WHO Prequalification of Diagnostics Programme
PUBLIC REPORT

Product: BD FACSPresto Near-Patient CD4 Counter System
PQ number: PQDx 0197-045-00

BD FACSPresto Near-Patient CD4 Counter, BD FACSPresto Cartridge and BD FACSPresto cartridge kit[1] with product codes **651000, 657681, 655495** and associated product codes, manufactured by **Becton, Dickinson and Company**, **CE-marked regulatory version**, was accepted for the WHO list of prequalified in vitro diagnostics and was listed 19 September 2014.

Summary of Prequalification status for BD FACSPresto Near-Patient CD4 Counter with BD FACSPresto Cartridge and BD FACSPresto Cartridge kit

	Date	Outcome
Prequalification listing	18 September 2014	listed
Dossier assessment	28 August 2014	MR
Site inspection(s) of the quality management system	13 February 2017	MR
Product performance evaluation	25 August 2014	MR

MR: Meets Requirements

Report amendments and product changes

This public report has since been amended. Amendments may have arisen because of changes to the prequalified product for which the WHO has been notified and has undertaken a review. Amendments to the report are summarised in the following table, and details of each amendment are provided below.

Public report amendment	Summary of amendment	Date of report amendment
1.0	Addition of a manufacturing site (additional site), changes to manufacturing quality control procedures and labelling.	24 March 2016
2.0	Extension of the shelf life of FACSPresto Cartridge and Cartridge Kit.	21 February 2019

[1] Please note the product will be discontinued from the market on 31 July 2024.

3.0	Removal of the Tuas Singapore manufacturing site from being a manufacturing site for BD FACSPresto Near Patient CD4 Counter. Labelling updates made to the BD FACSPresto Near-Patient CD4 Counter, BD FACSPresto Cartridge, and BD FACSPresto Cartridge Kit.	26 July 2023

Intended use:

According to the claim of intended use from Becton, Dickinson and Company, BD Biosciences, *"BD FACSPresto Near-Patient CD4 System consists of BD FACSPresto Counter and BD FACSPresto cartridge which contains dried flourochrome-conjugated antibody reagents. This automated system is intended for in vitro enumeration of CD4 absolute count, CD4 percentage and hemoglobin concentration in human capillary and venous blood specimens. The number of CD4+ T cells in the peripheral blood is currently used to decide when to initiate treatment and monitor response to treatment in HIV infected individuals."*

Assay Description:

According to the claim of assay description from Becton, Dickinson and Company, BD Biosciences, "*When blood is introduced into the BD FACSPresto Cartridge, the specific antibodies bind to the surface antigens on the T lymphocytes and monocytes during the incubation period. When the stained cartridge is inserted into the counter, the dedicated software identifies and counts the CD4+ T lymphocyte absolute and percentage cells and calculates the hemoglobin concentration. The BD FACSPresto Cartridge also contains immobilised antibodies as a quality control measure which the instrument uses to ensure that the reagents are present and sufficient blood specimen volume has been added."*

Product test components:

Catalogue Number	Product Description
651000	BD FACSPresto instrument packaging includes: • Portable instrument • Power supply • Adapter Cords • Instrument Cover • Work station • Printer Paper • USB Flash Drive • BD FACSPresto Power Supply Adapter • BD FACSPresto Near-Patient CD4 counter Instruction for use
657681	BD FACSPresto Cartridge packaging includes

	• BD FACSPresto Cartridge (100 tests) • BD Disposable Pipettes (100 pipettes) • BD FACSPresto Cartridge Instruction for use
655495	FACSPresto Cartridge Kit packaging includes • BD FACSPresto Cartridge • BD FACSPresto Finger Stick Sample Collection Kit • BD Microtainer Contact-Activated Lancet • Sterile Alcohol Prep Pads • Plastic Adhesive Bandage • A sterile, Nonwoven Sponge
658210	• BD FACSPresto Instrument Carrying Case
658212	• BD FACSPresto Solar Charge Kit (includes a solar panel, solar generator and power supply)
658885	• BD FACSPresto Solar Generator
658860	• BD FACSPresto Car Battery Charger Adapter (12V DC power adaptor)

Storage:
The BD FACSPresto Cartridge should be stored at 4 to 31 °C.

Shelf-life:
23 months.

Warnings/limitations:

Refer to the current version of the manufacturer's instructions for use.

Prioritisation for prequalification:
Becton, Dickinson and Company submitted an application for prequalification of BD FACSPresto Near-Patient CD4 Counter System. Based on the established prioritisation eligibility criteria, BD FACSPresto Near-Patient CD4 Counter System was given priority for prequalification assessment.

Product dossier assessment

Becton, Dickinson and Company submitted a product dossier for BD FACSPresto Near-Patient CD4 Counter System as per the Instructions for compilation of a product dossier (PQDx_018 v1). The information submitted in the product dossier was reviewed by WHO staff and external experts (assessors) appointed by the WHO in accordance with the internal report on the screening and assessment of a product dossier (PQDx_009 v2). Based on the product dossier screening and assessment findings, a recommendation was made to accept the product dossier for BD FACSPresto Near-Patient CD4 Counter System for prequalification.

Commitments for prequalification:

The current shelf life for the FACSPresto Cartridge is 23 months at 4-31 °C and is supported by accelerated stability studies. In addition, to support the accelerated stability study, real-time stability testing is ongoing to support the extended shelf life. This proposed change has demonstrated no effect on the quality, efficacy or safety of the product. Real-time stability studies are ongoing and expected to support a shelf life of 23 months at 40 °C. This will be followed up at the next re-inspection.

Manufacturing site inspection

A comprehensive inspection was performed at the site of manufacture (2350 Qume Drive, San Jose, 95131 CA, USA) of the BD FACSCount System in February 2017 as per the Information for manufacturers on prequalification inspection procedures for the sites of manufacture of diagnostics (PQDx_014 v1). The inspection found that the manufacturer had an acceptable quality management system and good manufacturing practices in place that ensured the consistent manufacture of a product of good quality.
The manufacturer's final responses to the observations and minor nonconformities and an action plan for outstanding issues were accepted on 11 May 2017

Product performance evaluation

The BD FACSPresto Near-Patient CD4 Counter System was evaluated in two WHO collaborating laboratories in Antwerp, Belgium and Dar es Salaam, Tanzania, between May and July 2014. The evaluation was conducted using the WHO evaluation protocol (PQDx 114), also approved by in-country ethical review boards in Belgium and Tanzania. A total of 1630 fresh capillary and venous blood specimens in Tanzania and Belgium were used to study failure rates, reproducibility (intra-assay variation, inter-assay variation, inter-instrument variation, instrument precision) and agreement with the FACSCalibur as the reference method. Lastly, ease of use was assessed.

The acceptance criteria are as follows: Specimen failure should be less than 10%. For reproducibility studies, a percentage coefficient of variation (%CV) should be less than 15% for CD4+ T counts of less than or equal to 200/µL, and %CV should be less than 10% for CD4 counts of more than 200 cells/µL. The bias should be less than 10% compared to the reference method.

Specimen failure, which was defined as failure of the instrument to provide valid results, was between 0-9 % for venous whole blood and between 2.5 and 5.5% for capillary whole blood.

Testing of fresh specimens was conducted to assess the ability of the BD FACSPresto Near-Patient CD4 Counter System to provide reproducible results. The results indicated that the intra-assay variation on venous blood ranged from 4.7% to 7.0% for CD4 absolute counts and from 4.3% to 8% for CD4 percentages. The inter-instrument variability was below 4.8% for both CD4 absolute counts and CD4 percentages. The inter-assay variation for specimens kept up to 24 hours after collection ranged from 5.2% to 8% for CD4 absolute counts and CD4 percentages. Lastly, BD FACSPresto Near-Patient CD4 Counter System had precision of less than 4% for CD4 absolute counts in both venous and capillary whole blood.

Regarding the agreement with the reference method and agreement between capillary and venous whole blood specimens, the correlation coefficients were high, with minimal bias in both laboratories. The performance of BD FACSPresto Near-Patient CD4 Counter System to measure hemoglobin was not assessed in the current evaluation.

Operational characteristics of the BD FACSPresto Near-Patient CD4 Counter System were assessed using a structured questionnaire by testing personnel. The BD FACSPresto Near-Patient CD4 Counter System was found to be simple to use.

In conclusion, based on the results of evaluations conducted in two laboratories under the instruction of WHO, the performance of the BD FACSPresto Near-Patient CD4 Counter System fulfilled the WHO laboratory performance criteria using both venous and capillary whole blood specimens compared to BD FACSCalibur.

Labelling

1. Labels

2. Instructions for use

1. Labels

1.1 BD FACSPresto Cartridge labels (product code 657681)

BD

Made in USA
23-23759-00

BD

RECYCLABLE

BD FACSPresto™ Cartridge

REF 657681

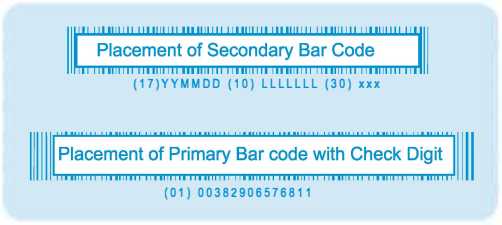
Warning

eifu.bd.com

CE 2797

IVD

LOT



Made in USA
23-23763-00

BD FACSPresto™ Finger Stick Sample Collection Kit

4 °C 31 °C

Σ 100

657682

Distributed by BD

Made in USA
23-23764-00

Becton, Dickinson and Company
BD Biosciences
2350 Qume Drive
San Jose, California 95131 USA

EC REP **Becton Dickinson Ireland Ltd.**
Donore Road, Drogheda
Co. Louth, A92 YW26
Ireland

CH REP **BD Switzerland Sàrl**
Terre Bonne Park – A4
Route de Crassier 17
1262 Eysins, Switzerland

Australian and New Zealand Distributors:

Becton Dickinson Pty Ltd.
66 Waterloo Road
Macquarie Park NSW 2113
Australia

Becton Dickinson Limited
14B George Bourke Drive
Mt. Wellington Auckland 1060
New Zealand

bdbiosciences.com
ClinicalApplications@bd.com

23-23765-00

1.2 FacsPresto Cartridge Kit labels (product code 655495)

BD

Made in USA
23-23761-00

BD

RECYCLABLE

BD

Made in USA
23-23761-00

BD

RECYCLABLE

BD FACSPresto™ Cartridge Kit

REF 655495

- BD FACSPresto™ Cartridge
- BD FACSPresto™ Finger Stick Sample Collection Kit

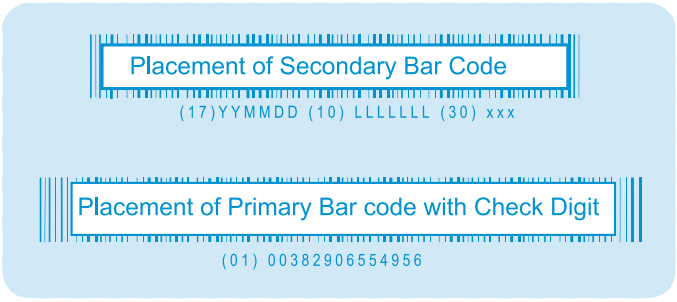




Warning

eifu.bd.com





LOT

Distributed by BD

Assembled in USA of US and imported parts.

23-23762-00

Becton, Dickinson and Company
BD Biosciences
2350 Qume Drive
San Jose, California 95131 USA

EC REP **Becton Dickinson Ireland Ltd.**
Donore Road, Drogheda
Co. Louth, A92 YW26
Ireland

CH REP **BD Switzerland Sàrl**
Terre Bonne Park – A4
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1262 Eysins, Switzerland

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66 Waterloo Road
Macquarie Park NSW 2113
Australia

Becton Dickinson Limited
14B George Bourke Drive
Mt. Wellington Auckland 1060
New Zealand

bdbiosciences.com
ClinicalApplications@bd.com

23-23765-00

1.3 Instrument Model Plate Label (product code 651000)

Model: BD FACSPresto™
Near-Patient CD4 Counter

REF

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any intereference received, including intereference that may cause undesired operation. This Class A digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations.

Cet appareil numèrique de classe A respecte toutes les exigences de Réglement sur le matèrial brouilleur du Canada.

SN:

VDC: 18 V⎓ | 3.3 A | Power: 60 W

IVD

eifu.bd.com

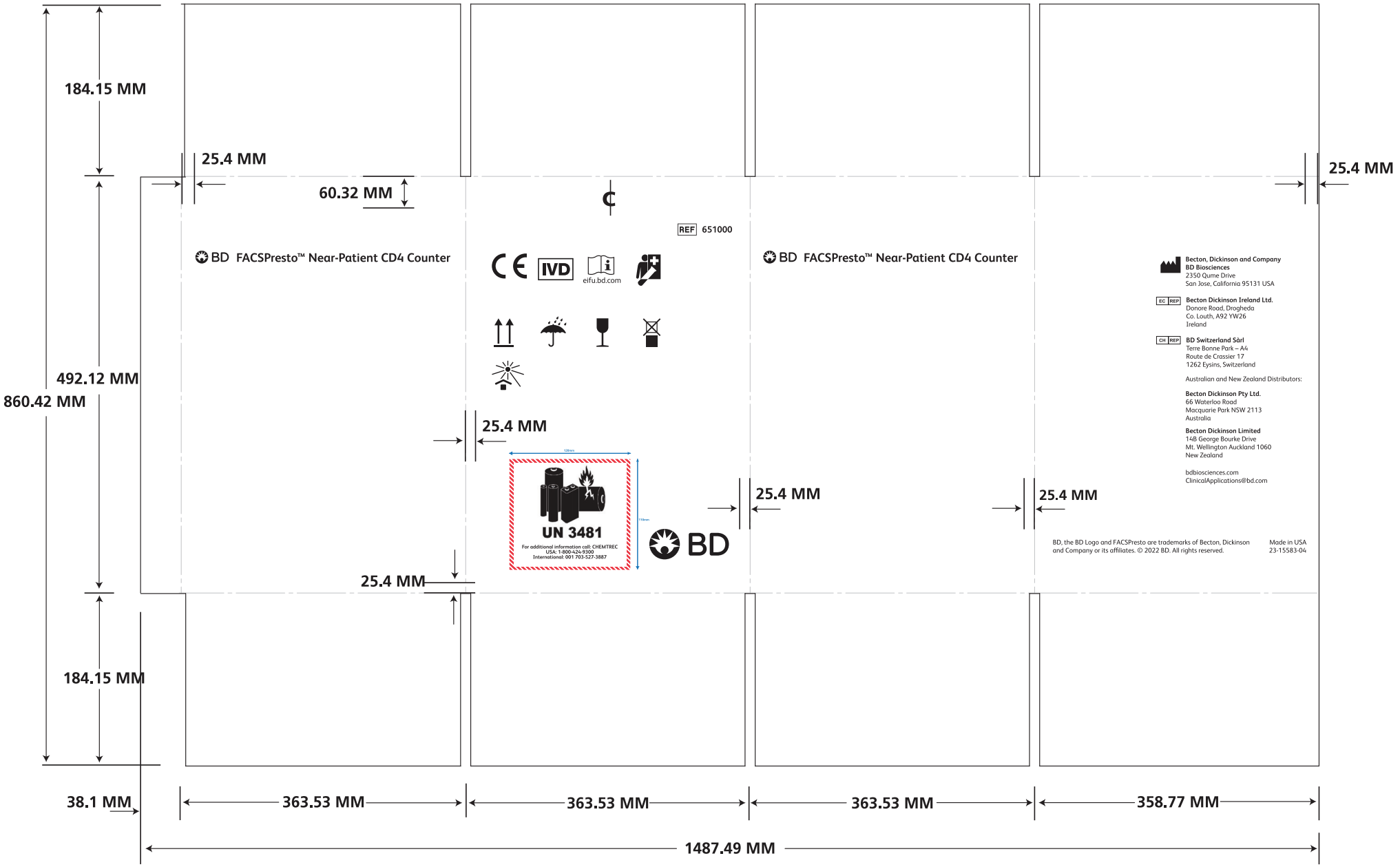
Becton, Dickinson and Company, BD Biosciences, 2350 Qume Drive San Jose, California 95131 USA
EC REP **Becton Dickinson Ireland Ltd.,** Donore Road, Drogheda, Co. Louth, A92 YW26, Ireland
CH REP **BD Switzerland Sàrl,** Terre Bonne Park – A4, Route de Crassier 17, 1262 Eysins, Switzerland

Made in USA
23-23890-00

Placement of 2D Bar Code

(01)xxxxxxxxxxxxxx(11)xxxxxx(21)xxxxxxxxxxxx

1.4 Instrument Shipping box Label


184.15 MM
25.4 MM
60.32 MM
25.4 MM
REF 651000
BD FACSPresto™ Near-Patient CD4 Counter
IVD
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BD FACSPresto™ Near-Patient CD4 Counter
Becton, Dickinson and Company
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2350 Qume Drive
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bdbiosciences.com
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492.12 MM
860.42 MM
25.4 MM
UN 3481
For additional information call: CHEMTREC
USA: 1-800-424-9300
International: 001 703-527-3887
25.4 MM
25.4 MM
25.4 MM
BD
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Made in USA
23-15583-04
184.15 MM
38.1 MM
363.53 MM
363.53 MM
363.53 MM
358.77 MM
1487.49 MM

2.0 Instructions for Use[2]

[2] English version of the IFU was the one that was assessed by WHO. It is the responsibility of the manufacturer to ensure correct translation into other languages.

BD FACSPresto™ Cartridge

Catalog No. 657681—100 Tests

Catalog No. 655495—BD FACSPresto™ Cartridge Kit—100 Tests

23-12814(03)
2022-02
English

CE 2797 IVD

1. INTENDED USE

The BD FACSPresto™ System consists of the BD FACSPresto™ Near-Patient CD4 Counter and the BD FACSPresto™ Cartridge. The BD FACSPresto™ System is a near-patient automated system for in vitro diagnostic use in enumerating absolute counts and percentages of $CD4^+$ T lymphocytes and determining hemoglobin concentration in human whole blood.

Clinical Applications

Determining percentages or absolute counts of $CD4^+$ T lymphocytes is used to evaluate the immune status of patients diagnosed with, or suspected of developing, immune deficiencies, which are frequently associated with human immunodeficiency virus (HIV) infection.[1,2]

Determining hemoglobin concentration is used to evaluate hemoglobin levels as an indicator of hematological abnormalities, such as anemia, which is frequently associated with HIV infection.[3,4,5]

The BD FACSPresto™ System is intended for use by trained health care professionals. The BD FACSPresto™ System can be used in either primary care centers or accredited laboratories.

2. SUMMARY OF THE TEST

Principle of Operation

The BD FACSPresto™ Cartridge, the CD4/%CD4/Hb cartridge, contains dried fluorochrome-conjugated antibody reagents. When blood reacts with the reagents, the antibodies in the reagents bind to the surface antigens on the lymphocytes and monocytes. After the incubation period, the cells are analyzed on the BD FACSPresto™

Near-Patient CD4 Counter (the instrument). The software identifies the cell populations of interest and calculates CD4 absolute counts, CD4 percentages of lymphocytes, and hemoglobin (Hb) concentration. The system measures total hemoglobin by a spectrophotometric method, using absorbance at an isobestic point for oxy-hemoglobin and deoxy-hemoglobin, with correction for scatter.

3. REAGENT

Reagent Composition

The cartridge contains the following dried antibody reagents.

Table 1 Antibody composition

Antibody	Fluorochrome	Clone	Isotype
CD4	PE-Cy5	SK3[6]	$IgG_{1,\kappa}$
CD3	APC	SK7[7,8]	$IgG_{1,\kappa}$
CD45RA	APC	HI100[9]	$IgG_{2b,\kappa}$
CD14	PE	MΦP9[10]	$IgG_{2b,\kappa}$

CD4 (SK3) recognizes an antigen that interacts with class II MHC molecules and is the primary receptor for HIV.[11,12] The CD4 antigen is present on the helper/inducer T lymphocyte subset[13,14] $CD3^+CD4^+$, which consists of 28% to 58%[15] of lymphocytes in normal peripheral blood,[16] and is present in low density on the cell surface of monocytes and in the cytoplasm of monocytes.[17] The CD4 antibody is derived from the hybridization of mouse myeloma cells with spleen cells from BALB/c mice immunized with human peripheral blood T lymphocytes.

CD3 (SK7) and CD45RA (HI100) enumerate total lymphocytes.

- CD3 (SK7) identifies T lymphocytes and recognizes the epsilon chain of the CD3 antigen/T-cell antigen receptor (TCR) complex.[18] The antigen recognized by CD3 antibodies is noncovalently associated with either α/β or γ/δ TCR.[19] CD3 reacts minimally with other cell populations.[15] The CD3 antibody is derived from the hybridization of NS-1 mouse myeloma cells with spleen cells from BALB/c mice immunized with human thymocytes.
- The CD45RA antigen is present on approximately 50% of $CD4^+$ T lymphocytes, approximately 75% of $CD8^+$ T lymphocytes, and on essentially all B lymphocytes and natural killer (NK) lymphocytes.[20] The helper/inducer T-lymphocyte subset

expresses the phenotype $CD4^+CD45RA^+$.[20] The CD45RA antigen is expressed on naive T lymphocytes. Antigen density decreases upon in vitro activation.[21] A selective loss of the $CD4^+CD45RA^+$ subset during active multiple sclerosis has been demonstrated.[20,22] The CD45RA (HI100) antibody is derived from the hybridization of mouse myeloma cells with spleen cells isolated from mice immunized with human whole blood cells (WBCs).

CD14 (MϕP9) identifies monocytes, which are excluded from the analysis. The CD14 antigen is present on the majority of normal peripheral blood monocytes.[10] The CD14 antibody recognizes a human monocyte/macrophage antigen of 55 kDa.[23] The CD14 antibody is derived from the hybridization of Sp2/0 mouse myeloma cells with spleen cells from BALB/c mice immunized with peripheral blood monocytes from a patient with rheumatoid arthritis.

Precautions

The reagent contains CMIT/MIT mixture (3:1) - a mixture of: 5-chloro-2-methyl-4-isothiazolin-3-one [EC No 247-500-7] and 2-methyl-4-isothiazolin-3-one [EC No 220-239-6] (3:1). This reagent is classified as hazardous according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) and Regulation (EC) No 1272/2008. Go to regdocs.bd.com/regdocs/sdsSearch to download the Safety Data Sheet.

	Warning
	H317: May cause an allergic skin reaction. H412: Harmful to aquatic life with long lasting effects.
Prevention	P261: Avoid breathing dust/fume/gas/mist/vapors/spray. P272: Contaminated work clothing should not be allowed out of the workplace. P280: Wear protective gloves/protective clothing/eye protection/face protection. P273: Avoid release to the environment.
Response	P302+P352: IF ON SKIN: Wash with plenty of water.

	Warning
	P333+P313: If skin irritation or rash occurs: Get medical advice/attention. P321: Specific treatment (see Safety Data Sheet). P362+P364: Take off contaminated clothing and wash it before reuse.
Disposal	P501: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Storage and Handling

- Store the cartridge:
  - In its original foil pouch
  - At 4–31 °C (39–88 °F)
  - In 10%–95% non-condensing humidity
  - Until the expiration date. Do not use the cartridge after the expiration date on the package.
- Do not use the cartridge if the pouch has been opened for more than 30 minutes.
- Incubate the cartridge at 10–40 °C (50–104 °F).
- Minimize exposure of the cartridges to light.
- Do not remove the channel protector on the cartridge until just before you insert the cartridge into the instrument.

4. INSTRUMENT

For use only with the BD FACSPresto™ Near-Patient CD4 Counter.

5. SPECIMEN COLLECTION AND PREPARATION

The assay is designed to be used only with peripheral whole blood collected by venipuncture into EDTA tubes or by finger stick.

Capillary[24] or venous blood samples are transferred directly into the cartridge and incubated. Samples are run on the instrument after incubation.

Follow these guidelines for handling your samples:

- Do not dilute whole blood before adding it to the cartridge.
- Do not refrigerate the whole blood specimen before sample preparation.
- Store whole blood collected in EDTA tubes at 20–25 °C (68–77 °F) up to 24 hours before applying the blood to the cartridge.

WARNING Do not use previously fixed and stored samples. Whole blood specimens refrigerated before staining can give incorrect results. Specimens from patients taking

immunosuppressive drugs can yield poor resolution.[25] Do not test hemolyzed specimens.

WARNING All biological specimens, as well as materials that come in contact with them, are considered biohazards. Handle as if capable of transmitting infection[26,27] and dispose of waste with proper precautions in accordance with federal, state, and local regulations. Never pipette by mouth. Wear suitable protective clothing, eyewear, and gloves.

Interfering Conditions

The following table lists the substances that were tested for interference[28] with the reagents in the cartridge. There was no detectable interference at the following concentrations.

Table 2 Interfering substances

Analyte	Maximum concentration
Acetaminophen	20 mg/dL
Albumin	6 g/dL
Amodiaquine	60 ng/mL
Artesunate	600 ng/mL
Ascorbic acid	6 mg/dL
Conjugated bilirubin	5 mg/dL
Creatinine	5 mg/dL
Efavirenz	16 µg/mL
Ethambutol	12 µg/mL
Gamma Globulin	40 mg/mL
Glucose	120 mg/dL
Hemolysis	20%
Ibuprofen	500 µg/mL
Iron	150 µg/dL
Isoniazid	40 µg/mL

Analyte	Maximum concentration
Lipemia (intralipid)	2,400 mg/dL
Magnesium	6.3 µg/dL
Methemoglobin	14%
Nevirapine	7 µg/mL
Quinine	48 µg/mL
Rifampicin	64 µg/mL
Salicylic Acid	200 µg/mL
Tenofovir	1,000 ng/mL
Tetracycline	150 µg/mL
Thrombocytes (Platelets)	1.541×10^6 cells/µL
Urea	40 mg/dL
Uric acid	9 mg/dL
White Blood Cells	25×10^3 cells/µL
Zidovudine	1,000 ng/mL

In addition, the following disease conditions did not interfere with the assay:

- Rouleaux formation
- Cold agglutinin

6. PROCEDURE

Reagents and Materials

Reagents and materials provided

Each box contains 100 cartridges and 100 pipettes. Each cartridge is for single use only. Use one cartridge per specimen. The cartridges are individually packaged in foil pouches. The dried antibody reagents in the cartridge include inert ingredients such as buffer, bovine serum albumin (BSA), and ProClin™ as a preservative.

The BD FACSPresto™ Cartridges can be bought alone or as part of the BD FACSPresto™ Cartridge Kit. The kit contains 1 box of BD FACSPresto™ Cartridges and

1 BD FACSPresto™ Finger Stick Sample Collection Kit. The finger stick kit includes the following:

- BD Microtainer® Contact-Activated Lancets (100 single-use lancets/kit)
- Alcohol pads (200/kit)
- Non-woven sponges (200/kit)
- Plastic adhesive bandages (100/kit)

Reagents and materials required but not provided

- BD FACSPresto™ Near-Patient CD4 Counter
- BD FACSPresto™ sample incubation work station
- BD Vacutainer® EDTA blood collection tubes (if not using the finger stick kit)
- Biohazardous sharps waste container

Cartridge Quality Control

Cartridge quality control (QC) uses immobilized antibodies. The instrument verifies that the reagent is present and that there is sufficient sample in the cartridge. Cartridge QC runs automatically at every cartridge run.

Process Controls

Process controls can be run on the BD FACSPresto™ Near-Patient CD4 Counter as an option. If process controls are run, they must be validated on the instrument. For information about process controls or external quality assessment products, contact your local BD Biosciences office or representative.

See the BD FACSPresto™ Near-Patient CD4 Counter on-board videos for information about the following procedures.

Preparing a Capillary Blood Specimen

Required materials:

- BD FACSPresto™ Cartridge Kit, or
- Cartridge
- Alcohol pad
- Nonwoven sponge
- Lancet
- Bandage

Before you begin:

- Open the alcohol pad package.
- Remove the cover from the lancet.
- Open the bandage package.

- Open the cartridge package. Write the patient ID on the cartridge. Face the inlet port up. You must use the cartridge within 30 minutes of opening the package.

To prepare a capillary blood specimen:

1. Prepare for puncture by increasing blood flow to the fingers.

   Ask the patient to extend his or her arm towards the floor and shake and squeeze his or her hand. If the patient's hand is cold, use a warming device or run the hand under warm water.
2. Firmly squeeze the base of the patient's fingers.
3. Select either the middle or ring finger, and clean the fingertip with an alcohol pad. Let the alcohol dry.
4. Place the tip of the lancet near the end of the finger, on the side of the fingertip. Push the lancet to puncture the finger.
5. Discard the lancet into a biohazardous sharps waste container.
6. Wipe away the first drop of blood with the sponge.

   The initial drop might contain tissue fluids that may dilute the specimen.
7. Wait until a large drop of blood forms.
8. Apply the blood to the inlet port of the cartridge.

   Hold the cartridge by its ridges only.

   Squeeze and hold the finger to maintain blood flow until blood reaches the top of the inlet port. Make sure the cartridge is level, with the barcode side up, at all times. Make sure that blood appears in the part of the channel not covered by the channel protector, next to the containment zone.
9. Apply the sponge and a bandage to the patient's finger to stop excess bleeding.
10. Close the cartridge cap securely.

    Make sure both latches on the cap snap closed.

    CAUTION If necessary, use a cloth dampened with bleach diluted to 0.5% sodium hypochlorite concentration to clean excess blood outside the containment zone. Be careful to not contaminate the inlet port or introduce any debris into the underside of the cartridge. Do not smear, contaminate, or damage the barcode. If you drop the cartridge into a contaminated area, discard the cartridge into a biohazardous waste container and start over with a new cartridge.
11. Set the on-board timer.

    See the *BD FACSPresto™ Near-Patient CD4 Counter Instructions for Use* (IFU).
12. Make sure the fill indicator is full.

13. Place the cartridge, barcode side up, on the work station.

Preparing a Venipuncture Blood Specimen

Required materials:

- Pipette
- Cartridge
- BD Vacutainer® EDTA blood collection tube containing room temperature blood

Before you begin:

Open the cartridge package. Write the patient ID on the cartridge. Face the inlet port up. You must use the cartridge within 30 minutes of opening the package.

To prepare a venipuncture specimen:

1. Invert the tube 10 times to mix the contents well.
2. Use the pipette to obtain the specimen.
3. Use only one pipette per specimen.
4. Gently squeeze the bulb on the pipette to form a drop of blood on the tip of the pipette.
5. Carefully dispense the specimen into the inlet port of the cartridge.

   Hold the cartridge by its ridges only.

   Make sure the blood reaches the top of the inlet port. If necessary, gently squeeze the bulb on the pipette to dispense more blood. Make sure the cartridge is level, with the barcode side up, at all times. Make sure that blood appears in the part of the channel not covered by the channel protector, next to the containment zone.
6. Discard the pipette into a biohazardous waste container.
7. Close the cartridge cap securely.

   Make sure both latches on the cap snap closed.

   CAUTION If necessary, use a cloth dampened with bleach diluted to 0.5% sodium hypochlorite concentration to clean excess blood outside the containment zone. Be careful to not contaminate the inlet port or introduce any debris into the underside of the cartridge. Do not smear, contaminate, or damage the barcode. If you drop the cartridge into a contaminated area, discard the cartridge into a biohazardous waste container and start over with a new cartridge.
8. Set the on-board timer.

   See the *BD FACSPresto™ Near-Patient CD4 Counter Instructions for Use* (IFU).
9. Make sure the fill indicator is full.

10. Place the cartridge, barcode side up, on the work station.

Running Samples

To set up the sample:

1. Make sure the cap on the cartridge is closed.
2. Press the **Run Test** tab.
3. Press **Patient ID**.
4. Enter the patient's ID and press **Accept**.

   The Confirm Patient ID screen opens.
5. Press **Accept**.

To insert the cartridge:

1. Select your Operator ID and press **Accept**.

   The cartridge door on the instrument opens.

   NOTE If possible, complete the following two steps within 30 seconds.
2. Remove the channel protector from the cartridge. Do not touch the cartridge except for the closed cap.
3. Hold the cap with the channel facing upwards. Insert the prepared cartridge into the cartridge door.

   The cartridge clicks in place. The cartridge door closes. If the cartridge door closes before you insert the cartridge, press **Open Door**.

   The sample is processed and a progress screen opens. Typically, a sample takes 4 minutes to process.

   When the process is complete, the instrument beeps 3 times, the results appear on the screen, and automatically print.
4. Press **Accept**.

   The cartridge door opens and the results screen closes.
5. Remove the ejected cartridge within 30 seconds.

   If you do not remove the cartridge within 30 seconds, the cartridge goes back into the instrument. If this happens, press **Open Door** and remove the ejected cartridge.
6. Press **Accept**.
7. Dispose of the used cartridge using proper precautions and in accordance with local regulations.

See the following for more information.

- BD FACSPresto™ Near-Patient CD4 Counter on-board videos
- *BD FACSPresto™ Near-Patient CD4 Counter Instructions for Use* (IFU)
- *BD FACSPresto™ Near-Patient CD4 Counter Quick Reference Guide*

7. LIMITATIONS

- Use the cartridge only with the BD FACSPresto™ Near-Patient CD4 Counter.
- Performance characteristics outside the validated range have not been established.
- Interfering substances in the sample may result in an inaccurate result.
- Follow the instructions in Preparing a Capillary Blood Specimen, Preparing a Venipuncture Blood Specimen, or the *BD FACSPresto™ Near-Patient CD4 Counter Instructions for Use* on preparing capillary and venous blood samples to ensure accurate results.
- For severely immunocompromised patients, e.g., with CD4 counts of <100 cells/µL, there is a bias of <10% for CD4 absolute counts and CD4 percentages. We recommend that you follow World Health Organization (WHO) or country-specific guidelines at clinical decision points.

8. REFERENCE INTERVALS

The reference intervals for the BD FACSPresto™ Cartridge shown in the following table are representative for hematologically normal adults.

Table 3 Representative reference intervals

Blood type	Parameter	Gender	N	Mean	Reference interval
Venous	CD4 (cells/µL)	Male	129	836	256–1,652 cells/µL
		Female	142	1,070.78	522–1,902 cells/µL
	%CD4	Male	129	46.35	31.51%–61.02%
		Female	142	49.91	34.67%–63.28%
	Hb (g/dL)	Male	129	14.81	12.3–16.6 g/dL
		Female	142	13.08	11.3–14.9 g/dL

Blood type	Parameter	Gender	N	Mean	Reference interval
Capillary	CD4 (cells/µL)	Male	133	856.09	276–1,515 cells/µL
		Female	140	1,131.21	536–2,031 cells/µL
	%CD4	Male	133	46.14	31.33%–62.11%
		Female	140	50.50	33.06%–66.48%
	Hb (g/dL)	Male	133	14.96	12–17.3 g/dL
		Female	140	13.37	11–15.4 g/dL

We recommend that laboratories and other users establish their own reference intervals for their patient populations using the BD FACSPresto™ System to reflect potential sources of variability, such as patient gender, race, age, and preparation techniques.

9. PERFORMANCE CHARACTERISTICS

Specimen Handling and Collection (AOB/AOS)

The stability of EDTA-anticoagulated blood specimen to be used with the BD FACSPresto™ System was evaluated at 1 site by assessing the combined effect of:

- Age of Blood (AOB): The length of time between specimen draw and transferring blood into the BD FACSPresto™ Cartridge.
- Age of Stain (AOS): The length of time between adding specimen into the BD FACSPresto™ Cartridge and sample acquisition on the BD FACSPresto™ instrument.

Whole blood samples were tested up to 30 hours post draw, and samples were tested up to 3 hours post addition of blood into the cartridge. All samples were maintained at room temperature (20–25 °C, 68–77 °F) before addition of blood into the cartridge or acquisition. Based on the results of this study, cartridges should be prepared with whole blood samples within 24 hours of draw, and then run within 2 hours of adding blood into the cartridge.

Method Comparison

Performance of the BD FACSPresto™ Cartridge was established by testing at 7 external clinical sites. Two of the sites placed the BD FACSPresto™ System in primary care centers, in a near-patient setting, for collection and testing of capillary blood by health care professionals.

Absolute counts of $CD4^+$ T cells, the percentage of $CD4^+$ T cells in the lymphocyte population, and total hemoglobin concentration in whole blood from HIV-infected patients were determined using the BD FACSPresto™ System. Results were compared with results using the BD Tritest™ CD3/CD4/CD45 reagent with BD Trucount™ Tubes on the BD FACSCalibur™ flow cytometer using BD Multiset™ software for $CD4^+$ T cells, and the Sysmex® KX-21N hematology analyzer for hemoglobin. Venous and capillary blood specimens were analyzed. Regression statistics indicate the results are substantially equivalent. The scatter plots with Deming fit or weighted Deming fit are shown in the figures.

Table 4 Method comparison statistics for venous and capillary blood

Specimen type	Parameter	N	Slope	R^2	Intercept	Range
Venous blood	CD4 (cells/µL)	716	0.97 (0.96, 0.98)	0.99	0.02 cells/µL	5–5,204 cells/µL
	%CD4 (%)	716	1.01 (1.00, 1.02)	0.98	0.51%	0.3–59.82%
	Hb (g/dL)	720	1.03 (0.99, 1.06)	0.91	–0.6 g/dL	3–21.2 g/dL
Capillary blood	CD4 (cells/µL)	681	1.03 (1.02, 1.05)	0.97	0.71 cells/µL	8–5,216 cells/µL
	%CD4 (%)	681	1.01 (1.00, 1.03)	0.96	–0.31%	0.57–58.5%

For hemoglobin capillary samples, the % bias for 87 specimens was calculated at the clinical decision point (10.5±1 g/dL) with a 95% confidence interval (CI) as 1.83% (0.78%–2.87%).

Figure 1 Scatter plot with weighted Deming fit (y= –0.3555 + 0.9466x) for CD4 counts in venous blood

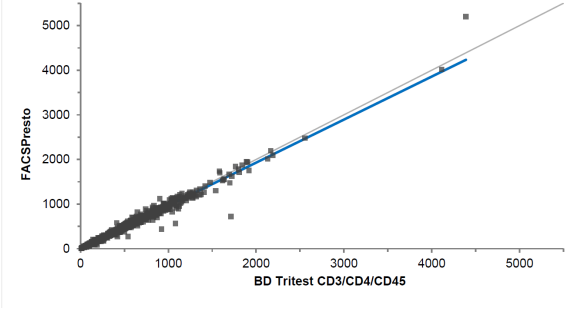


Figure 2 Scatter plot with Deming fit (y= 0.4026 + 1.009x) for %CD4 in venous blood

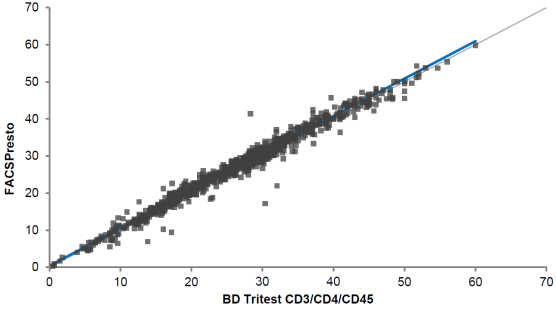


Figure 3 Scatter plot with Deming fit (y= –0.3527 + 1.008x) for Hb in venous blood

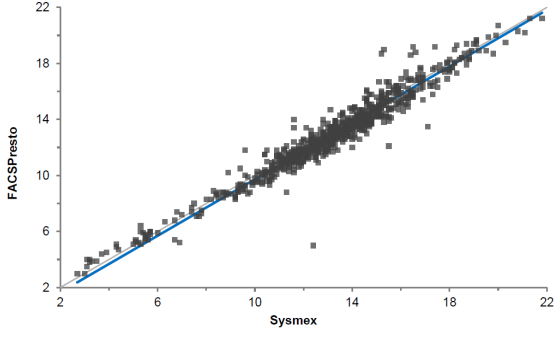


Figure 4 Scatter plot with weighted Deming fit (y= 0.7231 + 1.032x) for CD4 counts in capillary blood

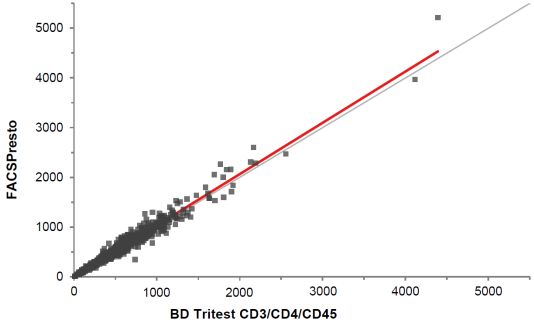
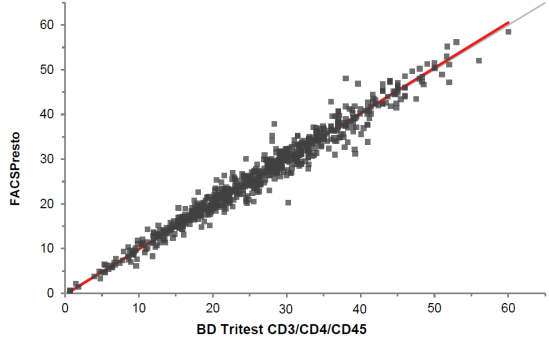


Figure 5 Scatter plot with Deming fit (y= –0.3061 + 1.014x) for %CD4 in capillary blood



A subset of patients from a near-patient setting at two of the sites were analyzed separately. The specimens obtained in a near-patient setting were all capillary blood. Three sets of comparisons were made:

A = Capillary blood analyzed on BD FACSPresto™ in a near-patient setting vs venous blood stained with BD Tritest™ CD3/CD4/CD45 and analyzed on a BD FACSCalibur™ flow cytometer or Sysmex® KX-21N (Hb) in a lab setting.

B = Capillary blood analyzed on BD FACSPresto™ in a near-patient setting vs venous blood analyzed on BD FACSPresto™ in a lab setting.

C = Venous blood analyzed on BD FACSPresto™ in a lab setting vs venous blood stained with BD Tritest™ CD3/CD4/CD45 and analyzed on a BD FACSCalibur™ flow cytometer or Sysmex® KX-21N (Hb) in a lab setting.

Regression statistics indicate the results are substantially equivalent. The scatter plots with Deming fit or weighted Deming fit are shown in the figures.

Table 5 Method comparison statistics for a near-patient setting

Parameter	Comparison	N[a]	R^2	Intercept	Slope
CD4 (cells/µL)	A	148	0.973	2.86	1.00 (0.96, 1.04)
	B	145	0.973	0.53	1.07 (1.03, 1.11)
	C	158	0.995	–7.43	0.96 (0.91, 1.00)
%CD4 (%)	A	148	.0977	–0.01	0.99 (0.96, 1.03)
	B	145	0.977	–0.26	0.97 (0.93, 1.01)
	C	158	0.990	0.19	1.03 (1.00, 1.05)
Hb (g/dL)	A	149	0.881	–1.46	1.11 (1.02, 1.20)
	B	146	0.879	–0.86	1.09 (0.99, 1.20)
	C	158	0.959	–0.50	1.01 (0.96, 1.07)

a. N = number of matched sets of specimens from the same patient.

Figure 6 Scatter plot with weighted Deming fit for CD4 counts (cells/µL) in capillary blood on BD FACSPresto™ (near-patient setting) vs venous blood using BD Tritest™ CD3/CD4/CD45 (lab setting)

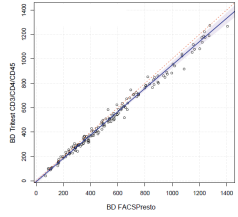


Figure 7 Scatter plot with weighted Deming fit for CD4 counts (cells/µL) in capillary blood on BD FACSPresto™ (near-patient setting) [1] vs venous blood on BD FACSPresto™ (lab setting) [2]

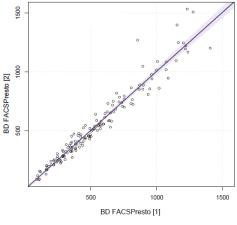


Figure 8 Scatter plot with weighted Deming fit for CD4 counts (cells/µL) in venous blood on BD FACSPresto™ (lab setting) vs venous blood using BD Tritest™ CD3/CD4/CD45 (lab setting)

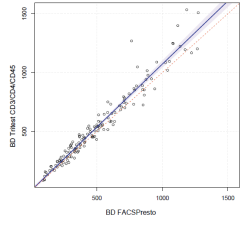


Figure 9 Scatter plot with Deming fit for CD4 percentages in capillary blood on BD FACSPresto™ (near-patient setting) vs venous blood using BD Tritest™ CD3/CD4/CD45 (lab setting)

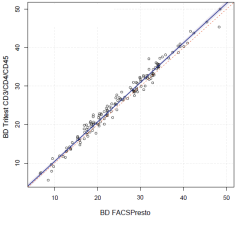


Figure 10 Scatter plot with Deming fit for CD4 percentages in capillary blood on BD FACSPresto™ (near-patient setting) [1] vs venous blood on BD FACSPresto™ (lab setting) [2]

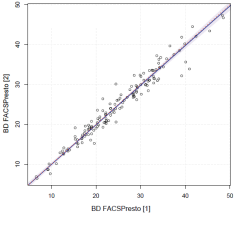


Figure 11 Scatter plot with Deming fit for CD4 percentages in venous blood on BD FACSPresto™ (lab setting) vs venous blood using BD Tritest™ CD3/CD4/CD45 (lab setting)

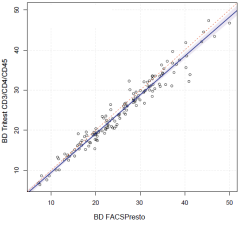


Figure 12 Scatter plot with Deming fit for hemoglobin (g/dL) in capillary blood on BD FACSPresto™ (near-patient setting) vs venous blood on Sysmex® KX-21N (lab setting)

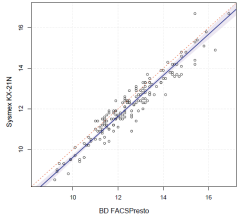


Figure 13 Scatter plot with Deming fit for hemoglobin (g/dL) in capillary blood on BD FACSPresto™ (near-patient setting) [1] vs venous blood on BD FACSPresto™ (lab setting) [2]

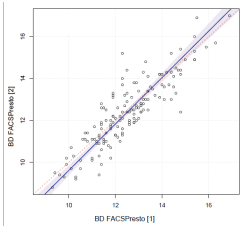
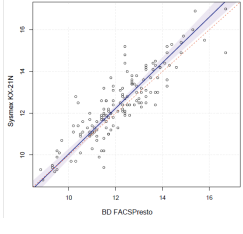


Figure 14 Scatter plot with Deming fit for hemoglobin (g/dL) in venous blood on BD FACSPresto™ (lab setting) vs venous blood on Sysmex® KX-21N (lab setting)



Precision (repeatability), peripheral blood

A single-site precision study was performed to evaluate system repeatability and within-site precision using venous blood specimens. The study used 3 lots of BD FACSPresto™ Cartridges, 3 BD FACSPresto™ instruments, and 3 operators. All testing was carried out in duplicate cartridges. A total of 67 venous blood specimens for absolute $CD4^+$ T-cell counts and 68 venous blood specimens for hemoglobin concentration from HIV-infected individuals and healthy subjects were enrolled. The percentage coefficient of variation (%CV) was calculated for repeatability and within-site precision of CD4 counts, percent CD4, and hemoglobin concentration.

Table 6 Repeatability and within-site precision of CD4 counts by CD4 bins

CD4 bins (cells/µL)	Mean (cells/µL)	Repeatability (%CV)	Within-site precision (%CV)
≤ 200	97.26	7.13	7.6
> 200 to ≤ 500	327.02	5.28	5.65
> 500 to ≤ 1,000	691.35	3.22	3.32
> 1,000 to < 5,000	1,367	2.37	2.57

Table 7 Repeatability and within-site precision by parameter

Parameter	Mean	Repeatability (%CV)	Within-site precision (%CV)
CD4 counts	623.6 cells/µL	3.49	3.7
%CD4	26.92%	2.69	2.8
Hb concentration	13.49 g/dL	2.92	5.11

Precision (reproducibility), control material

A study was performed at 3 sites to assess reproducibility of the BD FACSPresto™ System. The study used 3 BD FACSPresto™ instruments and 3 operators at 1 internal and 2 external sites with CD-Chex Plus® BC (CDN) and CD-Chex Plus® BC CD4 Low (CDL) process controls for $CD4^+$ T-cell measurements, and Eurotrol CueSee® Hb301 Control (Low, Normal, and High) for hemoglobin measurements. Testing was done in triplicate cartridges during 5 non-consecutive days, with 2 runs per day of testing.

Total reproducibility with 95% CI for CD4+ T cells and 97.5% CI for hemoglobin concentration were estimated for CD4 counts, percent CD4, and hemoglobin

concentration. Results are reported as standard deviation upper limit (SD UL) and %CV upper limit (%CV UL).

Table 8 Reproducibility of the system by parameter

Parameter	Sample type	Mean	SD UL	%CV UL
CD4 counts	CDL	138.93 cells/µL	N/A	5.98
	CDN	848.32 cells/µL	N/A	2.88
%CD4	CDL	12.75%	0.67	N/A
	CDN	44.16%	N/A	1.98
Hb concentration	Hb301 Low	7.23 g/dL	N/A	3.18
	Hb301 Normal	12.93 g/dL	N/A	1.72
	Hb301 High	17.12 g/dL	N/A	1.42

Trueness of Measurement (Hb assay)

Trueness of measurement is the closeness of agreement between the average value obtained from a large number of test results and an accepted reference value. The BD FACSPresto™ System was evaluated for trueness in determining Hb concentration compared to the reference method, ICSH HiCN (hemoglobincyanide).[29] Trueness was evaluated for the range of 2–22 g/dL on both systems, and compared.

Table 9 Summary of results for trueness of hemoglobin concentration

Method	Slope	Intercept	R^2	Mean bias (%)
BD FACSPresto™ System	1.03	–0.42	0.992	0.38

Linearity

Linearity was assessed using triplicate measurements of 11 concentrations of $CD4^+$ T cells, total lymphocytes, and hemoglobin across a range approximately 20 to 30% wider than the anticipated linear range on the instrument. Linearity of the system was evaluated using 3 lots of BD FACSPresto™ Cartridges run on a single BD FACSPresto™ instrument. Results are linear in the following ranges.

Table 10 Linear ranges

Parameter	Linear range
$CD4^+$ T cells	50–4,000 cells/µL

Parameter	Linear range
Total lymphocytes	200–10,000 cells/µL
Hemoglobin	2–20 g/dL

Limit of Blank and Limit of Detection (CD4 Assay)

The detection capability of the CD4 assay on the BD FACSPresto™ instrument was assessed. For determining limit of blank (LOB), blank samples were produced by blocking CD4 binding sites before adding the sample to the BD FACSPresto™ Cartridge. For determining limit of detection (LOD), CD4 low level samples were produced by diluting normal donor blood with autologous plasma.

The evaluation was performed using 6 lots of BD FACSPresto™ Cartridges (3 lots for LOB and 3 lots for LOD) and 3 BD FACSPresto™ instruments. A total of 60 replicates for blank samples and 60 replicates for CD4 low level samples were tested. The LOB and LOD for absolute CD4 T-cell counts are shown in the following table.

Table 11 Detection capability for absolute CD4+ T-cell counts (LOB and LOD)

Sample type	LOB (cells/µL)	LOD (cells/µL)
Blank	10	–
CD4 low level	–	22

Limit of Detection (Hb Assay)

The LOD for hemoglobin was determined using a set of serial dilutions made from a sample of known hemoglobin concentration. The dilutions were tested in replicate to estimate the rate of successful Hb detections at each concentration.

Two lots of BD FACSPresto™ Cartridges were tested on 3 separate days with 3 different normal donor samples (1 sample per day) on 2 BD FACSPresto™ instruments. Each sample dilution level was tested in 10 replicate cartridges for each of the 2 lots. The probability of a successful hemoglobin detection was calculated and plotted against the hemoglobin concentration.

The LOD for hemoglobin using the BD FACSPresto™ System was determined to be 0.91 g/dL.

Limit of Quantitation (CD4 assay)

The LOQ for CD4 counts was determined using samples prepared from blood from three HIV patients. Patient blood samples were diluted in autologous plasma to give a

set of samples with nominal $CD4^+$ T-cell counts of 25, 35, 50, 75, and 100 cells/µL. The diluted sample set was measured by the BD FACSPresto™ System to obtain $CD4^+$ T-cell values.

Two lots of BD FACSPresto™ Cartridges were tested on 3 separate days with 3 different diluted HIV patient sample sets on 2 BD FACSPresto™ instruments. Total error data for each level of $CD4^+$ T-cell counts obtained over 3 days was combined and the LOQ value was determined. Based on this, the LOQ for the CD4 assay on the BD FACSPresto™ instrument was 35 $CD4^+$ T cells/µL.

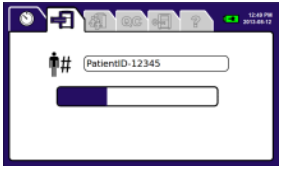
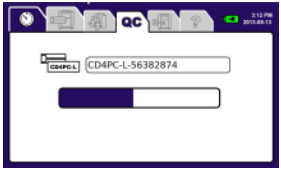
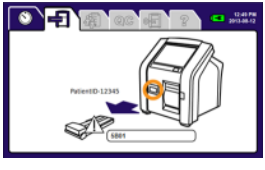
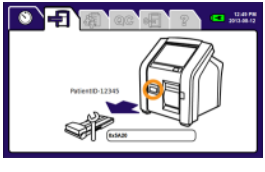
Limit of Quantitation (Hb assay)

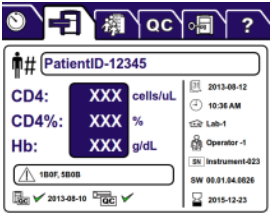
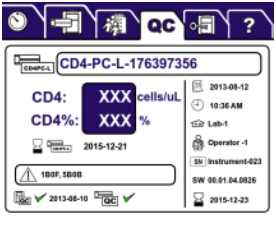
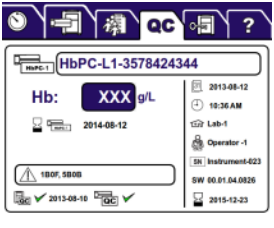
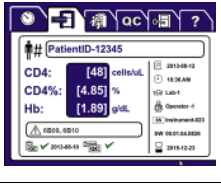
A sample of whole blood was diluted with plasma to a target hemoglobin level of 2 g/dL. Twenty replicates were tested on each of three lots of BD FACSPresto™ Cartridges on 1 of 3 BD FACSPresto™ instruments for a total of 60 replicates. The LOQ was determined to be 2 g/dL.

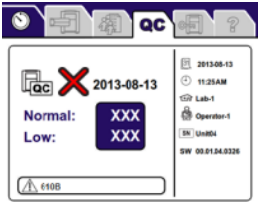
10. CARTRIDGE SPECIFICATIONS

Item	Description
Blood stability	Up to 24 hours after draw if stored in an EDTA tube at 20–25 °C (68–77 °F)
Sample stability	Up to 2 hours after addition of sample to cartridge
Sample throughput	More than 10 patient results per hour when run in batch mode
Validated range	CD4 count: 50–4,000 cells/µL %CD4: 5%–60% Hb concentration: 2.0–20 g/dL

11. TROUBLESHOOTING

Error displayed	Possible causes	Recommended solutions
 	The sample or process control run has stopped.	1. Wait 2 minutes. 2. If the progress bar does not move, press the power button until the instrument turns off. 3. Press the power button to turn on the instrument. 4. A screen with the Open Door button appears. 5. Press Open Door. 6. The cartridge is ejected. 7. Remove the cartridge. 8. Follow the instructions in Running Samples.
  • This error might appear in the Run Test tab. • The instrument ejects the cartridge.	The instrument cannot read the barcode or channel.	1. Make sure the channel protector is removed from the cartridge. 2. Clean the barcode label or channel. 3. Re-insert the cartridge into the instrument. 4. If the error persists, prepare a new cartridge.
	There is not enough blood or process control in the cartridge.	1. Make sure the channel is full of blood or process control. If it is not full, prepare a new cartridge. 2. Re-insert the cartridge into the instrument. 3. If the error persists, prepare a new cartridge.

Error displayed	Possible causes	Recommended solutions
  	Results are not shown.	If the error code is 6B16 or 6102: 1. Re-run instrument QC. 2. Insert the cartridge into the instrument again. If you get the same error screens, prepare a new cartridge. 3. For other error codes, insert the cartridge into the instrument again. If you get the same error screens, prepare a new cartridge.
	Results are out of the validated range.	Consult the lab manager.

Error displayed	Possible causes	Recommended solutions
	Instrument QC does not show results.	1. Press the power button until the instrument turns off. 2. Press the power button to turn on the instrument. 3. If the error persists, contact BD Biosciences.

See the troubleshooting section in the *BD FACSPresto™ Near-Patient CD4 Counter Instructions For Use* for additional error messages for the instrument.

REFERENCES

1. Giorgi JV, Hultin LE. Lymphocyte subset alterations and immunophenotyping by flow cytometry in HIV disease. *Clinical Immunology Newsletter*. 1990;10:55-61.
2. Schmidt RE. Monoclonal antibodies for diagnosis of immunodeficiencies. *Blut*. 1989;59:200-206.
3. Henry DH, Beall GN, Benson CA, et al. Recombinant human erythropoietin in the treatment of anemia associated with human immunodeficiency virus (HIV) infection and zidovudine therapy. Overview of four clinical trials. *Ann Intern Med*. 1992;117:739-748.
4. Firnhaber C, Smeaton L, Saukila N, et al. Comparisons of anemia, thrombocytopenia, and neutropenia at initiation of HIV antiretroviral therapy in Africa, Asia, and the Americas. *Int J Infect Dis*. 2010; 14:e1088-1092.
5. Levine AM, Berhane K, Masri-Lavine L, et al. Prevalence and correlates of anemia in a large cohort of HIV-infected women: Women's Interagency HIV Study. *J Acquir Immune Defic Syndr*. 2001,26:28-35.
6. Bernard A, Boumsell L, Hill C. Joint report of the first international workshop on human leucocyte differentiation antigens by the investigators of the participating laboratories. In: Bernard A, Boumsell L, Dausset J, Milstein C, Schlossman SF, eds. *Leucocyte Typing*. New York, NY: Springer-Verlag; 1984:9-108.
7. Haynes BF. Summary of T-cell studies performed during the Second International Workshop and Conference on Human Leukocyte Differentiation Antigens. In: Reinherz EL, Haynes BF, Nadler LM, Bernstein ID, eds. *Leukocyte Typing II: Human T Lymphocytes.* Vol 1. New York, NY: Springer-Verlag; 1986:3-30.

8. Knowles RW. Immunochemical analysis of the T-cell-specific antigens. In: Reinherz EL, Haynes BF, Nadler LM, Bernstein ID, eds. *Leukocyte Typing II: Human T Lymphocytes.* Vol 1. New York, NY: Springer-Verlag; 1986:259-288.
9. Schwinzer R. Cluster report: CD45/CD45R. In: Knapp W, Dörken B, Gilks WR, et al, eds. *Leucocyte Typing IV: White Cell Differentiation Antigens.* New York, NY: Oxford University Press; 1989:628-634.
10. Bernstein ID, Self S. Joint report of the myeloid section of the Second International Workshop on Human Leukocyte Differentiation Antigens. In: Reinherz EL, Haynes BF, Nadler LM, Bernstein ID, eds. *Leukocyte Typing II: Human Myeloid and Hematopoietic Cells*. Vol 3. New York, NY: Springer-Verlag; 1986:1-25.
11. Dalgleish AG, Beverley PCL, Clapham PR, Crawford DH, Greaves MF, Weiss RA. The CD4 (T4) antigen is an essential component of the receptor for the AIDS retrovirus. *Nature.* 1984;312:763-767.
12. Maddon PJ, Dalgleish AG, McDougal JS, Clapham PR, Weiss RA, Axel R. The T4 gene encodes the AIDS virus receptor and is expressed in the immune system and the brain. *Cell.* 1986;47:333-348.
13. Engleman EG, Benike CJ, Glickman E, Evans RL. Antibodies to membrane structures that distinguish suppressor/cytotoxic and helper T lymphocyte subpopulations block the mixed leukocyte reaction in man. *J Exp Med*. 1981;154:193-198.
14. Kotzin BL, Benike CJ, Engleman EG. Induction of immunoglobulin-secreting cells in the allogeneic mixed leukocyte reaction: regulation by helper and suppressor lymphocyte subsets in man. *J Immunol.* 1981;127:931-935.
15. Reichert T, DeBruyère M, Deneys V, et al. Lymphocyte subset reference ranges in adult Caucasians. *Clin Immunol Immunopath.* 1991;60:190-208.
16. Evans RL, Wall DW, Platsoucas CD, et al. Thymus-dependent membrane antigens in man: inhibition of cell-mediated lympholysis by monoclonal antibodies to T_{H2} antigen. *Proc Natl Acad Sci USA.* 1981;78:544-548.
17. Wood GS, Warner NL, Warnke RA. Anti–Leu-3/T4 antibodies react with cells of monocyte/macrophage and Langerhans lineage. *J Immunol.* 1983;131:212-216.
18. van Dongen JJM, Krissansen GW, Wolvers-Tettero ILM, et al. Cytoplasmic expression of the CD3 antigen as a diagnostic marker for immature T-cell malignancies. *Blood.* 1988;71:603-612.
19. Clevers H, Alarcón B, Wileman T, Terhorst C. The T cell receptor/CD3 complex: a dynamic protein ensemble. *Annu Rev Immunol.* 1988;6:629-662.
20. Sobel RA, Hafler DA, Castro EA, Morimoto C, Weiner HL. The 2H4 (CD45R) antigen is selectively decreased in multiple sclerosis lesions. *J Immunol*. 1988;140:2210-2214.

21. Serra HM, Krowka JF, Ledbetter JA, Pilarski LM. Loss of CD45R (Lp220) represents a post-thymic T cell differentiation event. *J Immunol*. 1988;140:1435-1441.
22. Rose LM, Ginsberg AH, Rothstein TL, Ledbetter JA, Clark EA. Selective loss of a subset of T helper cells in active multiple sclerosis. *Proc Natl Acad Sci USA*. 1985;82:7389-7393.
23. Goyert SM, Ferrero E. Biochemical analysis of myeloid antigens and cDNA expression of gp55 (CD14). In: McMichael AJ, Beverley PC, Cobbold S, et al, eds. *Leucocyte Typing III: White Cell Differentiation Antigens*. New York, NY: Oxford University Press; 1987:613-619.
24. *Procedures and Devices for the Collection of Diagnostic Capillary Blood Specimens; Approved Standard—Sixth Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2008. CLSI document GP42-A6.
25. Giorgi JV. Lymphocyte subset measurements: significance in clinical medicine. In: Rose NR, Friedman H, Fahey JL, eds. *Manual of Clinical Laboratory Immunology.* 3rd ed. Washington, DC: American Society for Microbiology; 1986:236-246.
26. *Protection of Laboratory Workers from Occupationally Acquired Infections; Approved Guideline—Fourth Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2014. CLSI document M29-A4.
27. Siegel JD, Rhinehart E, Jackson M, Chiarello L, the Healthcare Infection Control Practices Advisory Committee. *2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*. https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html. Accessed March 12, 2019.
28. McEnroe RJ, Burritt, MF, Powers DM, et al. *Interference Testing in Clinical Chemistry; Approved Guideline—Second Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2005. CLSI document EP7-A2.
29. *Reference and Selected Procedures for the Quantitative Determination of Hemoglobin in Blood; Approved Standard—Third Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2000. CLSI document H15-A3.

NOTICE

EU Only: Users shall report any serious incident related to the device to the Manufacturer and National Competent Authority.

Outside EU: Contact your local BD representative for any incident or inquiry related to this device.

Refer to the Eudamed website: https://ec.europa.eu/tools/eudamed for Summary of Safety and Performance.

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HISTORY

Revision	Date	Changes made
23-12814(03)	2022-02	Updated to meet requirements for Regulation (EU) 2017/746.

SYMBOLS GLOSSARY

SYMBOLS GLOSSARY [L006715(06) 2021-08]
Some symbols listed below may not apply to this product.
US Customers only: For symbol glossary, refer to **bd.com/symbols-glossary**

Symbol	Meaning
	Manufacturer
EC REP	Authorized representative in the European Community
CH REP	Authorised representative in Switzerland
	Date of manufacture
	Use-by date
LOT	Batch code
REF	Catalogue number
SN	Serial number
STERILE	Sterile
STERILE A	Sterilized using aseptic processing techniques
STERILE EO	Sterilized using ethylene oxide
STERILE R	Sterilized using irradiation
STERILE	Sterilized using steam or dry heat
	Do not resterilize
NON STERILE	Non-sterile
	Do not use if package is damaged and consult *instructions for use*
STERILE	Sterile fluid path
STERILE EO	Sterile fluid path (ethylene oxide)
STERILE R	Sterile fluid path (irradiation)
	Fragile, handle with care
	Keep away from sunlight
	Keep dry
	Lower limit of temperature
	Upper limit of temperature
	Temperature limit
	Humidity limitation
	Biological risks
	Do not re-use
	Consult *instructions for use* or consult electronic *instructions for use*
	Caution
LATEX	Contains or presence of natural rubber latex
IVD	In vitro diagnostic medical device
CONTROL -	Negative control
CONTROL +	Positive control
	Contains sufficient for <n> tests
	For IVD performance evaluation only
	Non-pyrogenic

Symbol	Meaning
#	Patient number
	This way up
	Do not stack
	Single sterile barrier system
PHT DEHP BBP	Contains or presence of phthalate: combination of bis(2-ethylhexyl) phthalate (DEHP) and benzyl butyl phthalate (BBP)
	Collect separately Indicates separate collection for waste of electrical and electronic equipment required.
CE	CE marking: Signifies European technical conformity
	Device for near-patient testing
	Device for self-testing
Rx Only	This only applies to US: "Caution: Federal Law restricts this device to sale by or on the order of a licensed practitioner."
	Country of manufacture "CC" shall be replaced by either the two letter or the three letter country code.
	Collection time
	Cut
	Peel here
	Collection date
	Keep away from light
	Hydrogen gas is generated
	Perforation
	Start panel sequence number
	End panel sequence number
	Internal sequence number
MD	Medical device
	Contains hazardous substances
	Ukrainian conformity mark
	Meets FCC requirements per 21 CFR Part 15
c UL us	UL product certification for US and Canada
UDI	Unique device identifier

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