



**Cancer Antigen 19-9 (CA 19-9)  
Test System  
Product Code: 3925-300**

**1.0 INTRODUCTION**

**Intended Use: The Quantitative Determination of Cancer Antigen 19-9 (CA 19-9) Concentration in Human Serum by a Microplate Enzyme Immunoassay, Colorimetric**

**2.0 SUMMARY AND EXPLANATION OF THE TEST**

A mucin type Sialyl Lewis Antigens group of glycoproteins (SLA) such as CA 19-9, 19-5 have been recognized as circulating cancer associated antigens for gastrointestinal cancer. The discovery of a monoclonal antibody clone (1116NS 19-9), which exhibited selective reactivity with human gastrointestinal carcinomas through the recognition of a carbohydrate determinant (CA 19-9) defined as a sialyl lacto-N-flucopenrose II, resulted in the successful purification and thus, determination of human gastrointestinal tumor associated glycoprotein antigen expressing CA 19-9 from colorectal carcinoma cell lines. Recently, reports indicate that serum CA 19-9 level is frequently elevated in the circulation of patients with various gastrointestinal malignancies, such as pancreatic, colorectal, gastric and hepatic carcinomas. Together with CEA, elevated CA 19-9 is suggestive of gallbladder disease. The tumor associated antigen may also be associated in some malignant conditions. Research studies demonstrate that serum CA 19-9 values may have utility in monitoring subjects with the above mentioned diagnosed malignancies.

In this method, CA 19-9 calibrator, patient specimen or control is first added to a streptavidin coated well. Biotinylated monoclonal antibody (specific for CA 19-9) is added and the reactants mixed. Reaction between the CA 19-9 antibodies and native CA 19-9 forms complex that binds with the streptavidin coated to the well. The excess serum proteins are washed away via a wash step. Another enzyme labeled monoclonal antibody specific to CA 19-9 is added to the wells. The enzyme labeled antibody binds to the CA 19-9 already immobilized on the well through its binding with the biotinylated monoclonal antibody. Excess enzyme is washed off via a wash step. A color is generated by the addition of a substrate. The intensity of the color generation is directly proportional to the concentration of the CA 19-9 in the sample.

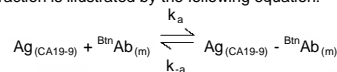
**3.0 PRINCIPLE**

**Immunoenzymometric sequential assay (TYPE 4):**

The essential reagents required for an immunoenzymometric assay include high affinity and specificity antibodies (enzyme and immobilized), with different and distinct epitope recognition, in excess, and native antigen. In this procedure, the immobilization takes place during the assay at the surface of a microplate well through the interaction of streptavidin coated on the well and exogenously added biotinylated monoclonal anti-CA19-9 antibody.

Upon mixing monoclonal biotinylated antibody, and a serum containing the native antigen, reaction results between the native

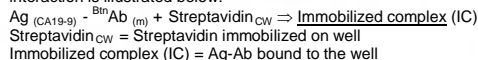
antigen and the antibody, forming an antibody-antigen complex. The interaction is illustrated by the following equation:



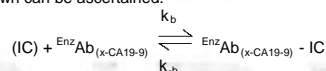
$B^{in}Ab_{(m)}$  = Biotinylated Monoclonal Antibody (Excess Quantity)  
 $Ag_{(CA19-9)}$  = Native Antigen (Variable Quantity)  
 $Ag_{(CA19-9)} - B^{in}Ab_{(m)}$  = Antigen-antibody complex (Variable Quantity)

$k_a$  = Rate Constant of Association  
 $k_{-a}$  = Rate Constant of Disassociation

Simultaneously, the complex is deposited to the well through the high affinity reaction of streptavidin and biotinylated antibody. This interaction is illustrated below:



After a suitable incubation period, the antibody-antigen bound fraction is separated from unbound antigen by decantation or aspiration. Another antibody (directed at a different epitope) labeled with an enzyme is added. Another interaction occurs to form an enzyme labeled antibody-antigen-biotinylated-antibody complex on the surface of the wells. Excess enzyme is washed off via a wash step. A suitable substrate is added to produce color measurable with the use of a microplate spectrophotometer. The enzyme activity on the well is directly proportional to the native free antigen concentration. By utilizing several different serum references of known antigen concentration, a dose response curve can be generated from which the antigen concentration of an unknown can be ascertained.



$Enz^{Ab}_{(x,CA19-9)}$  = Enzyme labeled Antibody (Excess Quantity)  
 $Enz^{Ab}_{(x,CA19-9)} - IC$  = Antigen-Antibodies Complex  
 $k_b$  = Rate Constant of Association  
 $k_{-b}$  = Rate Constant of Disassociation

**4.0 REAGENTS**

**Materials Provided:**

**A. CA 19-9 Calibrators – 1ml/vial - Icons A-F**

Six (6) vials of human serum based reference calibrators at concentrations of 0 (A), 10 (B), 50 (C), 100 (D), 250 (E) and 500 (F) U/ml. A preservative has been added. Store at 2-8°C.  
**Note:** The standards, human serum based, were made using a >99% pure affinity purified preparation of CA 19-9. The preparation was calibrated against Centocor CA 19-9 IRMA test.

**B. CA 19-9 Biotin Reagent – 13ml/vial ∇**

One (1) vial of Anti-Human CA19-9 (MoAb)-Biotin reagent in a protein-stabilized matrix. A preservative has been added. Store at 2-8°C.

**C. CA 19-9 Enzyme Reagent – 13ml/vial - Icon ⊕**

One (1) vial of Anti-Human CA19-9-HRP conjugate in a protein-stabilized matrix. A preservative has been added. Store at 2-8°C.

**D. Streptavidin Plate – 96 wells – Icon ∩**

One 96-well microplate coated with streptavidin and packaged in an aluminum bag with a drying agent. Store at 2-8°C.

**E. Wash Solution Concentrate – 20ml/vial - Icon ⬇**

One (1) vial containing a surfactant in buffered saline. A preservative has been added. Store at 2-8°C.

**F. Substrate A – 7ml/vial - Icon S<sup>A</sup>**

One (1) vial containing tetramethylbenzidine (TMB) in acetate buffer. Store at 2-8°C. See "Reagent Preparation."

**G. Substrate B – 7ml/vial - Icon S<sup>B</sup>**

One (1) vial containing hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) in acetate buffer. Store at 2-8°C. See "Reagent Preparation."

**H. Stop Solution – 8ml/vial - Icon ⊞**

One (1) vial containing a strong acid (1N HCl). Store at 2-8°C.

**I. Product Instructions.**

**Note 1:** Do not use reagents beyond the kit expiration date.

**Note 2:** Avoid extended exposure to heat and light. **Opened reagents are stable for sixty (60) days when stored at**

**2-8°C. Kit and component stability are identified on the label.**

**Note 3:** Above reagents are for a single 96-well microplate

**4.1 Required But Not Provided:**

1. Pipette capable of delivering 0.025 & 0.050ml (25 & 50µl) volumes with a precision of better than 1.5%.
2. Dispenser(s) for repetitive deliveries of 0.100 & 0.350ml (100 & 350µl) volumes with a precision of better than 1.5%.
3. Microplate washers or a squeeze bottle (optional).
4. Microplate Reader with 450nm and 620nm wavelength absorbance capability.
5. Absorbent Paper for blotting the microplate wells.
6. Plastic wrap or microplate cover for incubation steps.
7. Vacuum aspirator (optional) for wash steps.
8. Timer.
9. Quality control materials.

**5.0 PRECAUTIONS**

**For In Vitro Diagnostic Use  
Not for Internal or External Use in Humans or Animals**

All products that contain human serum have been found to be non-reactive for Hepatitis B Surface Antigen, HIV 1&2 and HCV Antibodies by FDA licensed reagents. Since no known test can offer complete assurance that infectious agents are absent, all human serum products should be handled as potentially hazardous and capable of transmitting disease. Good laboratory procedures for handling blood products can be found in the Center for Disease Control / National Institute of Health, "Biosafety in Microbiological and Biomedical Laboratories," 2nd Edition, 1988, HHS Publication No. (CDC) 88-8395.

**Safe disposal of kit components must be according to local regulatory and statutory requirement.**

**6.0 SPECIMEN COLLECTION AND PREPARATION**

The specimens shall be blood serum and the usual precautions in the collection of venipuncture samples should be observed. For accurate comparison to established normal values, a fasting morning serum sample should be obtained. The blood should be collected in a plain redtop venipuncture tube without additives or anti-coagulants. Allow the blood to clot for samples. Centrifuge the specimen to separate the serum from the cells.

**In patients receiving therapy with high biotin doses (i.e. >5mg/day), no sample should be taken until at least 8 hours after the last biotin administration, preferably overnight to ensure fasting sample.**

Samples may be refrigerated at 2-8°C for a maximum period of five (5) days. If the specimen(s) cannot be assayed within this time, the sample(s) may be stored at temperatures of -20°C for up to 30 days. Avoid use of contaminated devices. Avoid repetitive freezing and thawing. When assayed in duplicate, 0.050ml (50µl) of the specimen is required.

**7.0 QUALITY CONTROL**

Each laboratory should assay controls at levels in the low, normal and elevated range for monitoring assay performance. These controls should be treated as unknowns and values determined in every test procedure performed. Quality control charts should be maintained to follow the performance of the supplied reagents. Pertinent statistical methods should be employed to ascertain trends. Significant deviation from established performance can indicate unnoticed change in experimental conditions or degradation of kit reagents. Fresh reagents should be used to determine the reason for the variations.

**8.0 REAGENT PREPARATION**

1. **Wash Buffer**  
Dilute contents of wash solution to 1000ml with distilled or deionized water in a suitable storage container. Store diluted buffer at 2-30°C for up to 60 days.
2. **Working Substrate Solution** – Stable for one (1) year  
Pour the contents of vial labeled Solution 'A' into the vial labeled Solution 'B'. Place the yellow cap on the mixed reagent for easy identification. Mix and label accordingly. Store at 2-8°C.

**Note1: Do not use the working substrate if it looks blue.  
Note 2: Do not use reagents that are contaminated or have bacteria growth.**

**9.0 TEST PROCEDURE**

*Before proceeding with the assay, bring all reagents, serum reference calibrators and controls to room temperature (20 - 27°C).*

**\*\*Test procedure should be performed by a skilled individual or trained professional\*\***

1. Format the microplates' wells for each serum reference calibrator, control and patient specimen to be assayed in duplicate. **Replace any unused microwell strips back into the aluminum bag, seal and store at 2-8°C.**
2. Pipette 0.025ml (25µl) of the appropriate serum reference calibrator, control or specimen into the assigned well.
3. Add 0.100ml (100µl) of the biotinylated labeled antibody to each well. **It is very important to dispense all reagents close to the bottom of the coated well.**
4. Swirl the microplate gently for 20-30 seconds to mix and cover.
5. Incubate 60 minutes at room temperature.
6. Discard the contents of the microplate by decantation or aspiration. If decanting, tap and blot the plate dry with absorbent paper.
7. Add 0.350ml (350µl) of wash buffer (see "Reagent Preparation"), decant (tap and blot) or aspirate. Repeat two (2) additional times for a total of three (3) washes. **An automatic or manual plate washer can be used. Follow the manufacturer's instruction for proper usage. If a squeeze bottle is employed, fill each well by depressing the container (avoiding air bubbles) to dispense the wash. Decant the wash and repeat two (2) additional times.**
8. Add 0.100ml (100µl) of the CA19-9 Enzyme Reagent labeled antibody to each well.  
**DO NOT SHAKE THE PLATE AFTER ENZYME ADDITION**
9. Cover and incubate 60 minutes at room temperature.
10. Discard the contents of the microplate by decantation or aspiration. If decanting, blot the plate dry with absorbent paper.
11. Add 0.350ml (350µl) of wash buffer (see Reagent Preparation Section), decant (tap and blot) or aspirate. Repeat two (2) additional times for a total of three (3) washes. **An automatic or manual plate washer can be used. Follow the manufacturer's instruction for proper usage. If a squeeze bottle is employed, fill each well by depressing the container (avoiding air bubbles) to dispense the wash. Decant the wash and repeat two (2) additional times.**
12. Add 0.100 ml (100µl) of working substrate solution to all wells (see Reagent Preparation Section). **Always add reagents in the same order to minimize reaction time.**
13. Incubate at room temperature for fifteen (15) minutes.
14. Add 0.050ml (50µl) of stop solution to each well and gently mix for 15-20 seconds.
15. Read the absorbance in each well at 450nm (using a reference wavelength of 620-630nm to minimize well imperfections) in a microplate reader. **The results should be read within thirty (30) minutes of adding the stop solution.**

**DO NOT SHAKE THE PLATE AFTER SUBSTRATE ADDITION**

14. Incubate at room temperature for fifteen (15) minutes.
14. Add 0.050ml (50µl) of stop solution to each well and gently mix for 15-20 seconds.
15. Read the absorbance in each well at 450nm (using a reference wavelength of 620-630nm to minimize well imperfections) in a microplate reader. **The results should be read within thirty (30) minutes of adding the stop solution.**

**10.0 CALCULATION OF RESULTS**

A dose response curve is used to ascertain the concentration of CA19-9 in unknown specimens.

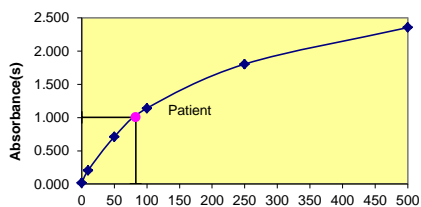
1. Record the absorbance obtained from the printout of the microplate reader as outlined in Example 1.
2. Plot the absorbance for each duplicate serum reference versus the corresponding CA 19-9 concentration in U/ml on linear graph paper (do not average the duplicates of the serum references before plotting).
3. Draw the best-fit curve through the plotted points.
4. To determine the concentration of CA 19-9 for an unknown, locate the average absorbance of the duplicates for each unknown on the vertical axis of the graph, find the intersecting point on the curve, and read the concentration (in U/ml) from the horizontal axis of the graph (the duplicates of the unknown may be averaged as indicated). In the following example, the average absorbance (1.004) intersects the dose response curve at 82.9U/ml CA 19-9 concentration (See Figure 1).

**Note:** Computer data reduction software designed for ELISA assay may also be used for the data reduction. **If such software is utilized, the validation of the software should be ascertained.**

**EXAMPLE 1**

Sample I.D.	Well Number	Abs (A)	Mean Abs (B)	Value (U/ml)
Cal A	A1	0.013	0.014	0
	B1	0.014		
Cal B	C1	0.210	0.208	10
	D1	0.212		
Cal C	E1	0.754	0.708	50
	F1	0.662		
Cal D	G1	1.128	1.140	100
	H1	1.152		
Cal E	A2	1.850	1.805	250
	B2	1.760		
Cal F	C2	2.310	2.355	500
	D2	2.400		
Patient	A3	1.009	1.004	82.9
	B3	0.999		

**Figure 1**



CA 19-9 Values in U/ml

\*The data presented in Example 1 and Figure 1 is for illustration only and **should not** be used in lieu of a dose response curve prepared with each assay.

**11.0 Q.C. PARAMETERS**

In order for the assay results to be considered valid the following criteria should be met:

- The absorbance (OD) of calibrator F should be  $\geq 1.3$
- Four out of six quality control pools should be within the established ranges.

**12.0 RISK ANALYSIS**

The MSDS and Risk Analysis Form for this product are available on request from Monobind Inc.

**12.1 Assay Performance**

- It is important that the time of reaction in each well is held constant to achieve reproducible results.
- Pipetting of samples should not extend beyond ten (10) minutes to avoid assay drift.
- Highly lipemic, hemolyzed or grossly contaminated specimen(s) should not be used.
- If more than one (1) plate is used, it is recommended to repeat the dose response curve.
- The addition of substrate solution initiates a kinetic reaction, which is terminated by the addition of the stop solution. Therefore, the substrate and stop solution should be added in the same sequence to eliminate any time-deviation during reaction.
- Plate readers measure vertically. Do not touch the bottom of the wells.
- Failure to remove adhering solution adequately in the aspiration or decantation wash step(s) may result in poor replication and spurious results.
- Use components from the same lot. No intermixing of reagents from different batches.
- Patient specimens with CA 19-9 concentrations above 500U/ml may be diluted (for example 1/10 or higher) with CA19-9 zero calibrator and re-assayed. The sample's

concentration is obtained by multiplying the result by the dilution factor (10).

- Accurate and precise pipetting, as well as following the exact time and temperature requirements prescribed are essential. Any deviation from Monobind's IFU may yield inaccurate results.
- All applicable national standards, regulations and laws, including, but not limited to, good laboratory procedures, must be strictly followed to ensure compliance and proper device usage.
- It is important to calibrate all the equipment e.g. Pipettes, Readers, Washers and/or the automated instruments used with this device, and to perform routine preventative maintenance.
- Risk Analysis - as required by CE Mark IVD Directive 98/79/EC - for this and other devices, made by Monobind, can be requested via email from [Monobind@monobind.com](mailto:Monobind@monobind.com).

**12.2 Interpretation**

- Measurements and interpretation of results must be performed by a skilled individual or trained professional.**
- Laboratory results alone are only one aspect for determining patient care and should not be the sole basis for therapy, particularly if the results conflict with other determinants.
- The reagents for the test system procedure have been formulated to eliminate maximal interference; however, potential interaction between rare serum specimens and test reagents can cause erroneous results. Heterophilic antibodies often cause these interactions and have been known to be problems for all kinds of immunoassays. (Boscato LM Stuart MC. 'Heterophilic antibodies: a problem for all immunoassays' Clin.Chem. 1988;34:27-33). For diagnostic purposes, the results from this assay should be used in combination with clinical examination, patient history and all other clinical findings.
- For valid test results, adequate controls and other parameters must be within the listed ranges and assay requirements.
- If test kits are altered, such as by mixing parts of different kits, which could produce false test results, or if results are incorrectly interpreted, **Monobind shall have no liability.**
- If computer controlled data reduction is used to interpret the results of the test, it is imperative that the predicted values for the calibrators fall within 10% of the assigned concentrations.
- CA 19-9 has a low clinical sensitivity and specificity as a tumor marker. Clinically an elevated **CA 19-9 value alone is not of diagnostic value as a test for cancer** and should only be used in conjunction with other clinical manifestations (observations) and diagnostic parameters.

**13.0 EXPECTED RANGES OF VALUES**

The serum CA 19-9 is elevated in 1% of normal healthy women, 3% of normal healthy women with benign ovarian diseases, 6% of patients with non-neoplastic conditions (including but not limited to first trimester pregnancy, menstruation, endometriosis uterine fibrosis, acute salpingitis, hepatic diseases and inflammation of peritoneum or pericardium).

**TABLE I**

Expected Values for CA 19-9 AccuBind® ELISA Test System	Healthy and non-pregnant subjects
	$\leq 40$ U/ml

It is important to keep in mind that establishment of a range of values, which can be expected to be found by a given method for a population of "normal" persons, is dependent upon a multiplicity of factors: the specificity of the method, the population tested and the precision of the method in the hands of the analyst. For these reasons, each laboratory should depend upon the range of expected values established by the Manufacturer only until an in-house range can be determined by the analysts using the method with a population indigenous to the area in which the laboratory is located.

**14.0 PERFORMANCE CHARACTERISTICS**

**14.1 Precision**

The within and between assay precision of the CA 19-9 AccuBind® ELISA test system were determined by analyses on three different levels of control sera. The number, mean value, standard deviation ( $\sigma$ ) and coefficient of variation for each of these control sera are presented in Table 2 and Table 3.

**TABLE 2**  
Within Assay Precision (Values in U/ml)

Sample	N	X	$\sigma$	C.V.
Level 1	20	3.1	0.22	7.1%
Level 2	20	28.0	1.42	5.0%
Level 3	20	161.2	4.21	2.6%

**TABLE 3**  
Between Assay Precision\* (Values in U/ml)

Sample	N	X	$\sigma$	C.V.
Level 1	10	3.7	0.34	9.2%
Level 2	10	25.3	1.81	7.1%
Level 3	10	154.0	5.11	3.4%

\*As measured in ten experiments in duplicate.

**14.2 Sensitivity**

The CA 19-9 AccuBind® ELISA test system has a sensitivity of 1.0 U/ml. The sensitivity was ascertained by determining the variability of the '0' calibrator and using the  $2\sigma$  (95% certainty) statistic to calculate the minimum dose.

**14.3 Accuracy**

The CA 19-9 AccuBind® ELISA test system was compared with a reference method. Biological specimens from low, normal, and elevated concentrations were assayed. The total number of such specimens was 136. The least square regression equation and the correlation coefficient were computed for the CA 19-9 in comparison with the reference method. The data obtained is displayed in Table 4.

**TABLE 4**

Method	Mean	Least Square Regression Analysis	Correlation Coefficient
This Method (X)	18.62	$x = 1.4577 + 0.8837(y)$	0.955
Reference (Y)	19.43		

**14.4 Specificity**

In order to test the specificity of the antibody pair used massive concentrations of possible cross-reactants were added to known serum pools and assayed in parallel with the base sera. No cross reaction was found. Percent cross-reactions for some of these additions are listed below in Table 5.

**TABLE 5**

Analyte	Concentration	Percent (%) Cross Reaction
CA 19-9	-	100
CA 125	10000 U/ml	0.001
CA 15-3	1000 U/ml	ND*
PSA	5000 ng/ml	ND*
AFP	10000 ng/ml	ND*
CEA	10000 ng/ml	ND*
HCG	10000 mIU/ml	ND*
RF	1000 kIU/ml	ND*

**15.0 REFERENCES**

- Zamcheck, N, *Adv Intern Med*, 19, 413 (1974).
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of patients with ovarian cancer", *Curr Opin Gynecol*, 9, 8-13 (1997).

Revision: 4 Date: 2019-Jul-16 DCO: 1353  
MP3925 Product Code: 3925-300

Size	96(A)	192(B)	
Reagent (fill)	A)	1ml set	1ml set
	B)	1 (13ml)	2 (13ml)
	C)	1 (13ml)	2 (13ml)
	D)	1 plate	2 plates
	E)	1 (20ml)	1 (20ml)
	F)	1 (7ml)	2 (7ml)
	G)	1 (7ml)	2 (7ml)
	H)	1 (8ml)	2 (8ml)

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**Glossary of Symbols**  
(EN 980/ISO 15223)

IVD In Vitro - Diagnostic Medical Device  
Temperature Limitation Storage Condition (2-8°C)  
Consult Instructions for Use  
REF Catalogue Number  
Contains Sufficient Test for Z  
Used By (Expiration Day)  
Date of Manufacturer  
Manufacturer  
EC REP Authorized Rep in European Country  
CE European Conformity