



## Evacuated Blood Collection System For In Vitro Diagnostic Use

**Intended Use:** VACUETTE® Tubes, Holders and Needles are used together as a system for the collection of venous blood. VACUETTE® tubes are used to collect, transport and process blood for testing serum, plasma or whole blood in the clinical laboratory.

**Product Description:** VACUETTE® tubes are plastic tubes with a pre-defined vacuum for exact draw volumes. They are fitted with color coded VACUETTE® SAFETY Caps (see table below). The tubes, additive concentrations, volumes of liquid additives, and their permitted tolerances, as well as the blood-to-additive ratio, are in accordance to the requirements and recommendations of the international standards ISO 6710 "Single-use containers for venous blood specimen collection" and the Clinical and Laboratory Standards Institute's Approved Standards (CLSI). Additive choice depends on the analytical test method. It is specified by the manufacturer of the test reagents and/or instrument on which the test is performed. Tube interiors are sterile.

### VACUETTE® SAFETY Cap Color Codes

Description	SAFETY Cap Color	Cap Inner Ring Color
<b>No Additive Tubes</b> No Additive	white	black
<b>Coagulation Tubes</b> Sodium Citrate 3.2% Sodium Citrate 3.8%	light blue light blue	black black
<b>Serum Tubes</b> Clot Activator Clot Activator w/Gel	red red	black yellow
<b>Heparin Tubes</b> Lithium Heparin Lithium Heparin w/Gel Sodium Heparin	green green green	black yellow black
<b>EDTA Tubes</b> K2EDTA K3EDTA	lavender lavender	black black
<b>EDTA Tubes</b> K2EDTA K2EDTA w/Gel K3EDTA	lavender lavender lavender	black yellow black
<b>Glycolytic Inhibitor Tubes</b> Potassium Oxalate/Sodium Fluoride (PO/NaF)	grey	black
<b>Trace Element Tubes</b> Sodium Heparin No Additive	royal blue royal blue	black black
<b>ESR Tubes</b> Sodium Citrate 3.2%	black	black

(Tubes with a white inner cap ring refer to smaller draw volumes of 1 ml or 2ml.)

### VACUETTE® Coagulation Tubes

VACUETTE® Coagulation Tubes are filled with buffered tri-sodium citrate solution. Citrate concentrations of either 0.109M (3.2%) or 0.129M (3.8%) are available. The choice of the concentration depends upon the policies of the laboratories. The mixing ratio is 1 part citrate to 9 parts blood.

### VACUETTE® Serum Tubes

VACUETTE® Serum Tubes are coated with micronized silica particles which activate clotting when tubes are gently inverted. VACUETTE® No Additive Tubes and VACUETTE® Serum Clot Activator Tubes may be used for routine immunohematology testing i.e., red cell grouping, Rh typing and antibody screening. VACUETTE® No Additive Tubes and VACUETTE® Serum Clot Activator Tubes may be used for viral marker testing in screening and clinical laboratories.

VACUETTE® Serum Tubes with Gel contain a barrier gel that is present in the bottom of the tube. The specific gravity of this material lies between the blood clot and the serum. During centrifugation, the barrier gel moves upward to the serum - clot interface, where it forms a stable barrier, separating the serum from fibrin and cells. Serum may be aspirated directly from the collection tube, which eliminates the need for transfer to another container. For specific parameter stability, refer to the recommendations of the assay and/or instrument manufacturer and/or specific CLSI documents (i.e., guidelines, standards). VACUETTE® Serum Clot Activator with Gel Tubes may be used for therapeutic drug monitoring (TDM) testing. Drugs may be stable in the primary tube up to 48 hours under the recommended storage conditions.

**NOTE:** Before sending the tubes by mail or through a pneumatic post system, the gel tubes should sit upright for one hour after centrifugation in room temperature, to minimize the risk of impairing the gel barrier through shock movements (vibration).

### VACUETTE® Heparin Tubes

The interior of the tube wall is coated with lithium heparin or sodium heparin. The anticoagulant heparin activates antithrombins which block the coagulation cascade and produce a whole blood / plasma sample instead of clotted blood plus serum.

VACUETTE® Plasma Tubes with Lithium Heparin and Gel contain a barrier gel in the tube. The specific gravity of this material lies between the blood cells and plasma. During centrifugation the gel barrier moves upward, where it forms a stable barrier separating the plasma from cells. Plasma may be aspirated directly from the collection tube, which eliminates the need for transfer to another container. For specific parameter

stability, refer to the recommendations of the assay and/or instrument manufacturer and/or specific CLSI documents (i.e., guidelines, standards). Do not use VACUETTE® Plasma Tubes with Lithium Heparin or with Lithium Heparin and Gel for lithium determinations or blood banking procedures. Do not use VACUETTE® Plasma Tubes with Sodium Heparin for sodium determinations or blood banking procedures.

**NOTE:** Before sending the tubes by mail or through a pneumatic post system, the gel tubes should sit upright for one hour after centrifugation in room temperature, to minimize the risk of impairing the gel barrier through shock movements (vibration).

### VACUETTE® EDTA Tubes

The interior of the tube wall is coated with either K2EDTA or K3EDTA. The EDTA binds calcium ions and blocks the coagulation cascade. VACUETTE® EDTA Tubes can be used in the closed mode with direct sampling analyzers. For parameter stability information, i.e., whole blood count (CBC) and differential (DIFF), follow the recommendations of the assay and/or instrument manufacturer. In addition, also refer to specific CLSI documents (i.e., guidelines, standards) for additional information.

VACUETTE® K3EDTA and K2EDTA Tubes may be used for routine immunohematology testing, i.e., red cell grouping, Rh typing and antibody screening. VACUETTE® K2EDTA and VACUETTE® K3EDTA Tubes may be used for viral marker testing in screening and clinical laboratories. VACUETTE® K3EDTA and K2EDTA Tubes are used for testing plasma in molecular diagnostics. The performance characteristics of this device have not been established for molecular diagnostics in general. Users must validate use of product for their specific molecular diagnostic assay. VACUETTE® K2EDTA with Gel Tubes are used for testing plasma in molecular diagnostics. For best results, centrifuge the VACUETTE® K2EDTA Gel Tubes within 6 hours after blood collection. For mid-term storage (2 weeks at -20°C.) or long-term storage (greater than 2 weeks at -70°C), transfer plasma to a secondary container, i.e., cryo vials and freeze.

### VACUETTE® Glycolytic Inhibitor Tubes

The tubes contain an anticoagulant and a stabilizer: potassium oxalate and sodium fluoride. VACUETTE® Glycolytic Inhibitor Tubes are suitable for the analysis of blood glucose and lactate.

### VACUETTE® Trace Element Tubes

VACUETTE® Trace Element Tubes contain sodium heparin or no additive and are used to test trace elements.

### VACUETTE® ESR Tubes

VACUETTE® ESR Tubes contain a 0.109M (3.2%) buffered tri-sodium citrate solution. The mixing ratio is 1 part citrate solution to 4 parts blood. VACUETTE® ESR Tubes are used for the collection and transport of venous blood for blood sedimentation rate testing. ESR measurements refer to the Westergren method.

### VACUETTE® ESR Systems

#### Closed VACUETTE® ESR System

The system consists of two parts:

- A 9/120mm glass tube with a citrate solution. Draw volumes of 1.6ml or 2.9ml are available.
- ESR rack with a scale suitable for 1.6ml tubes or an ESR rack with a scale suitable for 2.9ml tubes.

#### Procedures for closed VACUETTE® ESR measurement:

1. After sampling and also before starting the ESR measurement, gently invert the tube 5-10 times to obtain the correct mixture. Use of a rotating mixer is recommended.
2. Place the 1.6ml or the 2.9ml tube vertically, into the corresponding rack. Align the 0 mark at the top of scale with the bottom of the meniscus of the blood at the blood-air interface.

For the 1.6ml ESR tube, set the timer for 30 minutes.

The ESR rack suitable for 1.6ml tubes, delivers only the 1-hour Westergren value after 30 minutes of reading time.

For the 2.9ml ESR tube, set the timer for 60 minutes. The ESR rack for the 2.9ml tubes, delivers 1 hour and 2 hour Westergren values after 60 and 120 minutes of reading times.

3. Discard all closed VACUETTE® ESR Tubes in an approved biohazard container.  
The conversion scale becomes highly compressed above Westergren values of 100mm. If more precise values are required, ESR readings above this value should be repeated using the classic Westergren method.

### VACUETTE® Precautions/Cautions

#### For in vitro diagnostic use

##### Precautions

Do not use tubes if foreign matter is present!

##### Cautions

1. Handle all biological samples and blood collection “sharps” (lancets, needles, luer adapters, and blood collection sets) according to the policies and procedures of your facility.
2. Obtain appropriate medical attention in the case of any exposure to biological samples (for example, through a puncture injury), because of the possible transmission of HIV (AIDS), viral hepatitis or other infectious diseases.
3. Discard all blood collection “sharps” in approved biohazard containers.
4. Transferring a sample from a syringe to a tube is not a recommended procedure. Additional manipulation of sharps increases the potential for a needle stick injury. Using a syringe for blood transfer may also cause over or under filling of tubes, an incorrect blood-to-additive ratio and erroneous test results. In addition, depressing the syringe plunger during transfer can create a positive pressure, forcefully displacing the stopper and sample, resulting in a potential blood exposure. The use of the VACUETTE® Blood Transfer Unit is highly recommended. If blood is collected through an intravenous (IV) line, follow the policies and procedures of your institution to ensure that the line has been cleared of IV solution before beginning to fill the blood collection tubes. This is critical to avoid erroneous laboratory data from IV fluid contamination.
6. All liquid preservatives and anticoagulants are clear and colorless. Do not use if discoloration or precipitates are present.
7. Do not use the tubes after the expiration date.

##### Storage

Store tubes at 4–25°C (40–77°F).

**NOTE:** Avoid exposure to direct sunlight. Exceeding the maximum recommended storage temperature may lead to impairment of the tube quality (i.e. vacuum loss, drying out of liquid additives, coloring, etc.)

## Specimen Collection and Handling

READ THIS ENTIRE CIRCULAR BEFORE PERFORMING VENIPUNCTURE.

### Equipment required for specimen collection.

Be sure that the following materials are readily accessible before performing venipuncture:

1. All necessary tubes, identified for size, draw and additive.
2. Labels for positive patient identification of samples.
3. Blood collection needles and holders - **NOTE:** Greiner VACUETTE® devices (needles, single-use holders, safety devices) are designed to be used as a system of products. The integration of other manufacturer's products with a Greiner VACUETTE® device is solely the responsibility of the user.
4. Appropriate apparel, i.e., gloves (i.e., latex-free), laboratory coat, goggles, for protection from exposure to bloodborne pathogens.
5. Alcohol swab for cleansing site
6. Dry sterile gauze
7. Tourniquet (i.e., single-use, latex-free)
8. Adhesive plaster or bandage (i.e. hypoallergenic)
9. Approved biohazard container

### Recommended Order of Draw: (according to CLSI H3-A5 Standard)

1. Blood Culture tube
2. Coagulation tube
3. Serum tube with or without clot activator, with or without gel
4. Heparin tube with or without gel plasma separator
5. EDTA tube
6. Glycolytic Inhibitor tube

**NOTE:** If a winged blood collection set is used, the first tube in the series will be under-filled. Therefore, if a coagulation specimen is drawn first, a discard tube (a non-additive or coagulation tube) is recommended to be drawn prior to this tube to ensure the proper anticoagulant-to-blood ratio. In addition, even though studies have shown that PT and APTT tests are not affected if drawn first in a tube series, it is advisable to draw a second tube for other coagulation assays, since it is not known whether or not these tests will be affected.

**NOTE:** Always follow your facility's protocol for Order of Draw.

### Prevention of Backflow

Most evacuated blood collection tubes contain chemical additives. Therefore, it is important to avoid possible backflow from the tube, due to the possibility of adverse patient reactions. To prevent backflow from the tube into the patient's arm, observe the following precautions:

1. Place the patient's arm in a downward position.
2. Hold the tube with the cap uppermost.
3. Release the tourniquet as soon as blood starts to flow into the tube.
4. Make sure the tube contents do not touch cap or end of the needle during venipuncture.

## Venipuncture Technique and Specimen Collection

### General Instructions

**WEAR GLOVES DURING VENIPUNCTURE AND WHEN HANDLING BLOOD COLLECTION TUBES TO MINIMIZE EXPOSURE HAZARD.**

1. Select the tube or tubes appropriate for the required specimen.
2. Remove the cover over the valve section of the needle.
3. Thread the needle into the holder. Be sure needle is firmly seated to ensure that the needle does not unthread during usage.
4. Apply the tourniquet. Do not exceed one minute. Localized stasis with hemoconcentration and infiltration of blood into tissue may occur, resulting in erroneously high values for specific analytes, i.e., based analytes, packed cell volume, and other cellular elements.) Prepare venipuncture site with an appropriate antiseptic. **DO NOT PALPATE VENIPUNCTURE AREA AFTER CLEANSING.**
5. Place the patient's arm in a downward position.
6. Remove needle shield. Perform the venipuncture WITH THE ARM DOWNWARD AND TUBE CAP UPPER-MOST.
7. Push the tube into the holder and onto the needle valve puncturing the rubber diaphragm. Center the tubes in the holder when penetrating the cap to prevent sidewall penetration and subsequent premature vacuum loss.
8. **REMOVE THE TOURNIQUET AS SOON AS BLOOD APPEARS IN THE TUBE. DO NOT ALLOW CONTENTS OF TUBE TO CONTACT THE CAP OR END OF THE NEEDLE DURING PROCEDURE.** Always hold the tube in place by pressing it with a thumb. This will ensure a complete vacuum draw.

**NOTE:** Blood may occasionally leak from the needle sleeve. Practice universal safety precautions to minimize hazard exposure.

If no blood flows into tube or if blood flow ceases before an adequate specimen is collected, the following steps are suggested to complete a satisfactory collection:

- a) Push the tube forward until the tube cap has been penetrated. Always hold it in place by pressing it with the thumb to ensure a complete vacuum draw.
  - b) Confirm the correct position of the needle in the vein.
  - c) If blood still does not flow, remove the tube and place the new tube onto the holder.
  - d) If the second tube does not draw, remove the needle and discard. Repeat the procedure from step 1.
9. When the first tube is full and the blood flow ceases, gently remove it from the holder. Place the succeeding tubes in the holder. Refer to the recommended Order of Draw. Gently invert each tube immediately as it is removed from the holder, using the correct number of inversions to achieve the proper mix of additive and blood. Turn the filled tube upside down and return it to an upright position. This is one complete inversion.  
**NOTE:** Do not shake the tubes. Vigorous mixing may cause foaming or hemolysis. Insufficient mixing or delayed mixing in serum tubes may result in delayed clotting. In tubes with anticoagulants, inadequate mixing may result in platelet clumping, clotting and/or incorrect test results.
  10. As soon as the blood stops flowing in the last tube, remove the needle from the vein. Activate the safety mechanism of the device. Apply pressure to the puncture site with a dry sterile swab until the bleeding stops. Once clotting has occurred, apply a bandage, if desired. Hypoallergenic adhesives may be advisable.

**NOTE:** After the completion of the venipuncture procedure, the top of the cap may contain residual blood. Take the proper precautions when handling tubes to avoid contact with this blood. Dispose of the used needle safety device in an approved biohazard container.

## Centrifugation

Ensure that tubes are properly seated in the centrifuge carrier. Incomplete seating may result in the separation of the VACUETTE® SAFETY Cap from the tube.

**NOTE:** VACUETTE® Serum Tubes should be centrifuged 30 minutes after blood collection to minimize post clotting (build up fibrin) in serum. This could lead to contamination of the instrument and to erroneous results.

Tube Type	Recommended Inversions	Recommended g-force relative centrifugal force (rcf)	Recommended Time Minutes
VACUETTE® Serum Tubes (Clot Activator, No Additive)	5-10	Minimum 1500 g	10
VACUETTE® Serum Clot Activator w/Gel Tubes	5-10	1800 g	10
VACUETTE® K2EDTA w/Gel Tubes	8-10	1800 – 2200 g	10
VACUETTE® Plasma Tubes (Lithium Heparin, Sodium Heparin, PO/NaF)	5-10	2000 – 3000 g	15
VACUETTE® Lithium Heparin w/Gel Tubes	5-10	2200 g	15
VACUETTE® Coagulation Tubes (Sodium Citrate)	4		
Platelet tests (PRP)		150 g	5
Routine tests (PPP)		1500 – 2000 g	10
Preparation for deep freeze plasma (PFP)		2500 – 3000 g	20

Barriers are more stable when tubes are spun in centrifuges with horizontal swing-out rotors rather than those with fixed angle heads. Centrifugation should be done in a temperature-controlled centrifuge that maintains 15-25°C. Higher temperatures could have negative effects on the physical properties of the gel. Ideal separation of serum or plasma is achieved in this temperature range.

**NOTE:** Gel separation tubes should be centrifuged no later than 2 hours after collection. Extended contact of blood cells with the serum or plasma may lead to erroneous test results.

**NOTE:** It is not recommended to re-centrifuge tubes once the barrier has been formed. The re-centrifugation of tubes may lead to possible impairment of the gel barrier, causing the gel particles to separate and appear in the serum or plasma.

**NOTE:** Before sending the tubes by mail or through a pneumatic post system, the gel tubes should sit upright for one hour after centrifugation at room temperature in order to minimize the risk of impairing the gel barrier through shock movements (shaking).

### VACUETTE® Safety Caps

The VACUETTE® blood collection system features a unique safety cap designed to minimize aerosol generation. There are two different closure systems - pull and twist caps.

**13mm tubes with pull caps:** pull caps are removed with a pull action.





**13mm tubes with twist caps:** twist caps are removed by twisting the cap in a counter-clockwise direction with a twist-pull action. The cap cannot be removed by a simple pull action.

**16 mm tubes:** all 16mm tubes have pull caps that are removed with a pull action.

### Disposal

1. Follow OSHA and CDC Universal Precaution procedures to prevent the transmission of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other bloodborne pathogens.
2. Use protective equipment and wear disposable latex gloves (sensitivity/allergy appropriate) to prevent the risk of infection.
3. Follow OSHA and the policies and procedures of your facility for the disposal of contaminated equipment and specimen collection devices.

### Label Information

	Expiry Date: shows expiration date of tube. Tubes can be used through the end of the indicated month		Lot Number: batch number
	Reference Number: individual tubes can be ordered using these item numbers		Method of sterilization (radiation)

### References:

#### ISO / EN / ANSI/AAMI Standards

ISO 6710 "Single-use containers for venous blood specimen collection"

ANSI/AAMI/ISO 1137 "Sterilisation of health care products – Requirements for validation and routine control – Radiation sterilisation"

EN 552 "Sterilisation of medical devices – Validation and routine control of sterilisation by irradiation"

#### Clinical and Laboratory Standards Institute (CLSI)

H1-A5 "Evacuated Tubes and Additives for Venous Blood Specimen Collection: Approved Standard - 5<sup>th</sup> Edition

H2-A4 "Reference and Selected Procedure for the Erythrocyte Sedimentation Rate (ESR) Test; Approved Standard - 4<sup>th</sup> Edition

H3-A5 "Procedures for the Collection of Diagnostic Blood Specimens by Venipuncture"; Approved Standard-5th Edition

H21-A4 "Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays; Approved Guideline - 4th Edition.

H18-A3 Procedures for the Processing and Handling of Blood Specimens; Approved Guideline - 3<sup>rd</sup> Edition.

H20-A Reference Leukocyte Differential Count (Proportional) and Evaluation of Instrumental Methods; Approved Standard.

H26-A Performance Goals for the Internal Quality Control of Multichannel Hematology Analyzers; Approved Standard.



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