

# EDI™ Novel Coronavirus COVID-19 IgG ELISA Kit

*Enzyme Linked Immunosorbent Assay (ELISA) for the qualitative detection of the COVID-19 IgG in human serum.*

REF KTR-1032 RUO CANADA    

## INTENDED USE

This kit is for research use only. The kit is detecting novel COVID-19 IgG antibody in human serum. It is for screening or to aid in the diagnosis of COVID-19. Patients with suspected clustering cases require diagnosis or differential diagnosis of novel coronavirus infection. The assay is validated manually, but can be adapted to an automated instrument. The assay is for the qualitative detection only.

## SUMMARY OF PHYSIOLOGY

2019 novel coronavirus (COVID-19) is a single-stranded RNA coronavirus<sup>2</sup>. Comparisons of the genetic sequences of this virus have shown similarities to SARS-CoV and bat coronaviruses<sup>7</sup>. In humans, coronaviruses cause respiratory infections<sup>3</sup>. Coronaviruses are composed of several proteins including the spike (S), envelope (E), membrane (M), and nucleocapsid (N)<sup>4</sup>. Results suggest that the spike protein retains sufficient affinity to the Angiotensin converting enzyme 2 (ACE2) receptor to use it as a mechanism of cell entry<sup>6</sup>. Human to human transmission of coronaviruses is primarily thought to occur among close contacts via respiratory droplets generated by sneezing and coughing<sup>1</sup>. IgG is the most abundantly found immunoglobulin to be produced in response to an antigen and will be maintained in the body after initial exposure for long term response<sup>5</sup>.

## ASSAY PRINCIPLE

This ELISA kit is designed, developed, and produced for the qualitative measurement of the human anti-COVID-19 IgG antibody in serum. This assay utilizes the microplate based enzyme immunoassay technique.

Assay controls and 1:100 diluted human serum samples are added to the microtiter wells of a microplate that was coated with COVID-19 recombinant full length nucleocapsid protein. After the first incubation period, the unbound protein matrix is removed with a subsequent washing step. A horseradish peroxidase (HRP) labeled polyclonal goat anti-human IgG tracer antibody is added to each well. After an incubation period, an immunocomplex of "COVID-19 recombinant antigen – human anti-COVID-19 IgG antibody - HRP labeled anti-human IgG tracer antibody" is formed if there is specific coronavirus IgG antibody present in the tested specimen. The unbound tracer antibody is removed by the subsequent washing step. HRP-labeled tracer antibody bound to the well is then incubated with a substrate solution in a timed reaction and then measured in a spectrophotometric microplate reader. The enzymatic activity of the tracer antibody bound to the anti-COVID-19 IgG on the wall of the microtiter well is proportional to the amount of the anti-COVID-19 IgG antibody level in the tested specimen.

## REAGENTS: PREPARATION AND STORAGE

This test kit must be stored at 2 – 8°C upon receipt. For the expiration date of the kit refer to the label on the kit box. All components are stable until this expiration date.

### 1. COVID-19 antigen coated Microplate (31217)

Microplate coated with COVID-19 recombinant protein.

Qty: 1 x 96 well microplate  
Storage: 2 – 8°C  
Preparation: Ready to use.

### 2. COVID-19 IgG Sample Diluent (31218)

A ready-to-use sample dilution buffer.

Qty: 1 x 120 mL  
Storage: 2 – 8°C  
Preparation: Ready to use.

### 3. HRP labeled Anti-IgG Tracer Antibody (31220)

HRP labeled polyclonal goat anti-human IgG antibody in a stabilized protein matrix.

Qty: 1 x 11 mL  
Storage: 2 – 8°C  
Preparation: Ready to use.

### 4. ELISA Wash Concentrate (10010)

Surfactant in a phosphate buffered saline with non-azide preservative.

Qty: 1 x 30 mL  
Storage: 2 – 25°C  
Preparation: 30X Concentrate. The contents must be diluted with 870 mL distilled water and mixed well before use.

### 5. ELISA HRP Substrate (10020)

Tetramethylbenzidine (TMB) with stabilized hydrogen peroxide.

Qty: 1 x 15 mL  
Storage: 2 – 8°C  
Preparation: Ready to use.

### 6. ELISA Stop Solution (10030)

0.5 M sulfuric acid.

Qty: 1 x 15 mL  
Storage: 2 – 25°C  
Preparation: Ready to use.

### 7. COVID-19 IgG Negative Control (31221)

Negative control with a bovine serum albumin based matrix with non-azide preservative. Control products do not contain any serum from patients with new type of coronavirus infection.

Qty: 1 x 1 mL  
Storage: 2 – 8°C.  
Preparation: Ready to use.

### 8. COVID-19 IgG Positive Control (31222)

Positive control with a bovine serum albumin based matrix with non-azide preservative. Control products do not contain any serum from patients with new type of coronavirus infection.

Qty: 1 x 0.5 mL  
Storage: 2 – 8°C.  
Preparation: Ready to use.

## **SAFETY PRECAUTIONS**

The reagents are for research use only. Source material which contains reagents of bovine serum albumin was derived in the contiguous 48 United States. It was obtained only from healthy donor animals maintained under veterinary supervision and found free of contagious diseases. Wear gloves while performing this assay and handle these reagents as if they were potentially infectious. Avoid contact with reagents containing hydrogen peroxide, or sulfuric acid. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale fumes. On contact, flush with copious amounts of water for at least 15 minutes. Use Good Laboratory Practices.

## **MATERIALS REQUIRED BUT NOT PROVIDED**

1. Precision single channel pipettes capable of delivering 10 µL, 25 µL, 100 µL, and 1000 µL, etc.
2. Repeating dispenser suitable for delivering 100 µL.
3. Disposable pipette tips suitable for above volume dispensing.
4. Disposable 12 x 75 mm or 13 x 100 glass tubes.
5. Disposable plastic 1000 mL bottle with caps.
6. Aluminum foil.
7. Deionized or distilled water.
8. Plastic microtiter well cover or polyethylene film.
9. ELISA multichannel wash bottle or automatic (semi-automatic) washing system.
10. Spectrophotometric microplate reader capable of reading absorbance at 450 nm.

## **SAMPLE COLLECTION & STORAGE**

Only 10 µL of human serum is required for measurement in duplicate. Samples should only be used on the same day. Severe hemolytic samples should not be used.

## **ASSAY PROCEDURE**

### **1. Reagent Preparation**

1. Prior to use, allow all reagents to come to room temperature. Reagents from different kit lot numbers should not be combined or interchanged.
2. ELISA Wash Concentrate (10010) must be diluted to working solution prior to use. Please see REAGENTS section for details.

### **2. Sample Preparation**

1. Dilute sample by a 1:100 dilution ratio with the COVID-19 IgG Sample Diluent (31218). For each 10 µL of sample, 1000 µL of COVID-19 IgG Sample Diluent (31218) is needed.
2. Mix well prior to performing the assay.

### **3. Assay Procedure**

1. Place a sufficient number of microwell strips (31217) in a holder to run controls (31221, 31222) and samples in duplicate.
2. Test Configuration

Row	Strip 1	Strip 2	Strip 3
A	Negative Control	SAMPLE 3	SAMPLE 7
B	Negative Control	SAMPLE 3	SAMPLE 7
C	Negative Control	SAMPLE 4	SAMPLE 8
D	Positive Control	SAMPLE4	SAMPLE 8
E	SAMPLE 1	SAMPLE 5	SAMPLE 9
F	SAMPLE 1	SAMPLE 5	SAMPLE 9
G	SAMPLE 2	SAMPLE 6	SAMPLE 10
H	SAMPLE 2	SAMPLE 6	SAMPLE 10

3. Add **100 µL** of controls (31221, 31222) and 1:100 diluted samples into the designated microwells.
4. Mix gently and cover the plate with one plate sealer and aluminum foil. Incubate at **room temperature (20-25 °C)** for **30 minutes**.
5. Remove the plate sealer. Aspirate the contents of each well. Wash each well **5 times** by dispensing **350 µL** of diluted wash solution (10010) into each well, and then completely aspirate the contents. Alternatively, an automated microplate washer can be used.
6. Add **100 µL** of the HRP labeled Anti-hIgG Tracer Antibody (31220) into the microwells.
7. Mix gently and cover the plate with one plate sealer and aluminum foil. Incubate at **room temperature (20-25 °C)** for **30 minutes**.
8. Remove the plate sealer. Aspirate the contents of each well. Wash each well **5 times** by dispensing **350 µL** of diluted wash solution (10010) into each well, and then completely aspirate the contents. Alternatively, an automated microplate washer can be used.
9. Add **100 µL** of the substrate (10020) into the microwells.
10. Mix gently and cover the plate with aluminum foil. Incubate at **room temperature (20-25 °C)** for **20 minutes**.
11. Remove the aluminum foil and add **100 µL** of stop solution (10030) into each of the microwells. Mix by gently by tapping the plate.
12. Read the absorbance at **450 nm** within **10 minutes** with a microplate reader.

## **PROCEDURAL NOTES**

1. It is recommended that all samples be assayed in duplicate. The average absorbance reading of each duplicate should be used for data reduction and the calculation of results.
2. Keep light-sensitive reagents in the original bottles and avoid unnecessary exposure to the light.
3. Store any unused antibody-coated strips in the foil Ziploc bag with desiccant to protect from moisture.
4. Careful technique and use of properly calibrated pipetting devices are necessary to ensure reproducibility of the test.
5. Incubation times or temperatures other than those stated in this insert may affect the results.
6. Avoid air bubbles in the microwell as this could result in lower binding efficiency and higher CV% of duplicate reading.
7. All reagents should be mixed gently and thoroughly prior to use. Avoid foaming.

## **QUALITY CONTROL**

To assure the validity of the results each assay must include both negative and positive controls. The average value of the absorbance of the negative control is less than 0.25, and the absorbance of the positive control is not less than 0.30. We also recommend that all assays include the laboratory's own controls in addition to those provided with this kit.

## **INTERPRETATION OF RESULTS**

1. Calculate the average value of the absorbance of the negative control (xNC).
2. Calculate the cutoffs using the following formulas:
  - Positive cutoff = 1.1 X (xNC + 0.18)
  - Negative cutoff = 0.9 x (xNC + 0.18)
3. Determine the interpretation of the sample by comparing the OD to the following table:

Interpretation	Interval	Results
Negative	Measured value $\leq$ negative cutoff	The sample does not contain the new coronavirus ( COVID-19 ) IgG- related antibody
Positive	Measured value $\geq$ positive cutoff	The sample contains novel coronavirus ( COVID-19 ) an IgG - associated antibodies.
Borderline	Negative cutoff < Measured value < Positive cutoff	Retest the sample in conjunction with other clinical tests.

### EXPECTED VALUES

Samples from the clinical testing presented ODs of 0.441 – 1.832 for the positive values and 0.042 – 0.151 for the negative values. These values should not be in lieu of the interpretation of results calculation.

### LIMITATIONS OF THE PROCEDURE

- This test is only for qualitative detection. Test results should not be the sole basis for clinical diagnosis and treatment. The confirmation of infection with novel coronavirus (COVID-19) must be combined with the patient's clinical signs in conjunction to other tests.
- In the first week of the onset of the infection with the novel coronavirus (COVID-19) patients results may be negative for IgG. In addition, patients with low immunity or other diseases that affect immune function, failure of important systemic organs, and use of drugs that suppress immune function can also lead to negative results of new coronavirus IgG. Previous infection of SARS or other coronavirus strain may cause a light IgG positive in view of similarity of different strains.
- Bacterial or fungal contamination of serum specimens or reagents, or cross-contamination between reagents may cause erroneous results.
- Water deionized with polyester resins may inactivate the horseradish peroxidase enzyme.

### PERFORMANCE CHARACTERISTICS

#### Assay Development

This assay was developed by evaluating eight commercially available COVID-19 antigens to screen for optimal use in this serological test. The assays were first evaluated with normal healthy donor serum samples to obtain negative test results. The assays were further evaluated with 20 positive serum samples from confirmed COVID-19 patients tested by RT-PCR. The best performing antigen was selected for the development of the kit. During this time, cross-reactivity was identified, but eliminated during the final selection of the antigen.

#### Limit of Detection

Three lots of material were tested with one assay using a blank control in sixteen replicates. The LoD was calculated as the mean of the OD for the blank control plus three times the standard deviation. The highest value of the three runs was established for the LoD at 0.0666. The results are as follows:

	Average OD (450 nm)	CV (%)	LOD ( $\bar{x} + 3 SD$ )
Run 1	0.0481	4.83%	0.0550
Run 2	0.0518	5.71%	0.0606
Run 3	0.0531	8.44%	0.0666

#### Repeatability

One lot of material was tested with one assay using three samples (strong positive, light positive, and negative) in sixteen replicates. For all sixteen replicates, sample 1 and 2 are positive and in sample 3 is all negative. The repeatability results are very satisfactory with acceptable CV. The results are as follows:

ID	Average OD (450 nm)	Results	CV (%)
Sample 1	1.071	16/16 are Positive	6.35%
Sample 2	0.631	16/16 are Positive	3.11%
Sample 3	0.199	16/16 are Negative	4.99%

#### Reproducibility

One lot of material was tested over twelve assays using three samples (strong positive, light positive, and negative) in two replicates and a set of positive and negative controls in three replicates. For all twelve assays, sample 1 and 2 are positive and sample 3 is all negative. The results for reproducibility are very satisfactory with an acceptable CV. The results are as follows:

ID	Average OD (450 nm)	Results	CV (%)
Sample 1	1.11	12/12 are Positive	1.96%
Sample 2	0.65	12/12 are Positive	3.47%
Sample 3	0.19	12/12 are Negative	4.66%
Negative Control	0.17	12/12 are Negative	3.15%
Positive Control	0.65	12/12 are Positive	4.14%

#### Class Specificity

Five IgM Positive Samples were tested in duplicate in the IgG and IgM kit. This demonstrates that the assay is specific to the detection of IgG without cross reaction to COVID-19 IgM class. The results are as follows:

Sample ID	IgM Result	IgG Result
Sample 1	+	-
Sample 2	+	-
Sample 3	+	-
Sample 4	+	-
Sample 5	+	-

#### Cross-Reactivity

Specific positive panels were studied with confirmed disease state samples. The disease and Infection agents were selected based on recommendations from the FDA EUA Program. Per the recommendation, Anti-haemophilus influenzae IgG and Anti-Rhinovirus IgG were recommended but unable to be tested. No cross reactivity was observed for the following disease or infectious agents:

Agent	Disease State Confirmation Test
Influenza A	Viron/Serion
Influenza B	Viron/Serion
Respiratory syncytial virus	EIA
Hepatitis C Virus	Roche Ampliprep/Taqman
Antinuclear Antibodies	Bio-Rad Hep 2
Human Immunodeficiency Virus	Innogenetics
Hepatitis B Virus	Siemens

#### Normal US Population

Serum samples were tested at a university medical center in the United States. These 418 samples were collected from 2018 – June 2019. The results show excellent levels of specificity. The results are as follows:

	Number of Samples
IgG Positive	0
IgG Negative	418
IgG Equivocal	0
Total	418

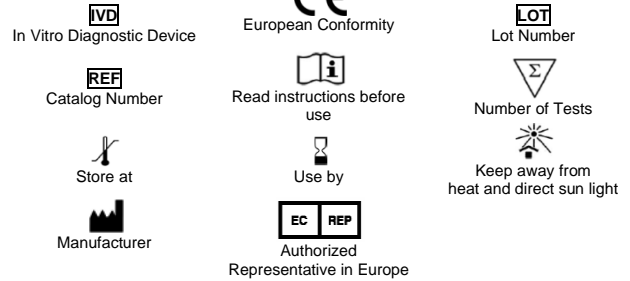
	Specificity
Equivocal calculated as Negative	100%
Equivocal calculated as Positive	100%

Serum samples were tested at a laboratory in the United States. The samples consisted of 100 males and females from ages 19 - 65. These samples were collected for testing **after the outbreak of COVID-19** and were not screened using additional testing methods. Specificity results are still satisfactory. The results are as follows:

	Number of Samples
IgG Positive	6
IgG Negative	87
IgG Equivocal	7
Total	100

	Specificity
Equivocal calculated as Negative	94%
Equivocal calculated as Positive	87%

## GLOSSARY OF SYMBOLS (EN 980/ISO 15223)



## CLINICAL TESTING

Serum Samples were tested using the IgG ELISA kit at the Jiaxing City Center for Disease Control and Prevention, Zhejiang University Hospital, and a laboratory in the United States. The combined cohort consisted of normal healthy patients with samples collected prior to the COVID-19 outbreak [December 3, 2019] (n=54) and RT-PCR confirmed positive patients (N = 54). The results are as follows:

	PCR Test Positive	PCR Test Negative
IgG Test Positive	54	0
IgG Test Negative	0	54
IgG Test Borderline	0	0
<b>Sensitivity</b>	<b>100%</b>	
<b>Specificity</b>	<b>100%</b>	
<b>Negative Predictive Value</b>	<b>100%</b>	
<b>Positive Predictive Value</b>	<b>100%</b>	

## WARRANTY

This product is warranted to perform as described in its labeling and literature when used in accordance with all instructions. Epitope Diagnostics, Inc. DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, and in no event shall Epitope Diagnostics, Inc. be liable for consequential damages. Replacement of the product or refund of the purchase price is the exclusive remedy for the purchaser. This warranty gives you specific legal rights and you may have other rights, which vary from state to state.


## REFERENCES

1. CDC (2020). Transmission of Novel Coronavirus (COVID-19).
2. Chenjia Yuan , Shi Jinsong , Qiudong An , Liu Chang , Li Xin , Qiang , Ruanji Shou , mountains . Wuhan 2019 Bioinformatics coronavirus genome analysis [J / OL]. Bioinformatics : 1-10 [2020-02-10 ].
3. Fehr, A. R., & Perlman, S. (2015). Coronaviruses: An Overview of Their Replication and Pathogenesis. *Coronaviruses Methods in Molecular Biology*, 1–23. doi: 10.1007/978-1-4939-2438-7\_1
4. Li, F., Li, W., Farzan, M., & Harrison, S. (2005). Structure of SARS coronavirus spike receptor-binding domain complexed with its receptor. doi: 10.2210/pdb2ajf/pdb
5. Wu, L.-P., Wang, N.-C., Chang, Y.-H., Tian, X.-Y., Na, D.-Y., Zhang, L.-Y., ... Liang, G.-D. (2007). Duration of Antibody Responses after Severe Acute Respiratory Syndrome. *Emerging Infectious Diseases*, 13(10), 1562–1564. doi: 10.3201/eid1310.070576
6. Xu, X., Chen, P., Wang, J., Feng, J., Zhou, H., Li, X., ... Hao, P. (2020). Evolution of the novel coronavirus from the ongoing Wuhan outbreak and modeling of its spike protein for risk of human transmission. *Science China Life Sciences*. doi: 10.1007/s11427-020-1637-5
7. Zhou, P., Yang, X.-L., Wang, X.-G., Hu, B., Zhang, L., Zhang, W., ... Shi, Z.-L. (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature*. doi: 10.1038/s41586-020-2012-7

## TECHNICAL ASSISTANCE AND CUSTOMER SERVICE

For technical assistance or place an order, please contact Epitope Diagnostics, Inc. at (858) 693-7877 or fax to (858) 693-7678.

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