possible to use a larger sample volume. Contact technical support for appropriate protocol modifications.
	Samples contain analyte concentrations greater than the highest standard point	Samples may require dilution and reanalysis.
High variation in samples and/or standards	Multichannel pipette errors	Confirm that pipettes are calibrated accurately.
	Plate washing was not adequate or uniform	Ensure pipette tips are tightly secured. Ensure uniformity in all wash steps.
	Non-homogenous samples	Thoroughly mix samples before assaying.
	Samples may have high particulate matter	Remove particulate matter by centrifugation.
	Cross-well contamination	Do not use plate sealers. Always change pipette tips between reagent additions. Ensure that pipette tips do not touch the reagents in the wells.

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RAPID MAX™ Kits are manufactured by BioLegend Inc.
8999 BioLegend Way
San Diego, CA 92121
Tel: 1.858.768.5800
Tel US & Canada Toll-Free: 1.877.Bio-Legend (1.877.246.5343)
Fax: 1.877.455.9587
Email: info@biolegend.com
biolegend.com

For a complete list of world-wide BioLegend offices and distributors, please visit our website at: biolegend.com