

PROGRAM Standard Operating Procedure – Laboratory Services	
Title: MIC72000 – GeneXpert System	Policy Number:
Program Name: Laboratory Services	
Applicable Domain: Lab, DI and Pharmacy Services	
Additional Domain(s): NA	
Effective Date:	Next Review Date:
Issuing Authority: Director, Laboratory and Diagnostic Imaging Services	Date Approved:
Accreditation Canada Applicable Standard: NA	

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**GUIDING PRINCIPLE:**

The GeneXpert System automates and integrates sample preparation, nucleic acid amplification, and detection of the target sequence in simple or complex samples using real-time Polymerase Chain Reaction (PCR).

**PURPOSE/RATIONALE:**

This standard operating procedure describes the GeneXpert System and its components.

**SCOPE/APPLICABILITY:**

This standard operating procedure applies to Medical Laboratory Technologists (MLTs) processing specimens using the GeneXpert System.

**SAMPLE INFORMATION:**

- Refer to assay specific GeneXpert procedures for sample information

**REAGENTS and/or MEDIA:**

- Refer to assay specific GeneXpert procedures for reagent information

**SUPPLIES:**

- Refer to assay specific GeneXpert procedures for supply information

**EQUIPMENT:**

- GeneXpert System
- Printer

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### ENVIRONMENTAL CONTROLS:

- Operating temperature: 15°C to 30°C
- Relative humidity: 10% to 95%, non-condensing

### SPECIAL SAFETY PRECAUTIONS:

Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials or cultures:

- Ensure that appropriate hand hygiene practices be used
- Lab gown must be worn when performing activities with potential pathogens
- Gloves must be worn when direct skin contact with infected materials is unavoidable
- Eye protection must be used when there is a known or potential risk of exposure of splashes
- All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC)
- The use of needles, syringes and other sharp objects should be strictly limited

All patient specimens are assumed to be potentially infectious. Routine Practices must be followed. Since viable micro-organisms are used, all cultures must be handled with appropriate precautions. All equipment in contact with cultures should be decontaminated by appropriate methods.

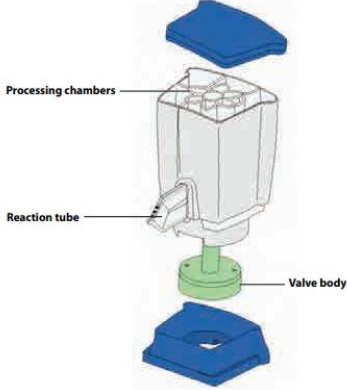
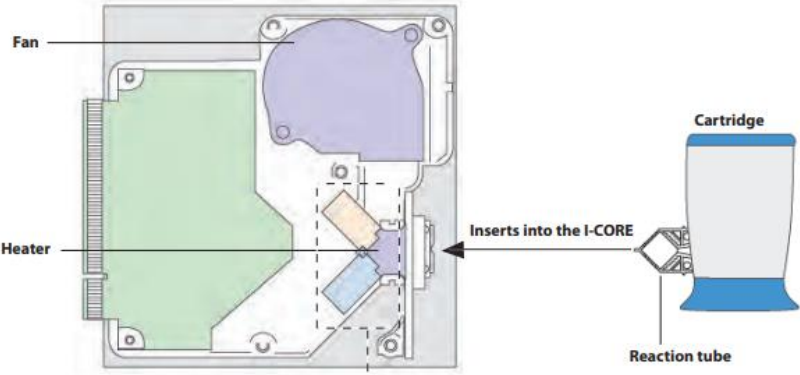
### QUALITY CONTROL:

- Refer to assay specific GeneXpert procedures for quality control information

### PROCEDURE INSTRUCTIONS:

Step	Action
<b>GeneXpert System Components</b>	
<b>1</b>	<b>GeneXpert System Instrument:</b> <ul style="list-style-type: none"><li>• The GeneXpert GX-IV System is composed of 4 modules</li><li>• The GeneXpert GX-XVI System is composed of 16 modules</li><li>• A cartridge loading and unloading mechanism assures the proper movement of the cartridge in the instrument</li><li>• The system is designed to perform a self-test before each assay starts to verify that the system is functioning properly</li><li>• Because the system allows you to control the modules independently, you can process different samples using different assay definitions in the same system at the same time</li></ul>
<b>2</b>	<b>GeneXpert System Cartridges:</b> <ul style="list-style-type: none"><li>• The disposable, single use GeneXpert System cartridge holds the samples and reagents that you want to process in the GeneXpert System</li><li>• Each cartridge consists of the processing chambers, valve body and reaction tube</li><li>• The cartridge is designed to keep the reagent contained within the cartridge. It is a closed system vessel:</li></ul>

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	 <p>The diagram shows a 3D exploded view of the I-CORE module. At the top is a blue cap. Below it is a grey rectangular block labeled 'Processing chambers'. A 'Reaction tube' is shown entering the side of the processing chambers. At the bottom is a green 'Valve body' which connects to the reaction tube. Below the valve body is another blue base.</p>
<p>3</p>	<p><b>I-CORE Module:</b></p> <ul style="list-style-type: none"> <li>The I-CORE (Intelligent Cooling/Heating Optical Reaction) module is the hardware component within each instrument module that performs PCR amplification and fluorescence detection</li> <li>As the cartridge is loaded onto the instrument, the reaction tube is inserted into the I-CORE module</li> <li>The sample and reagent mixture are pushed from the cartridge into the reaction tube</li> <li>During the amplification process, the I-CORE heater heats up and the fan cools down the reaction tube contents. The optical blocks excite the dye molecules and detect the fluorescence emitted:</li> </ul>  <p>The diagram illustrates the internal components of the I-CORE module. On the left, a green rectangular area is labeled 'Heater'. Above it, a grey area is labeled 'Fan'. In the center, a blue rectangular block is labeled 'Reaction tube'. To the right, a 'Cartridge' is shown with an arrow pointing to the reaction tube, labeled 'Inserts into the I-CORE'.</p>
<p>4</p>	<p><b>Heating and Cooling Mechanisms:</b></p> <ul style="list-style-type: none"> <li>Within the I-CORE, the heater consists of two ceramic plates that have high thermal conductivity to assure temperature uniformity and rapid heat transfer</li> <li>Resistive heater elements are deposited on the ceramic plates and a thermistor attached directly to each plate monitors its temperature</li> <li>A high efficiency fan cools the reaction tube contents by moving ambient air across the heater plates</li> <li>During thermocycling, the instrument firmware controls the temperature inside the instrument module</li> <li>The firmware incorporates a control loop to ensure rapid heating of the plates while minimizing the temperature overshoot around the desired target temperature</li> </ul>

5	<p><b>Optical System:</b></p> <ul style="list-style-type: none"><li>• Within the I-CORE, the optical system consists of two blocks:<ul style="list-style-type: none"><li>➢ <u>Six-color excitor module</u>-Contains high intensity light-emitting diodes (LEDs) to excite the reporter dye molecules</li><li>➢ <u>Six-color detector module</u>-Contains silicon photodetectors and filters to detect the six spectra bands</li></ul></li><li>• The optical blocks are positioned within the I-CORE such that their apertures mate with the optical windows of the reaction tube, allowing excitation and emission detection of the reaction mixture</li><li>• By using probes labeled with different fluorescent reporter dyes, up to six targets can be detected simultaneously in a single reaction tube</li><li>• The emission spectra of fluorescent dyes can overlap and a particular dye could produce signal in more than one channel. To compensate for the spectra overlap, the system uses appropriate calibration and data analyses algorithms to determine the concentrations of each dye</li></ul>
6	<p><b>System Calibration:</b></p> <ul style="list-style-type: none"><li>• The thermal reaction chamber thermistors are calibrated to <math>\pm 1.0^{\circ}\text{C}</math> using NIS traceable standards</li><li>• During the manufacturing process, the temperature of the heating system is measured at two temperatures: <math>60^{\circ}\text{C}</math> and <math>95^{\circ}\text{C}</math></li><li>• Calibration coefficients that correct for small errors in the raw thermistor readings for the heaters are stored in the memory of each I-CORE module</li></ul>
7	<p><b>GeneXpert System Software:</b></p> <ul style="list-style-type: none"><li>• The GeneXpert System software is installed on the supplied laptop and can accommodate a variety of applications:<ul style="list-style-type: none"><li>➢ <u>Administrative tasks</u>-Configure the system to accommodate your organization's preferences, define system users and set up permissions, import and delete <i>in vitro</i> diagnostic assay definitions, general external control trend reports and manage the test data in the database</li><li>➢ <u>Test tasks</u>-Create and start an <i>in vitro</i> diagnostic test, stop a test in progress, monitor a test in progress, view the test results, edit test information and generate test reports</li><li>➢ <u>Maintenance tasks</u>-Perform various maintenance tasks including plunger and valve maintenance controls for cleaning the module plungers and valves, performing a self-test manually for troubleshooting, checking the calibration and test counts and commands for opening a module door</li></ul></li></ul>

#### INTERPRETATION OF RESULTS:

- Refer to assay specific GeneXpert procedures for the interpretation of results

#### REPORTING INSTRUCTIONS:

- Refer to assay specific GeneXpert procedures for the reporting of results

#### CROSS REFERENCES:

NA

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**REFERENCES:**

1. Cepheid GeneXpert System. *GeneXpert System User Manual*. 301-0045, Rev.C, June 2012

**APPROVAL:**

\_\_\_\_\_  
Date

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Director, Laboratory and Diagnostic Imaging Services

**REVISION HISTORY:**

REVISION	DATE	Description of Change	REQUESTED BY
1.0	27 May 20	Initial Release	L. Steven
2.0	17 Oct 22	Procedure reviewed	L. Steven
3.0	01 Oct 24	Procedure reviewed	L. Steven