SOP Number	EQ-10-05
Title	Use and Maintenance of Incubated Orbital Shakers
Revisions Made	• Minor editorial changes for clarification purposes.

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Title	Use and Maintenance of Incubated Orbital Shakers
Scope	This SOP describes how to use and maintain orbital shakers.
Application	Shakers are used to grow microbial cultures under agitated conditions.

	Approval	Date
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1. Definitions	1. Additional abbreviations/definitions are provided in the text. 2. RPM = Rotations per minute 3. LCD = Liquid crystal display 4. ISO = International Organization for Standardization
2. Health and Safety	Follow procedures specified in SOP MB-01, Laboratory Biosafety. The Study Director and/or lead analyst should consult the Safety Data Sheet for specific hazards associated with products.
3. Personnel Qualifications and Training	Refer to SOP ADM-04, OPP Microbiology Laboratory Training.
4. Instrument Calibration	1. See Forma Model 420 and MaxQ Mini 4450 Orbital Shaker Manuals for: a. Temperature calibration b. Shaker speed calibration
5. Sample Handling and Storage	Ensure all vessels placed into the shaker are properly covered or sealed (e.g., caps, aluminum foil, parafilm).
6. Quality Control	1. Record the temperature of each unit on each working day on the appropriate temperature record form (see section 14) when the instrument is in use. 2. The thermometers used to record the temperature of each unit are point checked annually against an ISO accredited verification thermometer (See SOP EQ-02 Thermometers/hygrometers).
7. Interferences	1. Forma Shaker (Model 420) (Shakers #1 & #2) a. If the shaker is operated at a temperature 5-10°C above ambient, the circular vent at the rear of the cabinet must be 1 inch from the wall and the rear vent must be fully opened by turning the Phillips screw clockwise. If the operating temperatures are more than 10°C above ambient, the rear vent must remain closed (fully counterclockwise). b. Before inserting tubes or flasks, ensure the screws that attach the racks to the platform are tight. c. The lid must be closed to operate the shaker. d. Do not operate the shaker without a load. 2. MaxQ Mini 4450 Shaker (Shaker #3) a. Make sure all vessels are securely clamped before turning on unit.

	b. The shaker will not operate if the timer is in the Off position. c. Do not operate shaker with an unbalanced load. Platforms should be loaded for optimum stability. d. Do not lift shaker by the platform. e. If the shaker fails to heat with the "HEAT ON" lamp lit and the user settable high-limit thermostat set to the fully clockwise position, it will be necessary to reset the secondary over-temperature thermostat. f. If shaker fails to heat, see the Manual, Section 6: Troubleshooting, for instructions on how to proceed.
8. Non-conforming Data	1. Management of non-conforming data will be consistent with SOP ADM-07, Non-Conformance Reports. 2. Shakers #1-2: For maintenance, service, and troubleshooting refer to sections 3 and 4 of the Forma Model 420 Manual (see section 15). 3. Shaker #3: For maintenance, service, and troubleshooting refer to sections 6 and 7 of the MaxQ Mini 4450 Manual (see section 15).
9. Data Management	1. Data will be archived consistent with SOP ADM-03, Records and Archives. 2. Record the temperature of each shaker promptly, legibly, and in indelible ink on the appropriate temperature record form (see section 14).
10. Cautions	1. Do not leave any shaker unattended when starting the unit. Be sure all vessels, flasks, and test tube racks are firmly seated in the clips and routinely check the security of the flask clip and the platform attachment screws. 2. Forma Model 420 (Shakers #1 and #2) a. These shakers are attached to a Knee-well Slide Assembly – make sure the lever catches the latch tab after pushing the slide assembly back in prior to turning on the shaker. b. The shaker control system monitors and provides alarms for nine operating parameters (refer to pages 2-5 and 2-6 of the manual, see section 15). c. For spills inside of the shaker: i. Refer to SOP MB-13, Handling Spills, for the spill control procedures for biohazardous organisms in biosafety levels 1 and 2. ii. If liquids or materials have entered the unit through orbital mechanism hole, the shaker must be disassembled and

	cleaned immediately. iii. Place shaker on sturdy work area, make sure the unit is turned off, unplugged, and the line cord removed from the side of the cabinet; the platform should already be removed. iv. Remove the four screws securing the sheet metal cover plate located under the platform, the plate will remain in place. v. Remove the six screws securing the back panel and allow the back of the unit to swing down. vi. Remove four screws, two on either side of the back panel. Disconnect ribbon connector from J2 of the microprocessor board and remove the two screws from the ribbon cable cover plate on the base of the cabinet. vii. Remove the wire connector from J2 of the motor control board and disconnect the square connector where the wiring enters the base of the unit. viii. Slowly slide the cabinet back and carefully lift it off the base, being careful of any wiring. It will be necessary to feed the ribbon cable through the access hole. ix. Clean the mechanism area with 70% solution of alcohol. Everything must be cleaned, with special attention given to the area around the motor. x. Allow the unit to air-dry for at least one hour before reassembling.
11. Special Apparatus and Materials	See Attachment 1.
12. Procedure and Analysis	
12.1 General Shaker Operation	a. Forma Model 420 Shaker (Shakers #1 and #2): Turn on the unit using the main power switch (located on the right side of the unit next to the power cord) and press Start to operate the shaker. Be sure Knee-well Slide Assembly is locked prior to turning on Shakers #1 and #2. b. MaxQ Mini 4450 Shaker (Shaker #3): Turn on unit by pressing top portion of power switch. Press bottom portion of power switch to

	turn off shaker. The shaker will not operate if the timer is in the Off position. c. Shakers 1-3: Record the temperature of each unit when in use (refer to section 1 and 2 of the manual, see section 15).
12.2 Time Settings: Forma Model 420 Shaker	a. Hold: i. When time is set to Hold, the value shown in the Actual portion of the display represents the total operating time and may be reset at the operator's convenience. ii. The shaker will continue to count upwards even if the cover has been repeatedly opened and closed or turned off and on with the power switch. iii. The time will reset to 00:00 when the Stop button is pressed, and the unit then restarted by pressing the Start button. b. Countdown: i. When the Hold setpoint is changed to countdown entering a time value in hours and minutes, the shaker will operate for that period and automatically shut down. ii. The display will show the total time in the Setpoint segment and the operating time remaining in the Actual part of the display, as the microprocessor counts down to zero.
12.3 Time Settings: MaxQ Mini Shaker	a. Press TIMER/ELAPSED button until TIMER and SET TIME lights are illuminated. The HOURS or MINUTES light will also light up at this point, depending on which option was previously chosen. b. Press HOURS/MINUTES button for desired timing mode. c. Hold down appropriate arrow button in the TIME module of the control panel, up or down, until desired timing cycle is set from 0.1 hour up to 999 hours, or from 0.1 minute to 999 minutes depending on which timing mode is chosen. d. Press START to begin timed shaking; countdown will begin from time set. TIMER and MINUTES or HOURS lights will illuminate, and timer will count down from time selected. An audible alarm will sound at the end of the timing cycle and platform rotation will cease.
12.4 Speed Settings	a. Forma Model 420 Shaker: i. Press the button beneath the Speed setpoint, the RPM value will begin to flash. ii. Press the up or down arrows to set the new speed in 1 RPM

	increments. Hold either button to scroll. iii. Press the speed button again to return to the Operating Screen. b. MaxQ Mini Shaker: i. Hold down appropriate arrow membrane switch in the speed module of the control panel, up or down, until desired speed is set up to 500 rpm. SET RPM light will illuminate. ii. Press START membrane switch to begin shaking. RPM light will illuminate. iii. Press STOP membrane switch to end shaking. SET RPM light will illuminate. iv. Note: Speed can be changed without pressing the START or STOP switches. Simply press the appropriate UP or DOWN switch until desired RPM is reached.
12.5 Temperature Settings	a. Forma Model 420 Shaker: i. Press the button beneath the temperature setpoint (Temp °C), the temperature value will begin to flash. ii. Press the up or down arrows to set the new temperature in 0.1°C increments. Hold either button to scroll. iii. Press the temperature button again to return to the Operating Screen. b. MaxQ Mini Shaker: i. Press and hold the star (*) key on the control panel (next to the temperature down arrow key) and use either the up or down arrow key to adjust the set point to the desired temperature. Release the star (*) key. ii. Once set, temperature control is initiated by pressing the heat on button; the heater will react and start increasing the temperature to reach the set point. iii. Allow at least 30 minutes for the temperature to stabilize. iv. During operation, both the up and down arrow keys can be used to adjust the temperature to a new set point.
13. Data Analysis/ Calculations	None
14. Forms and Data	1. Test Sheets and attachments. Test sheets and attachments are stored

Sheets	separately from the SOP under the following file names: Orbital Shaker Inventory EQ-10-05_A1.docx Incubated Orbital Shaker Temperature Log EQ-10-05_F1.docx
15. References	1. Forma Orbital Shaker Operating and Maintenance Manual 7000420 Rev. 7. 2. MaxQ Mini Shaker Operating Manual and parts List 057-8100 Rev. 0.

Orbital Shaker Inventory

Unit #	Location	Shaker Name	Manufacturer	Model Number	Serial Number
1	B202	Forma Orbital Shaker	Thermo Scientific	420	131376-1816
2	B202	Forma Orbital Shaker	Thermo Scientific	420	131375-1815
3	B205	MaxQ Mini 4450 Shaker	Thermo Scientific	SHKE4450CC	1413060133455