

**510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION  
DECISION SUMMARY  
INSTRUMENT ONLY TEMPLATE**

**A. 510(k) Number:**

K071967

**B. Purpose for Submission:**

New Device

**C. Manufacturer and Instrument Name:**

Sysmex America, Inc., Sysmex® XE-5000 Analyzer

**D. Type of Test or Tests Performed:**

Quantitative, WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, NEUT%/#, LYMP %/#, MONO %/#, EO%/#, BASO %/#, NRBC, RDW-SD, RDW-CV, MPV, RET %/#, IRF, IG%/#, HPC#, RET-He, IPF, WBC-BF, RBC-BF, MN%/#, PMN%/#, TC-BF#

**E. System Descriptions:**

1. Device Description:

The Sysmex XE-5000 is part of The XE-Series instrument line. It is a multi-parameter hematology analyzer intended to perform tests in anticoagulated blood and body fluids. The instrument consists of three principal units: (1) Main Unit which aspirates dilutes, mixes and analyzed blood and body fluid samples; (2) Auto Sampler Units supplies samples to the Main Unit automatically; (3) IPU (Information Processing Unit) which processes data from the Main Unit and provides the operator interface with the system. The XE-5000 is equipped with a Sampler that provides continuous automated sampling for up to 100 tubes.

2. Principles of Operation:

The Sysmex XE-5000 performs analyses using the following methods: RF/DC Detection Method, Sheath Flow DC Detection Method, and Flow Cytometry Methods using a Semiconductor Laser. Particle characterization and identification is based on detection of forward scatter, fluorescence and adaptive cluster analysis. Using the same reagents as the XE-2100, the XE-5000 automatically classifies cells from blood and body fluids and carries out all processes automatically from aspiration of the sample to outputting the results.

The body fluid mode analysis mode of the XE-5000 uses the 4DIFF scattergram and the RBC distribution obtained from a specialized analysis sequence to calculate and display the WBC (WBC-BF) counts, mononuclear cell (MN)/polymorphonuclear cell (PMN) counts and percentages, TC-BF (Total Count) and RBC (RBC-BF) counts found in the body fluid.

Analysis results and graphics are displayed on the IPU screen. They can be printed on any of the available printers or transmitted to a Host computer.

3. Modes of Operation:

Manual, Capillary, Sampler (Automatic), Manual Closed

4. Specimen Identification:

Specimen information is managed by four menu lists and specimen identification input is manual (by operator) or by barcode reader.

5. Specimen Sampling and Handling:

There are three modes of specimen sampling: Manual, Capillary, Sampler (Automatic) and Manual Closed:

Venous blood is mixed with anticoagulant (EDTA 2K, EDTA-3K or EDTA-Na). Analyze samples within four hours of collection. If it is not possible to analyze within four hours samples are refrigerated at 2-8°C until they can be analyzed.

Capillary blood samples are placed directly into diluent to dilute them. No anticoagulant is used. Alternatively, samples are collected in a microcollection system, anticoagulant added and then diluted.

6. Calibration:

The manufacturer's instructions are to be followed for materials and frequency of calibration. Following installation calibration, it is requested to verify instrument calibration every six months or on an "as needed" basis, and maintain good QC practices, to ensure the accuracy of the system.

7. Quality Control:

The XE-5000 uses a specific control material the e-Check (XE) control.

8. Software:

The role of the software on the XE-2100DC Analyzer is to operate the instrument in order to analyze whole blood samples, and to way to store and review data.

One of the software programs allows the user to set user-definable flags according to their laboratory protocol. The XE IPU PIM (Patient Information Manager) software analyzes the data and works in conjunction with the Windows 2000 operating system, which serves as an administrative function.

FDA has reviewed applicant's Hazard Analysis and Software Development processes for this line of product types:

Yes   X   or No \_\_\_\_\_

**F. Regulatory Information:**

1. Regulation section:

21 CFR 864.5220, Automated Differential Cell Counter

2. Classification:

Class II

3. Product code:

GKZ, Counter, Differential Cell

4. Panel:

Hematology (81)

**G. Intended Use:**

1. Indication(s) for Use:

The Sysmex XE-5000 is an automated hematology analyzer for in-vitro diagnostic use in screening patient populations found in clinical laboratories. The XE-5000 classifies and enumerates the same parameters as the XE-2100 using whole blood as described below, cord blood for HPC and has a body fluid mode for body fluids. The Body Fluid mode analyzes WBC-BF, RBC-BF, MN%/#, PMN%/# and TC-BF in body fluids (cerebrospinal fluids (CSF), serous fluids, and synovial fluids with EDTA as needed).

WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, NEUT%/#, LYMP %/#, MONO %/#, EO%/#, BASO %/#, NRBC, RDW-SD, RDW-CV, MPV, RET %/#, IRF, IG%/#, HPC#, RET-He, IPF, WBC-BF, RBC-BF, MN%/#, PMN%/#, TC-BF#

2. Special Conditions for Use Statement(s):

Not applicable.

**H. Substantial Equivalence Information:**

1. Predicate Device Name(s) and 510(k) numbers:

Sysmex® XE-2100, K040073

2. Comparison with Predicate Device:

| <b>Similarities</b> |  |                        |
|---------------------|--|------------------------|
| <b>Item</b>         | <b>Sysmex® XE-5000</b>   | <b>Sysmex® XE-2100</b> |
| Intended Use        | Used as a quantitative, automated hematology analyzer and leukocyte differential counter for <i>in vitro</i> diagnostic use in clinical laboratories. The body fluid application adds a quantitative, automated procedure of analyzing cerebrospinal fluid, serous fluid and synovial fluid. | Same                   |
| Methodology         | Performs analyses using the following methods: RF/DC Detection Method, Sheath Flow DC Detection Method, and Flow Cytometry Methods using a Semiconductor Laser.  | Same                   |
| Calibrator          | XE Calibrator (X Cal)  | Same                   |
| Specimen Type       | Random whole blood and body fluid samples  | Same                   |

| <b>Differences</b> |   |  |
|--------------------|---|--|
| <b>Item</b>        | <b>Sysmex® XE-5000</b>  | <b>Sysmex® XE-2100</b>   |
| Parameters         | Body Fluid Parameters : WBC, RBC MN%/#, PMN%/#, TC-BF#<br><br>Capillary Mode Parameter (whole blood):<br>WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, NEUT%/#, LYMP %/#, MONO %/#, EO%/#, BASO %/#, NRBC%/#, RET %/#, IG%/# | Body Fluid Parameters: WBC, RBC<br><br>Capillary Mode Parameter (whole blood):<br><br>WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, RET %/# |
| Quality Control    | e-Check(XE) – 3 Levels  | e-Check– 3 Levels  |

**I. Special Control/Guidance Document Referenced (if applicable):**

EP5A *Evaluation of Precision Performance of Clinical Chemistry Device Approved Guideline*, NCCLS

*Guidelines for the valuation of blood cell analyzers including those used or differential leucocyte and reticulocyte counting and cell marker application*, ICSH, *Clin Lab Haematology*, 1994, 16(2): 157-174.

*Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices - Guidance for Industry and FDA Staff*, May 11, 2005.

**J. Performance Characteristics:**

1. Analytical Performance:

a. *Accuracy:*

The accuracy study was performed on 284 body fluid samples (CSF, Serous and Synovial,) at three sites. The performance of the XE-5000 Body Fluid mode was compared to the XE 2100 Body Fluid Application and manual method for cellular enumeration of WBC and RBC. The WBC differential (MN%/# and PMN %/#) of the body fluid mode was compared to the manual method of cell identification using the laboratories' manual differential method. Results are as follows using Deming regression:

**Accuracy of the XE-5000 White Cell Counts**

|                                     | n=  | Mean                        | r      | Slope | Intercept | Range<br>x10 <sup>3</sup> /μL |
|-------------------------------------|-----|-----------------------------|--------|-------|-----------|-------------------------------|
| XE-5000 WBC-BF vs.<br>XE-2100 WBC   | 269 | XE5 :1.121<br>XE21:1.2266   | 0.9965 | 0.929 | -0.0183   | 0-10.786                      |
| XE-5000 TC-BF vs.<br>XE-2100 WBC    | 168 | XE5: 0.9967<br>XE21: 1.0617 | 0.9954 | 0.954 | -0.0165   | 0-10.786                      |
| XE-5000 WBC-BF vs.<br>Manual WBC    | 254 | XE5 :1.0428<br>Man :1.1793  | 0.9616 | 0.876 | 0.0095    | 0-13.1                        |
| XE-5000 TC-BF vs.<br>Manual WBC     | 161 | XE5 :0.9011<br>Man :1.0548  | 0.9501 | 0.867 | -0.0139   | 0-10.14                       |
| XE-5000 WBC-BF vs.<br>XE-5000 TC-BF | 185 | WBC: 0.9149<br>TC: 0.9499   | .9989  | 0.978 | -0.0140   | 0-10.14                       |

**Accuracy of the XE-5000 Red Blood Cell Counts**

|                                   | n=  | Mean                         | r      | Slope | Intercept    | Range<br>X10 <sup>6</sup> /μL |
|-----------------------------------|-----|------------------------------|--------|-------|--------------|-------------------------------|
| XE-5000 RBC-BF vs.<br>XE-2100 RBC | 252 | XE5 :0.698<br>XE21 :0.0719   | 0.9974 | 0.989 | -0.0013<br>- | 0-4.880                       |
| XE-5000 RBC-BF vs.<br>Manual RBC  | 167 | XE5: 0.05802<br>Man: 0.06278 | 0.9994 | 0.902 | 0.00142      | 0-5.370                       |

**Accuracy of XE-5000 Body Fluid Differential vs. Manual Differential**

|  | n=  | Mean                         | r      | Slope | Intercept | Range                           |
|--|-----|------------------------------|--------|-------|-----------|---------------------------------|
| XE-5000 MN# vs. Manual MN#             | 251 | XE5 : 0.5211<br>Man: 0.5465  | 0.9789 | 0.976 | -0.0121   | 0-9.929<br>x10 <sup>3</sup> /μL |
| XE-5000 MN% vs. Manual MN%             | 251 | XE5: 60.56<br>Man: 68.86     | 0.7525 | 1.209 | -22.69    | 0-100%                          |
| XE-5000 PMN# vs. Manual PMN#           | 251 | XE5 : 0.6580<br>Man : 0.5853 | 0.9239 | 1.120 | 0.0028    | 0-8.929<br>x10 <sup>3</sup> /μL |
| XE-5000 PMN% vs. Manual PMN%           | 251 | XE5 : 39.10<br>Man : 28.91   | 0.7589 | 1.195 | 4.54      | 0-100%                          |
| CSF: XE-5000 MN# vs. Manual MN#        | 52  | XE5 : 0.0400<br>Man : 0.0398 | 0.9949 | 1.016 | -0.0004   | 0-0.330<br>x10 <sup>3</sup> /μL |
| CSF: XE-5000 MN% vs. Manual MN%        | 52  | XE5 :67.37<br>Man :84.33     | 0.5715 | 2.091 | -108.92   | 0-100%                          |
| CSF: XE-5000 PMN# vs. Manual PMN#      | 52  | XE5 :0.0266<br>Man :0.0276   | 0.9963 | 0.941 | 0.0006    | 0-0.577<br>x10 <sup>3</sup> /μL |
| CSF: XE-5000 PMN% vs. Manual PMN%      | 52  | XE5 :32.63<br>Man :14.96     | 0.5614 | 2.150 | 0.46      | 0-100%                          |
| Serous: XE-5000 MN# vs. Manual MN#     | 141 | XE5 :0.6850<br>Man :0.7170   | 0.9838 | 0.975 | -0.0138   | 0-9.929<br>x10 <sup>3</sup> /μL |
| Serous: XE-5000 MN% vs. Manual MN%     | 141 | XE5 :60.58<br>Man :65.85     | 0.7947 | 1.097 | -11.62    | 0.9-100%                        |
| Serous: XE-5000 PMN# vs. Manual PMN#   | 141 | XE5 :0.6707<br>Man :0.5459   | 0.8448 | 1.397 | -0.0919   | 0-8.062<br>x10 <sup>3</sup> /μL |
| Serous: XE-5000PMN% vs. Manual PMN%    | 141 | XE5 :38.81<br>Man :30.92     | 0.8168 | 1.074 | 5.59      | 0-98%                           |
| Synovial: XE-5000 MN# vs. Manual MN#   | 58  | XE5 :0.5541<br>Man :0.5864   | 0.8984 | 1.015 | -0.0408   | 0-2.567<br>x10 <sup>3</sup> /μL |
| Synovial: XE5000 MN% vs. Manual MN%    | 58  | XE5 :54.40<br>Man :62.33     | 0.8350 | 1.040 | -10.41    | 4.3-99%                         |
| Synovial: XE-5000 PMN# vs. Manual PMN# | 58  | XE5 :1.1930<br>Man :1.1809   | 0.9885 | 0.947 | 0.0746    | 0-8.929<br>x10 <sup>3</sup> /μL |
| Synovial: XE-5000 PMN% vs. Manual PMN% | 58  | XE5 :45.60<br>Man :36.53     | 0.8188 | 1.009 | 8.75      | 0-96%                           |

Capillary Mode on Whole Blood

A study was performed to compare the Capillary Mode to the Auto and Manual modes on the XE-5000. 115 samples were run in the auto (sampler) mode and the capillary mode. 66 samples were run in the manual and capillary mode. The results are as follow using Deming regression:

**Accuracy of XE-5000 Capillary to Sampler (Auto) and Manual modes**

| Parameter                             | n=  | Mean                                 | r      | Slope | Intercept       | Range  |
|---------------------------------------|-----|--------------------------------------|--------|-------|-----------------|--|
| WBC XE-5000<br>Sampler vs. Capillary  | 115 | Auto :<br>13.298<br>Cap: 13.610      | 0.9989 | 0.984 | -0.088          | 1.66-<br>279.98<br>$\times 10^3/\mu\text{L}$ |
| RBC XE-5000<br>Sampler vs. Capillary  | 115 | Auto : 4.220<br>Cap: 4.195           | 0.9571 | 1.009 | -0.013          | 2.56-7.11<br>$\times 10^6/\mu\text{L}$       |
| HGB XE-5000<br>Sampler vs. Capillary  | 115 | Auto :<br>12.249<br>Cap: 12.181      | 0.9562 | 1.069 | -0.770          | 8.10-<br>16.20<br>g/dL                       |
| HCT XE-5000<br>Sampler vs. Capillary  | 115 | Auto :<br>38.397<br>Cap: 37.194      | 0.9195 | 1.027 | 0.207           | 23.90-<br>52.00%                             |
| MCV XE-5000<br>Sampler vs. Capillary  | 115 | Auto :<br>91.805<br>Cap: 89.411      | 0.9851 | 1.061 | -3.093          | 59.9-<br>115.0fL                             |
| MCH XE-5000<br>Sampler vs. Capillary  | 115 | Auto :<br>29.179<br>Cap: 29.222      | 0.9856 | 1.003 | -0.132          | 18.70-<br>37.60pg                            |
| MCHC XE-5000<br>Sampler vs. Capillary | 115 | Auto :<br>31.790<br>Cap: 32.682      | 0.9271 | 0.940 | 1.075           | 27.50-<br>36.10<br>g/dL                      |
| PLT XE-5000<br>Sampler vs. Capillary  | 115 | Auto :<br>251.157<br>Cap:<br>227.852 | 0.9898 | 1.060 | 9.532<br>12.150 | 13- 1685<br>$\times 10^3/\mu\text{L}$        |
| WBC XE-5000<br>Manual vs. Capillary   | 66  | Man :<br>18.350<br>Cap: 18.812       | 0.9993 | 1.007 | -0.591          | 1.66-<br>284.26<br>$\times 10^3/\mu\text{L}$ |
| RBC XE-5000<br>Manual vs. Capillary   | 66  | Man : 4.093<br>Cap: 4.140            | 0.9495 | 1.020 | -0.130          | 2.88- 7.07<br>$\times 10^6/\mu\text{L}$      |
| HGB XE-5000<br>Manual vs. Capillary   | 66  | Man : 11.57<br>Cap: 11.60            | 0.9417 | 1.082 | -0.98           | 8.4-15.9<br>g/dL                             |
| HCT XE-5000<br>Manual vs. Capillary   | 66  | Man : 36.63<br>Cap: 36.62            | 0.9143 | 1.010 | -0.34           | 26-52%                                       |
| MCV XE-5000<br>Manual vs. Capillary   | 66  | Man : 90.59<br>Cap: 89.41            | 0.9968 | 1.044 | -2.77           | 59.9-<br>114.2fL                             |
| MCH XE-5000<br>Manual vs. Capillary   | 66  | Man : 28.50<br>Cap: 28.27            | 0.9904 | 0.994 | 0.39            | 18.7-<br>33.1pg                              |
| MCHC XE-5000<br>Manual vs. Capillary  | 66  | Man : 31.49<br>Cap: 31.62            | 0.9501 | 1.109 | -3.57           | 28.0-35.4<br>g/dL                            |
| PLT XE-5000<br>Manual vs. Capillary   | 66  | Man : 263.7<br>Cap: 241.7            | 0.9899 | 1.069 | 5.5             | 11-1687<br>$\times 10^3/\mu\text{L}$         |

### WBC-D on Whole Blood Mode

Seventy-one samples were analyzed to compare the WBC-D on the XE-5000 to the XE-2100. The expected result ( $\pm 5.0\%$ ) is based on samples with WBC counts  $>4.0 \times 10^3/\mu\text{L}$ . The results are as follows:

**Accuracy of WBC-D on XE-5000 vs. XE-2100 Auto Mode**

| <b>WBC-D<br/>XE-2100<br/>Mean</b> | <b>WBC-D<br/>XE-5000<br/>Mean</b> | <b>Percent<br/>Deviation</b> | <b>Expected result</b> | <b>Range</b>                              | <b>n=</b> |
|-----------------------------------|-----------------------------------|------------------------------|------------------------|---|-----------|
| 18.87                             | 18.95                             | 0.42%                        | $\pm 5.0\%$            | 1.82-<br>284.26 $\times 10^3/\mu\text{L}$ | 66        |

*b. Precision/Reproducibility:*

Within run precision was performed on using CSF, Synovial and Serous fluid types assayed 10 consecutive times and covered the whole measuring range for the WBC and RBC parameters. In addition, a precision study was performed (10 consecutive replicates on several samples) to show that the differential parameters of the Capillary Mode of the XE-5000 met the performance specifications at specific mean values for each of the differential parameters. Results for all studies were within manufacturer specifications.

A precision was also performed to show that the WBC-D parameter (Whole Blood Mode) met the performance specifications at specific normal mean value ( $\text{WBC} \geq 4.0 \times 10^3/\mu\text{L}$ ). Within run precision data was collected and ten consecutive replicates on three normal samples were analyzed on the XE-5000. Performance was within performance specifications.

*c. Linearity:*

Linearity was performed on the WBC-BF, RBC-BF and TC-BF parameters by diluting samples with instrument diluent. Linearity was tested on the following:

| <b>Parameter</b> | <b>XE-5000 Body Fluid Ranges</b>  |
|------------------|---|
| WBC-BF           | 0.000 – 0.050 $\times 10^3/\mu\text{L}$ (within $\pm 0.010 \times 10^3/\mu\text{L}$ )<br>0.050 – 10.000 $\times 10^3/\mu\text{L}$ ( $\leq 20\%$ ) |
| RBC-BF           | 0.000 – 5.000 $\times 10^6/\mu\text{L}$ ( $\leq 2.0\%$ or within $\pm 0.020 \times 10^6/\mu\text{L}$ )  |
| TC-BF            | 0.000 – 0.050 $\times 10^3/\mu\text{L}$ (within $\pm 0.010 \times 10^3/\mu\text{L}$ )<br>0.050 – 10.000 $\times 10^3/\mu\text{L}$ ( $\leq 20\%$ ) |

**Results: Linearity Results for Body Fluid Mode**

| Parameter     | Range Tested   | Units                | r <sup>2</sup> | r    | Slope  | Intercept |
|---------------|----------------|----------------------|----------------|------|--------|-----------|
| <b>WBC-BF</b> | 0.001-0.052    | x10 <sup>3</sup> /μL | 0.00           | 0.99 | 0.9974 | 1.0093    |
|               | 0.001-5.901    | x10 <sup>3</sup> /μL | 1.00           | 1.00 | 1.0005 | 0.0557    |
|               | 0.268-10.547   | x10 <sup>3</sup> /μL | 1.00           | 1.00 | 0.9949 | 0.0946    |
|               | 0.009-56.281   | x10 <sup>3</sup> /μL | 1.00           | 1.00 | 0.9902 | 138.1555  |
| <b>RBC-BF</b> | 0.001-0.032    | x10 <sup>6</sup> /μL | 1.00           | 1.00 | 0.9995 | 0.0002    |
|               | 0.000-0.048    | x10 <sup>6</sup> /μL | 1.00           | 1.00 | 1.0027 | 0.0004    |
|               | 0.001-1.445    | x10 <sup>6</sup> /μL | 1.00           | 1.00 | 1.0033 | 115.3005  |
|               | 0.140-5.307    | x10 <sup>6</sup> /μL | 1.00           | 1.00 | 1.0119 | 0.0677    |
|               | 0.002-5.359    | x10 <sup>6</sup> /μL | 1.00           | 1.00 | 1.0081 | 0.0286    |
| <b>TC-BF</b>  | 0.001 - 0.049  | x10 <sup>3</sup> /μL | 0.99           | 0.99 | 1.0125 | -0.0003   |
|               | 0.264 - 10.549 | x10 <sup>3</sup> /μL | 1.00           | 1.00 | 0.9943 | 0.1010    |
|               | 0.014 - 56.22  | x10 <sup>3</sup> /μL | 1.00           | 1.00 | 1.0022 | 0.0824    |

*d. Carryover:*

Carry-over effect was evaluated by assaying a sample with a high cell count three consecutive times followed immediately by testing a low count sample consecutively 3 times for WBC-BF, RBC-BF, TC-BF and WBC-DF (Whole Blood Mode). Types of fluid samples used were CSF, Serous, and Synovial. Performance met manufacturer's specifications for all parameters.

*e. Interfering Substances:*

Results may be compromised with clotted samples and synovial samples that contain uric acid crystals or have a high viscosity.

Samples results with Errors related to WBC-BF and RBC-BF parameters should not be used.

2. Other Supportive Instrument Performance Data Not Covered Above:

**Stability on Whole Blood**

Specimens used to determine sample stability were split into 2 aliquots---one room temperature (RT) (20-28°C) and the other at low temperature (LT) (4°C). The separate aliquots were stored at room temperature and low temperature respectively at baseline (immediately after blood collection), 24, 48, 72 and 96 hours.

Normal samples are stable up to 48 hours at room temperature (20-28°C) and at low temperature (4°C) for the following parameters: WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, Neut %, Lymph%, Mono%, Eosin% and Baso%.

**K. Proposed Labeling:**

The labeling is sufficient and it satisfies the requirements of 21 CFR Part 809.10.

**L. Conclusion:**

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.

