
**BD Vacutainer™ PLUS SST™ and Serum Tubes,
Catalog #367969 and #367895:
A Comparative Evaluation of the 16mm BD Hemogard™ Closures
with Respect to User Exposure to Blood and
Cap Removal and Reinsertion Forces**

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INTRODUCTION

B D Vacutainer Systems (BDVS) currently manufactures both a PLUS SST™ (Catalog # 367969) and Serum tube (Catalog # 367895) with a 16mm BD Hemogard™ Closure. This closure has a rubber stopper with a skirted plastic shield. The shield on the SST™ tube is gold in color with a solid red rubber stopper, while the shield on the Serum tube is a solid red color with a grey rubber stopper. The 16mm BD Hemogard™ closure is an enlarged version of the current 13mm BD Hemogard™ Closure and contains all of the same design features. These include reduction of blood exposure (splatter) during capping and recapping procedures, preventing blood from contaminating work surfaces. This evaluation was initiated to assess user exposure to blood and relative ease of removing and reinserting the 16mm BD Hemogard™ closure and included 13x100mm and 16x100mm BD Vacutainer™ PLUS SST™ tubes with BD Hemogard™ Closures, Catalog #s 367986 and 367969, 13x100mm and 16x100mm BD Vacutainer™ PLUS Serum tubes with BD Hemogard™ Closures, Catalog #s 367814 and 367895, 16x100mm BD Vacutainer™ PLUS SST™ and Serum tubes with conventional rubber stopper, Catalog #s 367988 and 367820 and the following competitive product: Greiner Vacuette® Gel tubes, Catalog # 455071.

OBJECTIVES

The objective of this evaluation is to compare the amount of blood splattered within a designated area on a piece of white paper upon stopper and closure removal and reinsertion, blood splatter on the user's gloves upon stopper and closure removal and reinsertion, the ease of removing and reinserting the closures, and the presence of blood on the outside rim of the tube upon reinsertion of the closure.

METHODS

Twelve different phlebotomists conducted this study in which three sets of seven tubes (13x100mm and 16x100mm BD Vacutainer™ PLUS SST™ tubes with Hemogard™ Closures, 13x100mm and 16x100mm BD Vacutainer™ PLUS Serum tubes with BD Hemogard™ Closures, 16x100mm BD Vacutainer™ PLUS SST™ and Serum tubes with conventional rubber stopper, and Greiner Vacuette® Gel tubes) were filled using a BD Vacutainer™ Standard Yellow Holder with Multiple Sample Needle with citrated sheep blood. Each tube was mixed using 10 complete inversions. White paper was placed behind a plastic biohazard shield. Each tube was held vertically 6 inches above the center point of the paper. The closures and stoppers were removed. Observations for the presence of blood droplets on the paper and gloves were made and recorded. The closures and stoppers were reinserted and observations were again made for the presence of blood droplets on the paper, gloves and outside rim of the tube.

The force of removal and reinsertion was also evaluated.

RESULTS AND DISCUSSION

Results of the blood exposure observations (splatter) and removal and reinsertion forces are summarized in the table below:

Observations	16x100mm Conventional PLUS SST™ Tube Cat #367988	13x100mm Hemogard™ PLUS SST™ Tube Cat #367986	16x100mm Conventional PLUS Serum Tube Cat #367820
Cap Removal Force (As expected/Easier/Harder)	21 As expected 2 Easier 13 Harder	28 As expected 4 Easier 4 Harder	23 As expected 10 Easier 3 Harder
Splatter on Gloves upon removal (Yes/No)	13 Yes 23 No	0 Yes 36 No	13 Yes 23 No
Splatter on paper upon removal (Yes/No)	4 Yes 32 No	0 Yes 36 No	6 Yes 30 No
Cap Reinsertion Force (As expected/Easier/Harder)	10 As expected 2 Easier 24 Harder	28 As expected 4 Easier 4 Harder	21 As expected 12 Easier 3 Harder
Splatter on Gloves upon reinsertion (Yes/No)	22 Yes 14 No	0 Yes 36 No	15 Yes 21 No
Splatter on paper upon reinsertion (Yes/No)	3 Yes 33 No	0 Yes 36 No	1 Yes 35 No
Blood on Outside Rim of the Tube (Yes/No)	22 Yes 14 No	Not evaluated	Not evaluated

13x100mm Hemogard™ PLUS Serum Tube Cat #367814	16x100mm Hemogard™ PLUS SST™ Tube Cat #367969	16x100mm Hemogard™ PLUS Serum Tube Cat #367895	16x100mm GreinerVacuette® Gel Tube Safety Closure Cat #455071
18 As expected 16 Easier 2 Harder	30 As expected 4 Easier 2 Harder	21 As expected 13 Easier 2 Harder	6 As expected 0 Easier 30 Harder
0 Yes 36 No	0 Yes 36 No	3 Yes 33 No	1 Yes 34 No
1 Yes 35 No	0 Yes 36 No	1 Yes 35 No	3 Yes 32 No
16 As expected 20 Easier 0 Harder	28 As expected 8 Easier 0 Harder	15 As expected 20 Easier 1 Harder	20 As expected 3 Easier 12 Harder
2 Yes 34 No	0 Yes 36 No	1 Yes 35 No	0 Yes 35 No
0 Yes 36 No	0 Yes 36 No	0 Yes 36 No	0 Yes 35 No
Not Evaluated	0 Yes 36 No	1 Yes 35 No	1 Yes 35 No

Cap Removal

The 16mm SST™ and Serum BD Hemogard™ Closures demonstrated easier removal when compared to both the 16mm conventional stopper and the Greiner Vacuette® safety closure and equivalent removal when compared to the 13mm BD Hemogard™ Closure.

Cap Reinsertion

For Cap Reinsertion Forces, the 16mm SST™ BD Hemogard™ Closure performed better than the 16mm Conventional Stopper and the Greiner Vacuette® safety closure and the same as the 13mm BD Hemogard™ Closure.

For Cap Reinsertion Forces, the 16mm Serum BD Hemogard™ Closure performed essentially the same as the 16mm Conventional Stopper, the 13mm BD Hemogard™ Closure and the Greiner Vacuette® safety closures.

Splatter on Gloves and Paper

For Splatter on the Gloves upon Removal, the 16mm SST™ and Serum BD Hemogard™ Closures performed better than the 16mm Conventional Stopper and essentially the same as the 13mm BD Hemogard™ Closure and the Greiner Vacuette® safety closure.

For Splatter on the Gloves upon Reinsertion, the 16mm SST™ and Serum BD Hemogard™ Closures performed essentially the same as the 13mm BD Hemogard™ Closure and the Greiner Vacuette® safety closure and better than the 16mm Conventional Stopper.

For Splatter on the Paper upon Reinsertion, the 16mm SST™ and Serum BD Hemogard™ Closures performed the same as the 16mm Conventional Stopper, the 13mm BD Hemogard™ Closure and the Greiner Vacuette® safety closure.

Blood on Outside Rim of Tube

For Blood on the outside rim of the tube upon reinsertion the 16mm SST™ and Serum BD Hemogard™ Closures performed better than the 16mm Conventional Stopper and equivalent to the Greiner Vacuette® safety closure.

CONCLUSION

Both the 16mm SST™ and Serum BD Hemogard™ Closures demonstrated equivalent or better performance for Cap Removal Force, Splatter on Gloves and Paper Upon Removal and Reinsertion, Cap Reinsertion Force and Blood on the Outside Rim of the Tube when compared to both the 16mm Conventional Stopper, the 13mm BD Hemogard™ Closure and the Greiner Vacuette® safety closure.

Technical assistance

For more specific information on BD Vacutainer™ products,
please call Technical Services at 800.631.0174.

