

### INTENDED USE

CD8-FITC/CD4-PE/CD45-PECy5 is a three-color direct immunofluorescence reagent for use in flow cytometry designed for the identification and enumeration of helper/inducer T lymphocytes (CD4+CD8-) and suppressor/cytotoxic T lymphocytes (CD4-CD8+). The helper/suppressor ratio (CD4+/CD8+) can also be determined.

### SUMMARY AND EXPLANATION

Flow Cytometry (FC) is a powerful tool for the analytical and quantitative characterization of cells which provides rapid, quantitative and multiparametric analysis of heterogeneous cell populations on a cell-by-cell basis. Flow cytometry is performed on cells in liquid suspension that have been incubated with fluorescently-labeled antibodies directed against specific cellular proteins. The relative fluorescence intensity of the positive cells indicates the amount of antibody bound to specific binding sites on the cells, and therefore provides a relative measure of antigen expression.

Human lymphocytes may be classified in three main populations according to their biological function and their cell surface antigen expression: T lymphocytes, B lymphocytes and natural killer cells (NK). T lymphocytes, the precursors of which originate in the bone marrow and then migrate and mature in the thymus, can be subdivided as well in functionally different populations. The most clearly defined of these are helper/inducer T cells (CD8-CD4+) and suppressor/cytotoxic T cells (CD8+CD4-). T cells produce no antibodies and are the mediators of cell immunity.

The CD8-FITC/CD4-PE/CD45-PECy5 reagent recognizes the antigen CD8 present in suppressor/cytotoxic T cells, the antigen CD4 present in helper/inducer T cells, and the antigen CD45, the leucocyte common antigen (LCA) complex, which is expressed exclusively on cells of the haematopoietic system (lymphocytes, monocytes, and granulocytes) and their progenitors. This reagent can be used in the characterization studies for immunophenotyping of lymphocytes, which are widely applied for monitoring of the immunologic status of post-transplant patients and in the characterization and follow-up of immunodeficiencies, autoimmune diseases, leukemia etc<sup>(1-2)</sup>. Individuals with HIV typically exhibit a steady decrease of helper/inducer T lymphocyte counts as the infection progresses. The CD4 antigen is also detected on some monocytes.

### PRINCIPLES OF THE PROCEDURE

Flow cytometry is an innovative technology by means of which different cell characteristics are simultaneously analyzed on a single cell basis. This is achieved by means of hydrodynamic focusing of cells that pass aligned one by one in front of a set of light detectors; at the same time they are illuminated by a laser beam. The interaction of the cells with the laser beam generates signals of two different kinds: those generated by dispersed light (FSC/SSC), which mainly reflects the size of the cell and its internal complexity, and those related to the emission of light by the fluorochromes present in the cell. These signals become electric impulses which are amplified and registered as digital signals to be processed by a computer.

When the reagent is added to the sample, the fluorochrome-labelled monoclonal antibodies (MAb) present in the reagent (CD8-FITC, CD4-PE and CD45-PECy5) bind specifically to the antigens they are directed against, allowing the detection by FC of the cell populations carried by the antigens.

The erythrocyte population, which could hinder the detection of the target population, is eliminated by the use of a red blood cell lysing solution previous to acquire the sample on the cytometer. The use of Quicklysis™ (CYT-QL-1) erythrocyte lysing solution is recommended, since it requires no further washing step and contains no fixative, therefore minimizing the handling of the sample and avoiding the cell loss associated to the centrifuge process.<sup>(3,4)</sup>

The counts of suppressor/cytotoxic T lymphocytes (CD8+CD4-) and helper/inducer T lymphocytes (CD8-CD4+) are expressed as a percentage of the total amount of lymphocytes or leucocytes present in the sample which can itself be determined by FC based on its typical pattern of SSC / CD45+. Because each flow cytometer has different operating characteristics each laboratory must determine its optimal operating procedure.

### REAGENT COMPOSITION

CD8-FITC/CD4-PE/CD45-PECy5 reagent is provided in phosphate buffered saline with 0.1% sodium azide. It contains the following mixture of MAb:

- Fluorescein isothiocyanate (FITC)-labeled CD8, clone UCHT-4; isotype IgG2a
- Phycoerythrin (PE)-labeled CD4, clone Edu-2, isotype IgG2a.
- Phycoerythrin-cyanine (PECy5)-labeled CD45, clone IMMU19.2, isotype IgG1

Purification: Affinity chromatography

Amount per 1,5 ml vial: 100 tests (15 µl reagent to 10<sup>6</sup> cells)

Reagents are not considered sterile.

### STORAGE CONDITIONS

The reagent is stable until the expiration date shown on the label, when stored at 2-8°C. The reagent should not be frozen or exposed to direct light during storage or during incubation with cells. Keep the reagent vial dry. Once opened, the vial must be stored in a vertical position to avoid any possible spillage.

### WARNINGS AND RECOMMENDATIONS

1. For in vitro diagnostic use.
2. This product is supplied ready to use. If it is altered by dilution or addition of other components, it will be invalidated for in vitro diagnostic use.
3. The reagent is stable until the expiration date shown on the label if it is properly stored. Do not use after the expiration date shown on the label. If the reagents are stored in conditions different from those recommended, such conditions must be validated by the user.
4. Alteration in the appearance of the reagent, such as the precipitation or discoloration indicates instability or deterioration. In such cases, the reagent should not be used.

- It contains 0.1% sodium azide (CAS-Nr. 26628-22-8) as a preservative, but even so care should be taken to avoid microbial contamination of reagent or incorrect results may occur.
  - Sodium azide ( $\text{NaN}_3$ ) is harmful if swallowed (R22), if swallowed, seek medical advice immediately and show this container or label (S46).
  - Wear suitable protecting clothing (S36).
  - Contact with acids liberates very toxic gas (R32).
  - Azide compounds should be flushed with large volumes of water during disposal to avoid deposits in metal drains where explosive conditions may develop.
- All patient specimens and materials with which they come into contact are considered biohazards and should be handled as if capable of transmitting infection<sup>(6)</sup>, and disposed according to the legal precautions established for this type of product. Also recommended is handling of the product with appropriate protective gloves and clothing, and its use by personnel sufficiently qualified for the procedures described. Avoid contact of samples with skin and mucous membranes. After contact with skin, wash immediately with plenty of water.
- Use of the reagent with incubation times or temperatures different from those recommended may cause erroneous results. Any such changes must be validated by the user.

## PROCEDURE

### Material included

CD8-FITC/CD4-PE/CD45-PECy5 sufficient for 100 determinations (15  $\mu\text{L}$  reagent to  $10^6$  cells).

### Material required but not included

- 488 nm ion argon laser-equipped flow cytometer and appropriate computer hardware and software.
- Test tubes suitable for obtaining samples in the flow cytometer used. Usually tubes with a rounded bottom for 6 mL, 12x 75 mm are used.
- Automatic pipette (100 $\mu\text{L}$ ) and tips.
- Micropipette with tips.
- Chronometer
- Vortex Mixer
- Isotypic control reagent
- Quicklysis™ lysing solution
- Wash buffer as phosphate buffered saline (PBS) containing 0,1% sodium azide.

### Preparation

Whole blood sample must be taken aseptically by means of a venipuncture<sup>(6,7)</sup> in a sterilized tube for blood collection containing an appropriate anticoagulant (use of EDTA is recommended). The analysis requires one hundred (100)  $\mu\text{L}$  of the whole blood sample per tube, assuming a normal range of approximately 4 to  $10 \times 10^3$  leucocytes per  $\mu\text{L}$ . For samples with a high white blood cell count, dilute samples with PBS to obtain a concentration of cells approximately equal to  $1 \times 10^4$  cells/ $\mu\text{L}$ . Store the blood samples at 18-22°C until they are to be tested. It is advisable to test blood samples within the 24 hours after their extraction. Hemolyzed samples or samples with suspended cell aggregates should be rejected.

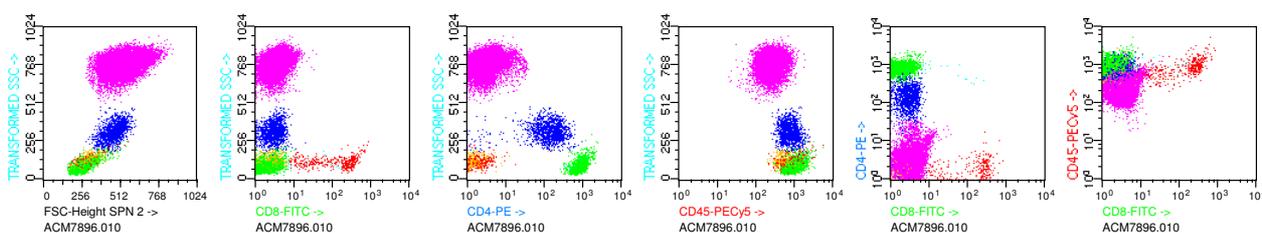
- Mix 100 $\mu\text{L}$  of peripheral blood with 15 $\mu\text{L}$  of CD8-FITC/CD4-PE/CD45-PECy5. In the case of working with other body fluids with fewer cells, such as cephalorraquid fluid, bronchoalveolar lavage, gastric lavage, start with an initial volume of 200  $\mu\text{L}$ . To evaluate the non-specific binding of the reagent, an appropriated isotype control tube can be prepared.
- Incubate for 10 minutes at room temperature in the dark.
- Add 2 ml of Quicklysis™\* erythrocyte lysing solution and incubate the sample for 10 minutes at room temperature in the dark.
- Acquire directly on the flow cytometer within the first four hours of finishing the sample preparation. If the samples are not acquired immediately after preparation, they should be stored at 2-8°C in the dark. Calibration of the instrument must be done according to the manufacturer's advice. Before acquiring samples, adjust the threshold or discriminator to minimize debris and ensure populations of interest are included. Before acquiring the sample on the flow cytometer, mix the cells on the vortex at low speed to reduce aggregation.

\*Note: The use of other lysing solutions may require the elimination of the lysed red blood cells. Follow the manufacturer's recommended protocol of the lysing solution used.

### Flow cytometry analysis

Check that the cytometer is correctly aligned and standardized for light dispersion (FSC/SSC on linear scale) and fluorescent intensity (FL1, FL2, FL3 and FL4 on logarithmic scale) and that the right color compensation has been set following the instructions of the cytometer manufacturer.

The following figures show representative flow cytometry data on peripheral blood (healthy individual) stained with the reagent. CD8-FITC/CD4-PE/CD45-PECy5 reagent allows to identify the suppressor/cytotoxic T lymphocytes as the CD4-CD8+CD45+ with low SSC subset (shown on red color), the helper/inducer T lymphocytes as the CD4+CD8-CD45+ with low SSC subset (shown on green color), a T lymphocyte subset characterized by the simultaneous expression of the antigens CD45, CD4 and CD8 with low SSC (shown on cyan color), B lymphocytes and NK cells are included in the CD45+ with low SSC subset shown on yellow color, monocytes are identified by its CD45 expression with intermediate SSC (shown on blue color), and granulocytes are identified by its CD45 expression with high SSC (shown on violet color).



The results are commonly reported as a percentage of the total of lymphocytes or leucocytes count present in the sample. The CD4+/CD8+ (helper/suppressor) lymphocyte ratio is quantified as the ratio of CD4+CD8- lymphocytes to CD4-CD8+ lymphocytes.

## LIMITATIONS

- Blood samples should be stored at 18-22°C and be tested within the 24 hours after they are obtained.
- It is advisable to acquire stained samples on the cytometer as soon as possible to optimize the results. Nonviable cells may stain nonspecifically. Prolonged exposure of whole blood samples to lytic reagents may cause white cell destruction and loss of cells from the target population.
- When using whole blood procedures, all red blood cells may not lyse under following conditions: nucleated red blood cells, abnormal protein concentration or hemoglobinopathies. This may cause falsely decreased results due to unlysed red blood cells being counted as leukocytes.
- Results obtained by flow cytometry may be erroneous if the cytometer laser is misaligned or the gates are improperly set
- Each laboratory should establish a normal range for suppressor/cytotoxic T lymphocytes and helper/inducer T lymphocytes using its own test conditions. The data for the reagent's performance have been obtained from whole blood samples collected with EDTA as anticoagulant. The reagent's performance may be affected by the use of other anticoagulants.
- Certain patients may present special problems due to altered or very low number of certain cellular population.
- Cells separated from whole blood by means of density gradients may not have the same relative concentrations of cells as unseparated blood. This may be relatively insignificant for samples from individuals with normal white blood cell counts. In leukopenic patients, the selective loss of specific subsets may affect the accuracy of the determination.
- It is important to understand the normal pattern of expression of this antigen and its relation to the expression of other relevant antigens to carry out an adequate analysis. <sup>(8-11)</sup>
- Abnormal states of health are not always represented by abnormal percentages of certain leukocyte populations. An individual who may be in an abnormal state of health may show the same leukocyte percentages as a healthy person. For this reason, it is advisable to use the test results in combination with other clinical and diagnosis data.

## EXPECTED VALUES

Each laboratory should establish its own normal reference ranges for suppressor/ cytotoxic T lymphocyte and helper/inducer T lymphocyte and B lymphocyte counts, since such values may be influenced by age, sex and race <sup>(12-14)</sup>. Based on the consulted bibliography and with a merely informative character, the percentage of suppressor/cytotoxic T cells regarding the total of lymphocytes obtained by CF in healthy individuals is around 8-31% for children of 0-3 years of age 14-34% for children older than 3 years <sup>(14)</sup> and 19-48% for adults between the ages of 18 and 70 <sup>(12)</sup>. The percentage of helper/inducer T cells regarding the total of lymphocytes obtained by CF in healthy individuals is around 33-57% for children of 0-3 years of age, 27-57% for children older than 3 years <sup>(14)</sup> and 28-58% for adults between the ages of 18 and 70 <sup>(12)</sup>.

## QUALITY CONTROL

- To obtain optimum results it is advisable to verify the precision of pipettes and that the cytometer is correctly calibrated.
- The fluorochromes fluorescein isothiocyanate (FITC), R-phycoerythrin (PE), R-phycoerythrin-cyanine 5 (PECy5); allophycyanin (APC) emit in different wavelengths but show a certain spectral overlapping which must be corrected by means of electronic compensation if combinations of different monoclonal antibodies are used conjugated with these fluorochromes. The optimum levels of compensation can be established by analysis in a dot-plot diagram of cells from healthy individuals stained with mutually exclusive monoclonal antibodies conjugated with the fluorochromes to be used in the test.
- To evaluate the non-specific binding of the antibody, an appropriated isotype control tube can be prepared.

## PERFORMANCE CHARACTERISTICS

### Reproducibility:

10 repeated measures from three peripheral blood samples representing high, medium and low leucocyte counts were evaluated. In the following table are shown the mean % of CD8+ cells of the total leucocyte count, the standard deviation and the coefficient of variation obtained for each of the three levels studied:

TOTAL LEUCOCYTES LEVEL	NUMBER OF REPEATED MEASURES	MEAN % OF CD8+ CELLS	STANDARD DEVIATION (SD)	COEFFICIENT OF VARIATION (%CV)
High	10	21.42	0.22	1.03
Medium	10	9.09	0.12	1.32
Low	10	6.81	0.11	1.62

10 repeated measures from other three peripheral blood samples representing high, medium and low leucocyte counts were evaluated. In the following table are shown the mean % of CD4+ lymphocytes of the total leucocyte count, the standard deviation and the coefficient of variation obtained for each of the three levels studied:

TOTAL LEUCOCYTES LEVEL	NUMBER OF REPEATED MEASURES	MEAN % OF CD4+ CELLS	STANDARD DEVIATION (SD)	COEFFICIENT OF VARIATION (%CV)
High	10	30.61	0.31	1.01
Medium	10	16.45	0.23	1.40
Low	10	9.97	0.21	2.11

10 repeated measures from other three peripheral blood samples representing high, medium and low leucocyte counts were evaluated. In the following table are shown the mean % of CD45+ cells of the total leucocyte count, the standard deviation and the coefficient of variation obtained for each of the three levels studied:

TOTAL LEUCOCYTES LEVEL	NUMBER OF REPEATED MEASURES	MEAN % OF CELLS CD45+	STANDARD DEVIATION (SD)	COEFFICIENT OF VARIATION (%CV)
High	10	97.08	0.18	0.20
Medium	10	94.72	0.25	0.26
Low	10	89.73	0.19	0.21

### Specificity:

The CD8 antigen is found on a subpopulation of peripheral blood T lymphocytes, 60% of thymocytes and a limited number of malignancies of T-cell origin. Normal B lymphocytes, monocytes and granulocytes do not express surface CD8 antigen. To evaluate the reagent's cross-reactivity with other cell populations, a study was carried out on 10 blood samples from healthy donors, stained with an adequate isotype control and the CD8-FITC monoclonal antibody (MAb) to study. The percentage of platelets, erythrocytes, lymphocytes, monocytes and granulocytes stained with the mentioned MAb was evaluated. The results obtained are shown in the following table:

	PLATELETS	RED BLOOD CELLS	LYMPHOCYTES	MONOCYTES	GRANULOCYTES
% Obtained	0.06	0.04	29.96	0.03	0.09
Range	(0 - 0.34)	(0 - 0.11)	(17.54 - 44.91)	(0 - 0.22)	(0 - 0.25)

The CD4 antigen is found on a subpopulation of peripheral blood T lymphocytes, some thymocytes and some malignant cells of T-cell origin. Monocytes and macrophages show a weak expression of CD4. Normal B lymphocytes and granulocytes do not express surface CD4 antigen. To evaluate the reagent's cross-reactivity with other cell populations, a study was carried out on 10 blood samples from healthy donors, stained with an adequate isotype control and the CD4-PE MAb to study. The percentage of platelets, erythrocytes, lymphocytes, monocytes and granulocytes stained with the mentioned MAb was evaluated. The results obtained are shown in the following table:

	PLATELETS	RED BLOOD CELLS	LYMPHOCYTES	MONOCYTES	GRANULOCYTES
% Obtained	0.05	0.08	42.04	90.32	1.37
Range	(0 - 0.15)	(0.04 - 0.13)	(26.06 - 58.22)	(77.63 - 95.78)	(0.27 - 2.85)

CD45 antigen is a pan-leucocyte antigen, displaying alternate splicing yielding 5 different types of surface molecules. Antibodies directed to the framework structure of CD45 recognize all isoforms of the molecules. CD45 is expressed on all normal hematopoietic cells except mature erythroid cells. To evaluate the reagent's cross-reactivity with other cell populations, a study was carried out on 10 blood samples from healthy donors, stained with an adequate isotype control and the CD45-PECy5 MAb to study. The percentage of platelets, erythrocytes, lymphocytes, monocytes and granulocytes stained with the mentioned MAb was evaluated. The results obtained are shown in the following table:

	PLATELETS	RED BLOOD CELLS	LYMPHOCYTES	MONOCYTES	GRANULOCYTES
% Obtained	0	0.25	94.65	98.51	99.95
Range	(0 - 0)	(0.15 - 0.33)	(90.35 - 97.59)	(95.85 - 99.53)	(99.78 - 100)

### Accuracy

The results for 10 different samples stained with 2 different lots of the CD8-FITC MAb were compared. Each pair of data for the same sample was analyzed, obtaining the mean fluorescence intensity (MFI) and the standard deviation from which a grouped % CV was calculated. The results of the analysis are shown in the following chart:

MEAN MFI	SD	GROUPED %CV
213.32	7.99	3.75%

The results for 10 different samples stained with 2 different lots of the CD4-PE MAb were compared. Each pair of data for the same sample was analyzed, obtaining the mean fluorescence intensity (MFI) and the standard deviation from which a grouped % CV was calculated. The results of the analysis are shown in the following chart:

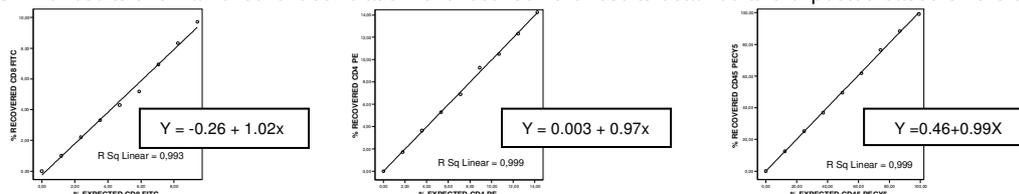
MEAN MFI	SD	GROUPED %CV
801.82	77.52	9.67%

The results for 10 different samples stained with 2 different lots of the CD45-PECy5 MAb were compared. Each pair of data for the same sample was analyzed, obtaining the mean fluorescence intensity (MFI) and the standard deviation from which a grouped % CV was calculated. The results of the analysis are shown in the following chart:

MEAN MFI	SD	GROUPED %CV
278.82	31.40	11.26%

### Linearity

Dilutions of a peripheral blood sample were made to check the concentration scale obtained of CD8+ cells, CD4+ cells and CD45+ cells. The results show an excellent correlation level between the results obtained and expected based on the dilution used.



### REFERENCES

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#### WARRANTY

This product is warranted only to conform to the quantity and contents stated on the label. There are no warranties that extend beyond the description on the label of the product. Cytognos's sole liability is limited to either replacement of the product or refund of the purchase price.

#### EXPLANATION OF SYMBOLS

	Use by (YYYY-MM)
	Storage temperature limitation
	Consult instructions for use
	<i>In vitro</i> diagnostic medical device
	Batch code
	Catalogue number
	Manufacturer

#### PRODUCED BY

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