Document History:

Title: Centrifuge Operation & Maintenance Standard Operating Procedure **Site(s): ALL**

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Approved by:	Paul Penner	**Date:**	29 Dec 2011

Approved by:	H Malvern	**Date:**	16 Oct 2020
Signature:	(Signature on File)		
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#	Details of Revisions:	Approval:	Date:
1	New document		
2	Entire document revised	SMT	15-Jun-10
3	Entire Document	MGRS/DSM OPS	05-MAY-2011
4	Added a Step to Appendix 1	P Penner	29-DEC-2011
5	Added instructions to perform hydraulic lid check to Daily Maintenance (p.5). Updated Centrifuge Maintenance Chart (appendix 7) for daily lid check (p.17).	H Malvern	16 Oct 2020

1.0 PURPOSE:

1.1 To provide general instruction on the safe operation and maintenance of centrifuge devices within the diagnostic laboratory

1.2 Where discipline or laboratory specific centrifuge operation and maintenance procedures are available, these should be adhered to.

2.0 DEFINITIONS:

2.1. Centrifuge: Equipment used to separate particles in a suspension by size or density, using centrifugal forces generated by a spinning rotor.

2.2. Rotor: The rotating component within the centrifuge that is capable of holding the buckets for canisters containing the sample tubes or holding the sample tubes. The rotor can be in a fixed position (fixed-angle or vertical rotors) or moveable position (swing-bucket rotors also known as horizontal rotors) that swings into a horizontal position as the rotor speed increases.

2.3. Biosafety Cabinet (BSC): A primary containment device consisting of a ventilated chamber with an open front. It is designed to provide personal, product and environmental protection by inward airflow and HEPA-filtered supply and exhaust air.

2.4. Canister/Adapter: The component that is capable of holding the sample tubes for centrifugation.

2.5. Bucket: The component that holds the canister or adapter.

2.6. Disinfectant: A chemical or mixture of chemicals used to kill or inactivate micro-organisms but not necessarily their spores.

2.7. Personal Protective Equipment (PPE): Safety equipment and clothing designed to protect the worker from workplace hazards (lab coats, non-latex gloves, safety glasses, N-95 or equivalent respirators etc.).

2.8. NIST: National Institute of Standards and Technology

2.9. Tachometer: An instrument that measures the rotation speed of a shaft or disk. The device usually displays the revolutions per minute.

2.10. RPM: Revolutions per minute.

2.11. PSI: Pounds per square inch.

2.12. RCF: Relative centrifugal field. Is the ratio of the centrifugal acceleration at the specified radius and speed (rw^2) to the standard acceleration of gravity (g).

2.13. g: Is the standard acceleration of gravity.

3.0 MATERIALS:

3.1. Centrifuge

- Bench Top – Room Temperature or Refrigerated
- Floor Model – Room Temperature or Refrigerated
- Microfuges
- Superspeed and Ultrafuges
- Cytocentrifuge

3.2. Rotors, buckets/adaptors, cytocentrifuge clips appropriate to centrifuge being utilized.
3.3. Canisters, cytospin funnels and caps appropriate to the buckets being utilized.
3.4. Centrifuge tubes appropriate to the density and chemical nature of specimens being centrifuged and the speed of the centrifuge.
3.5. Vibration mats.
3.6. NIST calibrated /certified Tachometer
3.7. Stopwatch
3.8. Maintenance Supplies:
- Soft nylon brushes
- Disinfectant (as recommended by the Manufacturer)
- Cleaning agent (as recommended by the Manufacturer)
- Silicone Vacuum grease
- Anti-Seize and Spin-Kote Lubricant
- Anti-Corrosive Oil
- O-Rings
- Rubber Cushions

4.0 SAFETY PRECAUTIONS:

4.1. Utilize Routine Practices. This includes but is not limited to wearing gloves and lab coats.
4.2. Use safety goggles when appropriate.
4.3. Departmental requirements may necessitate the opening of canisters in a Biosafety Cabinet.
4.4. Use heavy gloves as appropriate to remove rotors to prevent cuts and scratches from the threads of the rotor.
4.5. If an unusual noise or vibration occurs during operation immediately stop the centrifuge.
4.6. Clean up of Broken tubes and/or spills in centrifuge:
- See Appendix 1 – Clean-up of Broken Tubes and/or Spills in Centrifuge

5.0 QUALITY ASSURANCE:

5.1. Semi-annual RPM check with a NIST calibrated/certified tachometer.
5.2. Semi-annual Timer check with a stopwatch.
5.3. Routine daily, weekly, monthly and semi-annual maintenance must be performed, except where discipline or laboratory specific maintenance schedules are available for infrequently used centrifuges.

6.0 OPERATION:

6.1. Laboratory personnel shall be familiar with the manufacturer supplied equipment operators manual for each model of centrifuge in use.

6.2. Ensure the electrical cord is securely plugged into the electrical outlet.

6.3. Press the power switch to the ON position.

6.4. Open the centrifuge lid as per specific manufacturer instructions.

6.5. Visually inspect the interior of the centrifuge, the rotor, buckets, lids, and adapters for cleanliness and damage. Clean and repair as required.

6.6. All tubes to be centrifuged must be capped to prevent the release of aerosols. Buckets with lids for horizontal centrifuges and rotor with lid for fixed angle centrifuges **must** be used to prevent the release of aerosols.

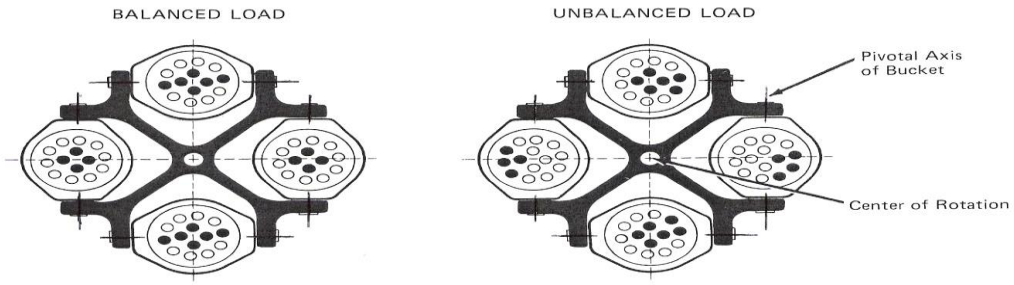
6.7. Balance tubes should contain the same density and volume of material as the specimens being centrifuged.

6.8. Loading Buckets – Horizontal:

6.8.1. Buckets must be loaded symmetrically with respect to their pivotal axis so that tube weight is distributed evenly. The pivotal axis can be imagined as a line extending across the bucket from one pivot pin to the other. See diagram below.

6.8.2. Securely attach the safety lids onto the canister.

6.8.3. Close and lock the centrifuge lid.



↑ ↑

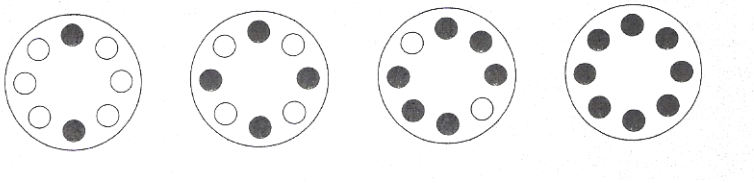
BALANCED **UNBALANCED**

6.9. Loading buckets – Fixed Angle Rotor:

6.9.1. The rotor should be loaded symmetrically with respect to its centre of rotation. See diagram on below.

6.9.2. Securely attach the rotor lid.

6.9.3. Close and lock the centrifuge lid



Typical examples of arranging tubes in the rotor.

6.10. Determine and select speed, time and braking options according to discipline specific SOP according to specimen type.

Note: Various speeds, times and braking options can be programmed for discipline specific SOP's. See manufacturer's instructions for setting the various programs.

6.11. Start centrifuge and allow the cycle to run.

6.12. Unlock the locking mechanism, if required, and open the centrifuge lid.
Note: Departmental requirements may necessitate the opening of canisters in a bio-safety cabinet.

7.0 MAINTENANCE:

Refer to Manufacturer Operation Manual for discrete maintenance procedures.

Document all maintenance procedures on Centrifuge Maintenance Log (F100-10-07A) or As-Needed Maintenance Log (F100-10-07B), as applicable.

7.1. Daily Maintenance:

7.1.1. Visually inspect the rotor, buckets, lids, caps and tube adapters/ inserts.

7.1.2. Perform Hydraulic lid check (if applicable, some models will not have hydraulic lid).

- Ensure that when lifted, lid stays open and does not fall or slam closed.

7.2. Weekly Maintenance (according to Manufacturer's Instructions):

7.2.1. Horizontal Buckets:

a. Wipe inside and outside surfaces of centrifuge including rotor with a manufacturer approved cleaner/disinfectant.
b. Remove buckets, lids and tube adapters/inserts from centrifuge
c. Remove the O-Rings from the buckets.
d. Wearing gloves, wash the buckets, lids, O-rings and tube adapters/inserts with a manufacturer approved cleaner/disinfectant. A soft nylon brush maybe used to clean the tube adapters/inserts.
e. Rinse buckets, lids, O-rings and tube adapters thoroughly with water.
f. Ensure all parts are thoroughly dry before re-assembling.
g. Lubricate O-rings with vacuum grease and place on bucket.
h. Saturate a lint free tissue with manufacturer recommended oil and lubricate the contract areas between the buckets and pins, as well as, lubricating the pins and sockets.
i. Replace buckets.

7.2.2. Fixed Angle Rotor:

a. Remove the rotor, according to manufacturer instructions.
b. Wipe the inside and outside surfaces of centrifuge with an approved cleaner/ disinfectant.
c. Wearing gloves, thoroughly wash the rotor with an approved cleaner/ disinfectant. A soft nylon brush maybe used to clean tube bores in a fixed angle rotor.
d. Rinse thoroughly and dry all parts before re-assembling.
e. Adonized aluminum rotors and parts must be treated with anti-corrosive protective oil. Recommend referring to manufacturer's operation manual.
f. Rotor yoke drive hole should be lubricated according to manufacturer's specification. **Note: Do not use any type of lubricant or grease on the threads of the drive shaft.**
g. Put a drop of manufacturer recommended oil between the pin and the rotor yoke.
h. Replace and secure rotor onto the rotor shaft.

7.3. Monthly Maintenance:

7.3.1. For those centrifuges with washable filters; wash filters.

7.4. Semi-Annual Maintenance:

7.4.1. RPM Check – Check and verify revolutions per minute using a NIST calibrated/certified Tachometer.

- Refer to Appendix 6 – Procedure: Centrifuge Speed Verification.

7.4.2. Timer Check – check and verify timer using a stopwatch.

- Refer to Appendix 2 – Timer Calibration

7.5. As Required:

7.5.1. Change filters of floor model centrifuges as recommended by the manufacturer.

7.6. Sterilization / Decontamination:

7.6.1. Most rotors can be autoclaved at 121ºC for a minimum of 15 minutes at 15 PSI.

7.6.2. Consult the Manufacturer's manual for recommendations regarding autoclaving of specific rotors.

8.0 EQUIPMENT MALFUNCTION:

8.1. If centrifuge malfunctions, service or maintenance personnel must be notified.
8.2. Place a STOP-Service Required placard (Appendix 4) on the unit.
8.3. If centrifuge malfunctions, complete F100-10-07C – Equipment Malfunctions and Corrective Action Record (Appendix 5) and inform supervisor.

9.0 PROCEDURAL NOTES:

9.1. Centrifuge should be placed on a sturdy counter with a hard smooth surface.
9.2. The use of vibration mats is recommended but not required.
9.3. Ensure adequate air circulation around centrifuge.
9.4. Calculating RCF is important for each centrifuge, since different rotor radii will achieve different RCF for the same RPM.
- Refer to Shared Health Policy 110-10-05, Appendix 1 (RCF Formula)

9.5. To convert g to RPM for see centrifuge manual or refer to Shared Health Policy 110-10-05, Table 4 (Centrifuge Radius / Speed (RPM))

10.0 REFERENCES:

10.1. Beckman Spinchron R and Spinchron KR Centrifuges Instruction Manual – CA-0992-.8-GP
10.2. Beckman Coulter Rotors for the GP Series Centrifuges
10.3. University of Nebraska Safe Operating Procedures
10.4. National Microbiology Laboratory-EQ-010 General Operation, Maintenance and Cleaning/Disinfection of a Centrifuge. 2009-08-10
10.5. Shared Health Policy 110-10-05: *Serum / Plasma Separation Procedure and Transport SOP*

11.0 RELATED DOCUMENTS:

11.1. Tachometer Standard Operating Procedure

12.0 APPENDICES:

12.1. Appendix 1 - Clean Up of Broken Tubes and/or Spills in Centrifuge.
12.2. Appendix 2 - Timer Calibration.
12.3. Appendix 3 - Do Not Use Broken Tube/Spill Placard
12.4. Appendix 4 - Stop Service Required Placard
12.5. Appendix 5 - Equipment Malfunction and Corrective Action Record, (F100-10-07C)
12.6. Appendix 6 - Centrifuge Speed Verification
12.7. Appendix 7 - Centrifuge Maintenance Log Sheet (F100-10-07A)
12.8. Appendix 8 - As Required Maintenance Log Sheet (F100-10-07B)

APPENDIX 1 – Clean Up of Broken Tubes and/or Spills in Centrifuge

Breakage or Spill in Sealed Safety Bucket	
Step 1	Stop the centrifuge.
Step 2	Remove sealed bucket to a biological safety cabinet
Step 3	Open the bucket, remove any unbroken tubes.
Step 4	**TEST barcode labels to ensure compatibility with disinfectant. Hydrogen Peroxide based disinfectants will render heat transfer barcode labels unreadable.**
Step 5	Place capped unbroken specimens in disinfectant for time recommended for selected disinfectant, remove, and rinse, dry and process.
Step 6	Leave broken tubes in bucket, replace lid loosely and place in approved disinfectant and let stand for time recommended for selected disinfectant. Refer to manufacturer operator's manual to select disinfectant.
Step 7	After recommended disinfections time, remove O-ring from bucket and rubber cushions from bucket rack.
Step 8	Carefully remove all broken tubes and place into a sharps disposal container.
Step 9	Rinse the canister and tube rack and let dry.

Breakage or Spill in Unsealed Bucket or Fixed Angle Rotor	
Step 1	Stop the centrifuge
Step 2	Place a DO NOT USE/Broken Tube/Spill Sign (Appendix 3) on the centrifuge and **do not** open the centrifuge for 30 minutes to allow aerosols to disperse and settle.
Step 3	Slowly open centrifuge lid, carefully remove all broken tubes and place into a sharps disposal container.
Step 4	**TEST barcode labels to ensure compatibility with disinfectant. Hydrogen Peroxide based disinfectants will render heat transfer barcode labels unreadable.**
Step 5	Place capped unbroken specimens in disinfectant for time recommended for selected disinfectant, remove and rinse, dry and process.
Step 6	Remove adapters and rotor and place in an approved disinfectant and let stand for time recommended for selected disinfectant. Refer to manufacturer operator's manual to select disinfectant.
Step 7	Wipe the bowl of the centrifuge twice with disinfectant, rinse with water and dry. Dispose of washing/wiping cloths into an autoclave bag.
Step 8	Remove adapters and rotor from disinfectant, rinse well, dry and replace in centrifuge. Dispose of washing/wiping cloths into an autoclave bag.

APPENDIX 2 – Timer Calibration

Step1	Obtain a NIST calibrated/certified stopwatch/timer.
Step 2	Turn the timer on the centrifuge to the times being measured.
Step 3	Start the stopwatch/timer.
Step 4	Stop the stopwatch immediately when the centrifuge begins deceleration.
Step 5	Compare the set centrifugation time with the stopwatch time.
Step 6	Stopwatch must be within ±5% of the set time to pass.
Step 7	Repeat steps 1 – 6 for all times routinely used
Step 8	Document the time being measured and the actual time on the stopwatch pass or fail on the Centrifuge Maintenance Log Sheet. (Appendix 6)
Step 9	If centrifuge fails timer check, inform the Charge technologist or designate and document actions taken on Centrifuge Maintenance Log Sheet. (Appendix 6)

APPENDIX 3 – Do Not Use Broken Tube/Spill Placard

DO NOT USE
BROKEN TUBE/SPILL

APPENDIX 4 – Stop Service Required Placard

SERVICE REQUIRED

APPENDIX 5 - Equipment Malfunction and Corrective Action Record, (F100-10-07C)

Equipment: _____	Model: _____
Serial #: _____	Shared Health #: _____
Location: _____	
Date: _____	Time: _____
Reported By: _____	

State Problem (use as much detail as possible):

Was Service Company or Maintenance called? † ☐ Yes †☐ No

Name of Service/Maintenance Personnel contacted. _____

Corrective Action taken:

Supervisory review: Must be reviewed by a Charge or Senior Technologist

Reviewed By: Signature: _____ Date: _____

APPENDIX 6 - Centrifuge Speed Verification

1.0 PURPOSE:

1.1. To verify centrifuge speed accuracy in relation to the display on the unit.

2.0 EQUIPMENT:

2.1. Traceable Tachometer laser complying with ISO 9001 supplied with adhesive reflective tape.

3.0 SUPPLIES:

3.1. Traceable Tachometer Laser
3.2. Reflective tape
3.3. Centrifuge Maintenance Log sheet – Appendix 7

4.0 PROCEDURE:

4.1. Apply a thin strip of reflective tape supplied with laser tachometer to the centre of rotor axle. This thin strip of reflective tape is to remain in place for future speed verifications. See Diagram 1.

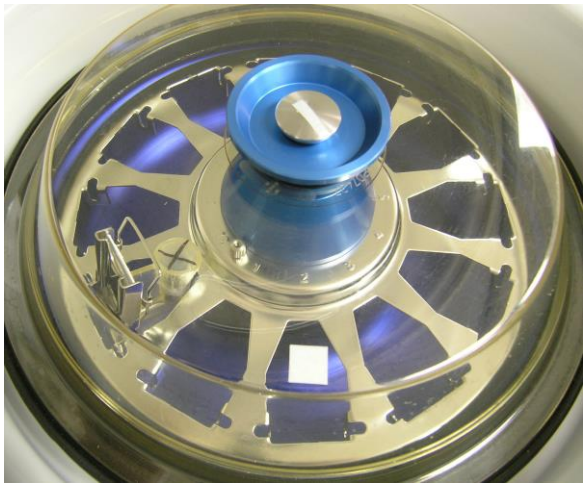
4.2. Start centrifuge at 1500 RPM and hold laser such that the laser pointer is shining on the reflective tape, depress the triangular “Hold/Power” button. If centrifuge has a central opening in the lid the unit may be shone through the clear hole cover to read the rotor speed. After two seconds a reading will be obtained.

4.3. Record the reading when stabilized, on the LCD display (if available) on unit. By depressing the hold button the reading can be locked onto the screen.

4.4. Repeat the above three (3) steps for all speeds used.
Safety Precaution: Caution should be exercised when verifying centrifuge speeds on centrifuges that may require the lid to be open while measuring speeds with the laser tachometer.

4.5. Note: Microfuges without a window in the lid will require the lid lock mechanism to be defeated by using a pen inserted in the opening where the lid pin inserts to engage lock mechanism.
See Diagram 2.

Diagram 1: Application of Reflective Tape



Affix Reflective tape to center of rotor of centrifuge. For Cytospin rotors affix tape to lid of rotor so as to be visible through Cytospin lid window if so equipped. Otherwise attach to center of rotor.

If Cytospin is not equipped with a lid window, remove rotor and apply reflective strip to the cone on the motor axle.

Diagram 2: Obtaining Tachometer reading

Reading Cytospin through window in lid.

Reading Cytospin through window in lid.

Reflective tape on axle.

Defeated lid lock mechanism.

5.0 INTERPREATION/RESULTS:

5.1. The reading on the laser tachometer should be within ±10% of RPM setting displayed on centrifuge unit.

5.2. Record reading on document F100-10-07 Centrifuge Maintenance Log.

5.3. If tachometer reading is >10% of the RPM setting, repeat the reading and if the same reading is obtained, have the unit checked and repaired.

6.0 METHOD LIMITATIONS:

6.1. Take note of the recalibration date on the calibration certificate to ensure the unit is within the limits of the calibration guaranteed time period.

7.0 REFERENCES:

7.1. Control Company Traceable Tachometer Instructions

APPENDIX 7 – Centrifuge Maintenance Log Sheet (F100-10-07A)

Site: _____ Lab/location: _____

Month: _____ Year: _____

Centrifuge Model: _____ Serial #: _____ Asset #: _____

Acceptable Temperature Range (if applicable): _____ °C to _____ °C

Daily	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Visual Inspection of rotors, canisters, adapters and caps																															
Record temperature if applicable																															
Lid Hydraulics operation check																															
Performed By (initial):																															
Weekly																															
Clean inside Centrifuge																															
Clean outside Centrifuge																															
Clean Rotor, canisters, adapters, caps, O-rings																															
Coat O-rings with vacuum grease																															
Grease bucket pivots/pins/sockets																															
Performed By (initial):																															
Monthly																															
Wash filters																															
Change balance tubes																															
Performed By (initial)																															

Semi-Annual – Rpm & Timer Checks (Date next due: _____)

RPM Setting	_____ rpm ± 10%	Pass/Fail	_____ rpm ± 10%	Pass/Fail	Performed By (Initial):	Date
Tachometer Reading						
Tachometer Reading						
Timer Check Setting	_____Minutes±5%	Pass/Fail	_____Minutes±5%	Pass/Fail	Performed by (initial):	Date
Stopwatch reading						
Stopwatch reading						

Reviewed by: _____ **Date:** _____

APPENDIX 8 – As Required Maintenance Log Sheet (F100-10-07B)

Site: _____ Lab/location: _____

Month: _____ Year: _____

Centrifuge Model: _____ Serial #: _____ Asset #: _____

Month/Year_____	**DD/MM**	**DD/MM**	**DD/MM**	**DD/MM**	**DD/MM**	**DD/MM**	**DD/MM**
As Required							
Visual Inspection of rotors, canisters, adapters and caps							
Inspected By : Initial							
As Required							
Clean inside Centrifuge							
Clean outside Centrifuge							
Clean Rotor, canisters, adapters, caps, O-rings							
Coat O-rings with vacuum grease							
Grease bucket pivots/pins/ /sockets							
Performed By: Initial							
As Required							
Wash filters							
Change balance tubes							
Performed By: Initial							
As Required							
Replace Filters							
Sterilization/Decontamination							
Seal Replacement							
Other							
Other							
Performed By: Initial							

Reviewed by: _____ **Date:** _____