



Certificate of Calibration

Cattle and deer: <i>Leishmania infantum</i> infection		
Cat. Centre	University of Bristol	Yes
Original paper	Yes (Table)	Yes (Table)
2. <i>Leishmania infantum</i> in cattle	Yes (Table)	Yes (Table)

Run	Wavelength (nm)	Exposure Time (min)	Exposure Area (cm ²)	Exposure Dose (mJ/cm ²)	Exposure Rate (mW/cm ²)	Exposure Time (min)	Exposure Area (cm ²)	Exposure Dose (mJ/cm ²)	Exposure Rate (mW/cm ²)
1	365	10	1.0	10.0	1.0	10	1.0	10.0	1.0
2	365	20	1.0	20.0	2.0	20	1.0	20.0	2.0
3	365	30	1.0	30.0	3.0	30	1.0	30.0	3.0
4	365	40	1.0	40.0	4.0	40	1.0	40.0	4.0
5	365	50	1.0	50.0	5.0	50	1.0	50.0	5.0
6	365	60	1.0	60.0	6.0	60	1.0	60.0	6.0
7	365	70	1.0	70.0	7.0	70	1.0	70.0	7.0
8	365	80	1.0	80.0	8.0	80	1.0	80.0	8.0
9	365	90	1.0	90.0	9.0	90	1.0	90.0	9.0
10	365	100	1.0	100.0	10.0	100	1.0	100.0	10.0

NAME	DATE	TIME	LOCATION	REMARKS
1. 1000	10/10/10	10:00	1000	1000
2. 1000	10/10/10	10:00	1000	1000
3. 1000	10/10/10	10:00	1000	1000
4. 1000	10/10/10	10:00	1000	1000
5. 1000	10/10/10	10:00	1000	1000
6. 1000	10/10/10	10:00	1000	1000
7. 1000	10/10/10	10:00	1000	1000
8. 1000	10/10/10	10:00	1000	1000
9. 1000	10/10/10	10:00	1000	1000
10. 1000	10/10/10	10:00	1000	1000

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Journal of Internal Medicine 255: 103–110



Certificate of Calibration

Equipment:	Balance	Certificate No.	C01193060
Model:	AB204-S	Issued Date:	28 August 2019
Serial No. (or ID.)	1123163290 (MEC-LAB602)	Job No.:	KCAL1911191
Manufacturer:	Mettler Toledo	Page:	1 of 3
Condition:	In condition		

Customer: MINE ENGINEERING CONSULTANT CO.,LTD.
2/115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd.
Soi. Rangsit-Nakhon Nayok 34/1, Prachathipat,
Thanyaburi, Pathum Thani 12130 Thailand.

Environment Condition	Temperature	± 0.7 °C
Humidity	57 %RH	± 4.7 %RH

Calibration Place
MINE ENGINEERING CONSULTANT CO.,LTD. (☎u 4)
2/115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
Sri. Rangsit-Nakhon Nayok 34/1, Prachathipat,
Thanyaburi, Pathum Thani 12130 Thailand.

Calibration By: Mr. Piyapong So
Calibration Date: 22 August 2019

The Method used
In house method, SPCC-WI-47, base on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC Calibration Center Co., Ltd. Certificate No. C02182473, C02182572

(Mr. Piyapong Sornkaew)
Person in charge



(Mr. Rungrod Jenkittrakulchai)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standards or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC Calibration Center Co., Ltd.

Certificate No.: C01193060 Page: 2 of 3

Calibration Results:

Before Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		Reference Points (g)				
		A	B	C	D	E
20		-0.0001	0.0001	0.0001	0.0000	0.0000
200						

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00004

Departure of Indication from nominal value., Readability 0.0001 (g)						k
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Correction of Balance (g)	Uncertainty (g)		
0.001	0.00100	0.0010	0.0000	0.00010		2.02
0.01	0.01000	0.0100	0.0000	0.00010		2.02
0.1	0.10000	0.1000	0.0000	0.00010		2.02
1	1.00000	1.0000	0.0000	0.00010		2.02
5	5.00000	5.0000	0.0000	0.00010		2.02
10	9.99998	10.0000	0.0000	0.00010		2.02
50	49.99997	49.9992	0.0008	0.00012		2.01
100	99.99999	99.9990	0.0010	0.00017		2.00
150	149.99996	149.9985	0.0015	0.00023		2.00
200	199.99987	199.9980	0.0019	0.00029		2.00

Certificate No.: C01193060 Page: 3 of 3

After Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		Reference Points (g)				
		A	B	C	D	E
20						
200		0.0000	0.0000	0.0000	0.0000	0.0000

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00005

Departure of Indication from nominal value., Readability 0.0001 (g)						k
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Correction of Balance (g)	Uncertainty (g)		
0.001	0.00100	0.0010	0.0000	0.00010		2.03
0.01	0.01000	0.0100	0.0000	0.00010		2.03
0.1	0.10000	0.1000	0.0000	0.00010		2.03
1	1.00000	1.0000	0.0000	0.00010		2.03
5	5.00000	5.0000	0.0000	0.00010		2.02
10	9.99998	10.0000	0.0000	0.00010		2.02
50	49.99997	50.0000	0.0000	0.00012		2.01
100	99.99999	100.0000	0.0000	0.00017		2.00
150	149.99996	150.0000	0.0000	0.00023		2.00
200	199.99987	200.0000	-0.0001	0.00029		2.00

The End of Certificate

Erkrankung Nierenstein

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By a majority
 of the
 Board of Directors
 of the
 City of New York
 in the
 year 1900

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HOMES + 1

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1. *Public Health* (1998) 101, 1031-1032.
 2. *Journal of the American Medical Association* (1998) 279, 1031-1032.

Calibration Certificate

Part Number: 721A2601
 Description: Micromate DIN Base Unit
 Serial Number: UM14539
 Calibration Date: DEC 13 2019
 Calibration Equipment: 714J7402

Instantel certifies that the above product was calibrated in accordance with the applicable International Protocols. These procedures are part of a quality system that is designed to ensure that the product tested adheres to the applicable International specifications.

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology, or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

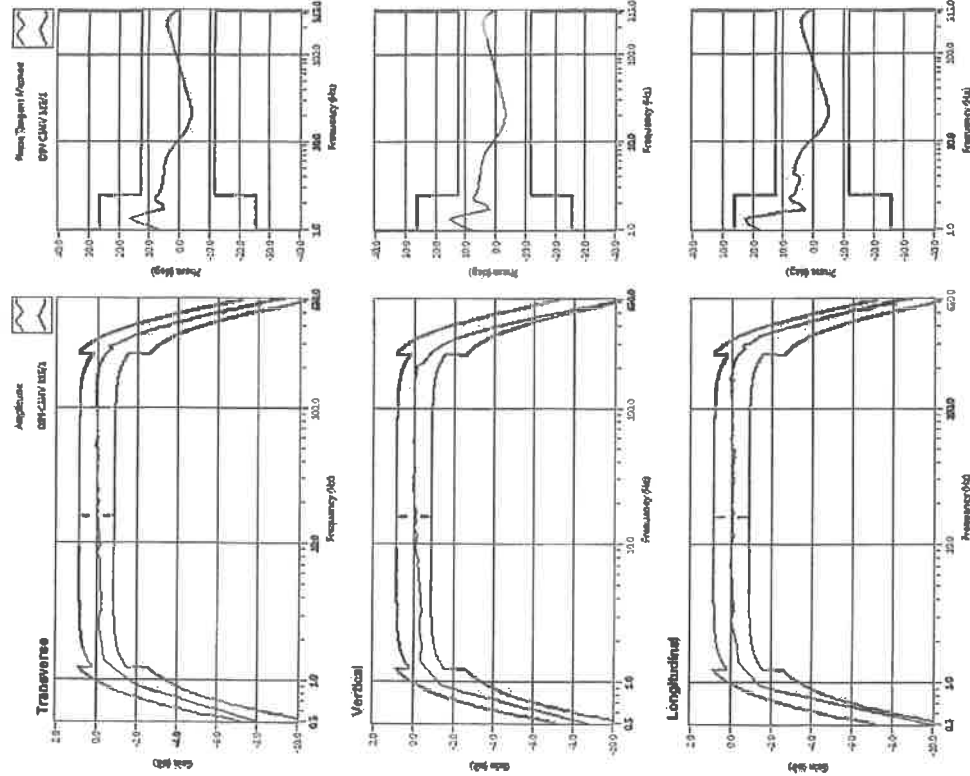
Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which is a process that involves the use of known inputs and outputs to determine the accuracy of the instrument. Calibration is performed by a known standard and is not a function of the instrument's internal calibration.

Calibrated By:

Xiaoming Yang



Frequency Response of UM14539



Calibration Certificate

Part Number: 721A0201
Description: MicroMate Linear Mic (2-250Hz)

Serial Number: UL3696
Calibration Date: DEC 13 2019
Calibration Equipment: 714J7402

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology, or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

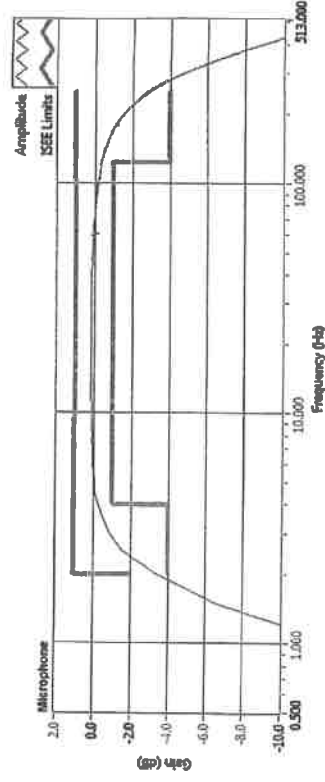
Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By:


Thanh Nguyen



Amplitude Frequency Response of UL3696



Microphone Stand Assembly (Part No. 720A6001)

Explanation

The Microphone Stand Assembly provides increased flexibility for various heights dependent on assembly, as follows:

Number of Sections	Assembled Height
• 3 Sections	33.25" (84.46 cm)
• 2 Sections	22.25" (56.52 cm)
• 1 Section	13.25" (22.02 cm) (Requires optional Ground Spike, Part No. 1100241)

If height is required beyond the three combined sections, additional sections may be ordered or used from another existing microphone stand assembly.

Package Contents

Microphone Stand Assembly Part No. 720A6001

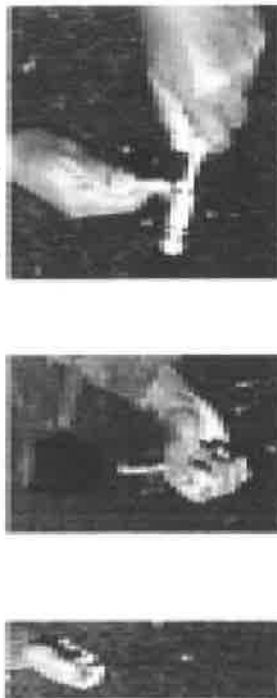
Tools and Materials Required

- Microphone Stand Assembly, Part No. 720A6001.
- Optional Microphone Stand Assembly Extension Section, Part No. 400-720020-000, for extended length installations.
- Optional Goophone Spike, 3" (75 mm), Part No. 1100241, for short length installations.
- Rubber mallet, as required.

Installation

1. Determine the required height and assemble the Microphone Stand by firmly hand-tightening the sections together. Do not use tools, such as a pliers or vice grips, to tighten the sections as this may damage the threads.
2. Locate the Microphone Stand Assembly and ensure that the clip will allow you to insert the microphone oriented towards the event to be recorded.
3. Firmly push the Microphone Stand Assembly into the ground using your hand, or if the ground is too solid, use a rubber mallet and strike the top of the stand, being careful not to damage the microphone clip. DO NOT use a metal hammer as it will damage the stand.
4. Insert the microphone into the clip.

Use your hand or a rubber mallet to install the Microphone Stand; clip on the microphone.
NOTE: DO NOT use a metal hammer as it will damage the microphone stand.



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www.instantel.com

Warranty

Instantel's products are warranted against defects in materials and workmanship and shall perform in accordance with published specifications for a period of ninety days. This warranty is void if the protective heat-shrink is removed from the cables. The company makes no warranty, expressed or implied of fitness for purpose, merchantability or function of the products. Instantel does not represent that any product will prevent bodily injury or damage to property.

Should a product fail to operate to these specifications within the warranty period it shall be repaired or replaced free of charge. This warranty is void if the equipment has been dismantled, altered or abused in any way. Authority to return the product must be obtained from Instantel prior to shipment. Shipping charges to Instantel's factory will be paid by the customer and Instantel shall pay for the return freight.

Instantel assumes no responsibility for damages of any description resulting from the operation or use of its products. Since it is impossible to anticipate all of the conditions under which its products will be used, either by themselves or in conjunction with other products, Instantel cannot accept responsibility for the results unless it has entered into a contract for services which clearly define such an extension of responsibility and liability. Instantel retains the right to change specifications without notice.



The World's Most Trusted Vibration Monitors



950-72000-000 Rev 01 - Product Specifications are Subject to Change



Merci d'avoir choisi Instantel!

Votre engagement avec
« *le leader mondial en matière de moniteurs* »
vous servira pour les années à venir.

Grâce à votre achat, vous êtes à la pointe de la technologie en matière de moniteurs. Au nom de tous les collaborateurs d'Instantel, nous vous remercions d'avoir fait choix nos produits pour la réalisation de vos projets. Les produits Instantel incluent les éléments les plus aboutis du domaine tels que :

- 1) plus de 30 années au service des secteurs du bâtiment, d'activités minières et de géotechnologie
- 2) des conceptions durables et résistantes
- 3) des produits faciles à utiliser grâce à une interface intuitive
- 4) des options étendues de conformité réglementaire
- 5) un programme d'assistance, un service technique et une aide en ligne complets
- 6) Le logiciel Blastware® est fourni avec une garantie d'un an et des mises à jour gratuites pour la première année
- 7) Si un moniteur ou un capteur est ramené à l'usine pour étalonnage jusqu'à un an après la date d'achat, la garantie sera automatiquement prolongée d'un an supplémentaire.

Instantel est **RESPECTUEUX DE L'ENVIRONNEMENT** ! Instantel n'envoie plus de manuels en version papier. Les manuels du logiciel Blastware® et tous les manuels d'utilisation seront disponibles sur le CD fourni, au format PDF Adobe Acrobat® ou vous pourrez vous les procurer en version papier auprès de votre distributeur Instantel.

Nous nous engageons pour que votre satisfaction en tant que client soit la meilleure possible. En cas de questions ou de commentaires, n'hésitez pas à nous contacter. Veuillez appeler notre numéro gratuit +1 800 267 9111 ou nous envoyer un e-mail à service@instantel.com ou sales@instantel.com.

Nous vous remercions de nouveau et avons hâte de collaborer avec vous !

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Stanley Black & Decker



Thank you for selecting Instantel as part of your team!

Your Investment In
"The World's Most Trusted Monitors"
will serve you for years to come.

Your purchase places you on the leading edge of monitoring technology. On behalf of everyone at Instantel, thank you for choosing our monitoring products for your projects. Instantel's products include the following industry leading features and benefits:

- 1) Over 30 years serving the Construction, Mining and Geotechnical Industries
- 2) Rugged, long lasting designs
- 3) Easy to use with an intuitive interface
- 4) Expansive regulatory compliance options
- 5) Comprehensive support program, technical service and online help
- 6) Blastware® Software comes with a 1 Year Warranty and free upgrades for the first year
- 7) If a monitor or sensor is returned to the factory for calibration one year from its purchase date, the warranty will automatically be extended for a second year.

Instantel is **GREEN!** Instantel no longer ships manuals. The manuals for Blastware® and each product Operator Manual will be available on the included CD, as an Adobe Acrobat® PDF format, or requested from your Instantel Dealer Representative in hardcopy.

We are committed to providing you with the highest level of customer satisfaction possible. If for any reason you have questions or comments, we would be interested to hear from you. Call our toll-free number, 1.800.267.9111, or send us email at service@instantel.com or sales@instantel.com.

Again, thank you, and we look forward to working with you!

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Stanley Black & Decker

Component List

Component / Specific Model	Serial #	Configuration Notes
-	-	-

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
0995098	Air Filter-Spectrometer	Clean
N077520	Air Filter-RF Generator	Clean
09992731	Axial Window	Clean
B0810377	Radial Window	Clean
N0770438	O-ring kit, injector support adapter	Check
N0780437	O-ring kit, torch	Check

Additional Reagents and Standards Required for PM			
Part Number (if applicable)	Description	Quantity	Batch/Lot # Expiration Date: (MM/YY)
N0691579	Multi-Element Standard (N069-1579 diluted 10X)	1	2-30WGX1 Apr-2020
N9300221	Instrument Calibration-4 (N9300221 diluted 100X)	1	5-97MKY1 Dec-2019

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ☒ Ask customer about unit's performance since last visit.
- ☒ Check incoming AC line voltage under load for proper levels and grounding.
- ☒ Is the instrument operational?

2. Mechanical:

- ☒ Inspect and clean all fans and filters.
- ☒ Inspect and replace torch components and necessary.

Torch Components Replaced: ☐ Yes ☒ No
If yes, list components replaced:

- ☒ Inspect all tubing for signs of cracking or leaking and replace as necessary.

Tubing Replaced: ☐ Yes ☒ No
If yes, list tubing replaced:

- ☒ Inspect the peristaltic pump for proper operation.

- ☒ Check and adjust if necessary, the external nitrogen, argon shear gas and water supply pressures.
- ☒ Check and adjust if necessary, the internal nitrogen, main argon, torch argon and shear gas pressures

Regulator	Measured Pressure	Set Pressure
Nitrogen	N/A	NA (calibrated in Factory)
Main Argon	76	75psig
Torch Argon	67	67psig
Shear Gas	65	65psig
Water	35	35psi

- ☒ Check the shear gas nozzle for blockages and proper, uniform flow.
- ☒ Inspect nitrogen Hi/Low purge and shear gas solenoids for proper function.
- ☒ Inspect the function of all spectrometer motors. Drive the motors from the Spectrometer DCM. Check all motors, couplings, set screws, gears or drive assembly located on the spectrometer (prism/grating wavelength drives, slits, shutter, DV mirror, X/Y mirror) if problems are found.
- ☒ Perform preventative maintenance on the chiller as required. Make the customer aware of the importance of maintaining the chiller fluid level and filter replacement.
- ☒ Drain air compressor surge tank.
- ☒ Clean exterior of instrument.

3. Electrical:

- ☒ Visually inspect all PC boards for cleanliness and signs of corrosion.
- ☒ Check all RF generator and spectrometer power supply voltages.
- ☒ Run instrument diagnostic checks from the appropriate Device Control Module.

RF Generator:

- ☒ Check the RF generator status screens.
- ☒ Check the function of all interlocks.

Spectrometer:

- ☒ Check the spectrometer status screens.
- ☒ Check for proper function of all motors from the Motor Control window.

4. Optical:

- ☒ Check the neon lamp for proper operation.
- ☒ Ensure that neon initialization passes at power up.
- ☒ Ensure that there is a single, well defined peak of sufficient intensity (approximately 15,000 to 60,000 cts.) for the 703.241nm neon line viewed in the DCM Collect Spectra window. Re-generate the neon correction table if problems are encountered. If problems are still exhibited after the table is re-generated, replace the neon lamp assembly.

Neon Lamp Replaced: ☐Yes ☒No

- ☒ Perform the Initialize Optics routine from the Spectrometer Control window.
- ☒ Insure that the routine passes with no error codes. If it fails, run a manual prism scan from the spectrometer DCM.
- ☒ Insure the Dark Current measurement (Detector Calibration) passes at initialization.
- ☒ Check the shutter home sensor position.
- ☒ Check prism/electronics temperature sensor readback values from the DCM. It is normal for these readings to be shown in red. A typical prism temperature is approximately 29.5 degree C. A typical electronics temperature is approximately 35 degree C.
- ☒ Check the detector temperature from the DCM for -7.0 to -8.5 degree C. If outside of this range the detector cooling fan may not be operational. Further inspection may be necessary.
- ☒ Inspect for proper function of the transfer optics. 1) shutter 2) DV mirror 3) X/Y mirror.
- ☒ Clean or replace the axial and radial view windows as necessary.

Axial Window Replaced: ☐Yes ☒No
Radial Window Replaced: ☐Yes ☒No

5. Post PM Performance Tests:

- ☒ Perform View Align.

5.1 Spectral Resolution:

- ☒ Measure the spectrometers ability to separate two adjacent wavelengths.

Parameter	Specification	Test Result	Pass/Fail
As 193.696 - Resolution	≤0.009	0.007	Passed
Ni 231.604 - Resolution	≤0.011	0.008	Passed
Ni 341.476 - Resolution	≤0.015	0.012	Passed
Ba 455.403 - Resolution	≤0.020	0.017	Passed

5.2 Precision:

- ☒ Test for reproducibility of a set of measurement.

Parameter	Specification	Test Result	Pass/Fail
Zn 213.856	%RSD ≤ 1 %	0.42	Passed
Mg 280.856	%RSD ≤ 1 %	0.38	Passed
Mg 285.207	%RSD ≤ 1 %	0.31	Passed
Ba 455.403	%RSD ≤ 1 %	0.57	Passed

5.4 Mn BEC:

- ☒ Run Axial and Radial BEC according to the A&T spec, or the commissioning test procedure.

Mn Background Equivalent Concentration:

Method "MnBEC" For Samples "IB (2% HNO_3)" and "IS (N069-1579/10)", record intensities.

Calculated BEC: BEC = (IB * Conc of Std) / (IS - IB). Where Conc of Std = 1,000 PPB

Element	Mode	Conc.	IB	IS
Mn 257.610	Radial	1,000 ppb	5224.2	443356.8
	Axial	1,000 ppb	14670.5	1167676.0
Mn 257.610	IB*Conc.	IS - IB	BEC	Spec
	Radial	5224200	440132.6	11.86
	Axial	14670500	1153005.5	12.72
				Pass/Fail
				Passed
				Passed

6. Review:

- ☒ Review with the customer PM work performed.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

Additional Comments



Additional Comments Regarding the PM

Review

The preventive maintenance checks and if applicable performance tests for ICP-OES/Avio200 have been completed.

This ICP-OES/Avio200 Passes ☒ Fails ☐ the preventive maintenance.

Review of Preventive Maintenance:

Authorized PerkinElmer Representative:		Date: 30-May-2019 (DD-MMM-YYYY)
Authorized Customer Representative:		Date: 30-May-2019 (DD-MMM-YYYY)

ICP-OES/Avio200 Preventive Maintenance (PM)

Page 6 of 6



Certificate of Calibration

Equipment: pH METER
Model: pH700
Serial No. (or ID.): 983068
Manufacturer: EUTECH
Electrode Serial No. 029
Condition: In Condition

Certificate No. C07190490
Issued Date: 26 August 2019
Job No.: KCAL1911196
Page: 1 of 4
Model: 93X218814 Brand EUTECH

Customer: MINE ENGINEERING CONSULTANT CO., LTD.
2/115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
Soi. Rangsit-Nakhon Nayok 34/1, Prachathipat,
Thanyaburi, Pathum Thani 12130 Thailand.

Environment Condition
Temperature 23 °C ± 2 °C
Humidity 50 %RH ± 15 %RH

Calibration Place
Environment Laboratory, SPC Calibration Center Co., Ltd
1194 Soi Wachirathamsatit 57, Sukhumvit 101/1 Rd.,
Bangchak, Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Piypat Saidoung
Calibration Date: 26 August 2019

The Method used: In house method, SPC-WI-58, base on ASTM E 70-07

Traceability:
This certificate is traceable to the CRM maintained by DAkkS/DKD calibration laboratory through Radiometer Analytical Co., Ltd. Certificate No. 1289, 1285, 1288 and traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No 0530EL18



(Mr. Piypat Saidoung)
Person in charge



(Mr. Dumrong Boonsopon)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC Calibration Center Co., Ltd.



Calibration Results:

pH Scale

Input (mV)	pH Meter Reading		Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	(pH)		
414.12	-0.12	0.02	0.58	2.00
354.96	0.04	1.02	0.58	2.00
295.80	0.20	2.02	0.58	2.00
236.64	0.36	3.01	0.58	2.00
177.48	0.02	4.01	0.065	2.00
118.32	-0.02	5.01	0.065	2.00
59.16	0.04	6.00	0.065	2.00
0.00	0.00	7.00	0.065	2.00
-59.16	-0.04	8.00	0.065	2.00
-118.32	-0.08	8.99	0.065	2.00
-177.48	-0.12	9.99	0.065	2.00
-236.64	-0.36	10.99	0.58	2.00
-295.80	-0.20	11.98	0.58	2.00
-354.96	-0.04	12.98	0.58	2.00
-414.12	0.12	13.97	0.58	2.00



Electrode Test Results*

The two-point calibration using two standard buffer solutions; pH 4.004 and pH 7.001

The practical slope of the pH electrode; 58.93 (mV/pH), 99.62%

The zero point of the pH electrode; 6.83 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.004	4.01	0.006	0.0076	2.00
7.001	7.00	-0.001	0.0077	2.00
10.011	9.95	-0.061	0.0080	2.00

* Calibration Marked "Not TIS Accredited" in this Certificate have been included for completeness.

Electrode Test Results*

The two-point calibration using two standard buffer solutions; pH 7.001 and pH 10.011
 The practical slope of the pH electrode; 57.51 (mV/pH), 97.22%
 The zero point of the pH electrode; 6.82 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.004	3.95	-0.054	0.0076	2.00
7.001	7.00	-0.001	0.0077	2.00
10.011	10.01	-0.001	0.0080	2.00

* Calibration Marked * Not TISI Accredited " in this Certificate have been included for completeness.

The End of Certificate

Certificate of Calibration

Equipment: Digital Thermometer
 Model: pH 700
 Serial No.(or ID) 983068
 Manufacturer: EUTECH
 Condition: In Condition

Certificate No.: C15190293
 Issued Date: 23 August 2019
 Job No.: KCAL1911195
 Page: 1 of 2

Customer: MINE ENGINEERING CONSULTANT CO.,LTD.
 2/115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
 Soi. Rangsit-Nakhon Nayok 34/1, Prachathipat,
 Thanyaburi, Pathum Thani 12130 Thailand.

Environment Condition: Temperature: 22 °C ± 3.0 °C
 Humidity: 50 %RH ± 15.0 %RH
 Voltage: 230 VAC ± 11.0 VAC

Calibration Place: Sensor Laboratory, SPC Calibration Center Co., Ltd.
 1194 Soi Wachirathamsathit 57, Sukhumvit 101/1 Rd.,
 Bangchak, Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Twewong Thailiang
 Calibration Date: 23 August 2019
 The Method used: In house method, SPCC-WI-19, by comparison with standard thermometer
 Traceability: This certificate is traceable to the SI Units maintained by Quality Reborn Co.,Ltd
 (QR) Certificate No. QR19-1015



(Mr. Twewong Thailiang)

Person in charge



(Mr. Udon Srichana)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC Calibration Center Co., Ltd.

Certificate No.: C15190293

Page: 2 of 2

Calibration Results: Without Adjustment

Sensor Type: Thermistor

Diameter (mm): 3	Le	112	Immersion mm	110	Channel: -
Desired Temp. (°C)	25.0	STD. Reading (°C)	25.1	Correction of UUC (°C)	Uncertainty (± °C)
				-0.094	0.080

The End of Certificate

Certificate of Calibration

Equipment: Balance Certificate No. C01193059
Model: AZ214 Issued Date: 28 August 2019
Serial No. (or ID.): 28092281 (MEC-LAB01) Job No.: KCAL1911190
Manufacturer: Sartorius Page: 1 of 3
Condition: In condition

Customer: MINE ENGINEERING CONSULTANT CO., LTD.
2/115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
Sri Rangsit-Nakhon Nayok 34/1, Prachathipat,
Thanyaburi, Pathum Thani 12130 Thailand.

Environment Condition Temperature 25 °C ± 0.7 °C
Humidity 57 %RH ± 4.7 %RH

Calibration Place: MINE ENGINEERING CONSULTANT CO., LTD. (ชั้น 4)
2/115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
Sri Rangsit-Nakhon Nayok 34/1, Prachathipat,
Thanyaburi, Pathum Thani 12130 Thailand.

Calibration By: Mr. Piyaopong Somkaew

Calibration Date: 22 August 2019

The Method used: In house method, SPCC-WI-47, base on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC Calibration Center Co., Ltd. Certificate No. C02182473, C02182572

(Mr. Piyaopong Somkaew)
Person in charge

(Mr. Rungrod Jenkitrakulchai)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC Calibration Center Co., Ltd.

Certificate No.: C01193059 Page: 2 of 3

Calibration Results:

Before Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		Reference Points (g)				
		A	B	C	D	E
		-0.0001	-0.0001	-0.0001	0.0000	0.0000

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00005

Departure of Indication from nominal value., Readability 0.0001 (g)					k
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Correction of Balance (g)	Uncertainty (g)	
0.001	0.00100	0.0010	0.0000	0.00010	2.03
0.01	0.01000	0.0100	0.0000	0.00010	2.03
0.1	0.10000	0.1000	0.0000	0.00010	2.03
1	1.00000	1.0000	0.0000	0.00010	2.03
5	5.00000	5.0000	0.0000	0.00010	2.03
10	9.99998	10.0000	0.0000	0.00011	2.02
50	49.99997	50.0004	-0.0004	0.00012	2.01
100	99.99999	100.0022	-0.0022	0.00017	2.00
150	149.99996	150.0030	-0.0030	0.00023	2.00
200	199.99987	200.0040	-0.0041	0.00029	2.00

Certificate No.: C01193059 Page: 3 of 3

After Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		Reference Points (g)				
		A	B	C	D	E
		0.0001	0.0000	0.0000	-0.0001	0.0000

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00005
200	0.00005

Departure of Indication from nominal value., Readability 0.0001 (g)					k
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Correction of Balance (g)	Uncertainty (g)	
0.001	0.00100	0.0010	0.0000	0.00010	2.03
0.01	0.01000	0.0100	0.0000	0.00010	2.03
0.1	0.10000	0.1000	0.0000	0.00010	2.03
1	1.00000	1.0000	0.0000	0.00010	2.03
5	5.00000	5.0000	0.0000	0.00010	2.03
10	9.99998	10.0000	0.0000	0.00011	2.02
50	49.99997	50.0000	0.0000	0.00012	2.01
100	99.99999	100.0000	0.0000	0.00017	2.00
150	149.99996	149.9999	0.0001	0.00023	2.00
200	199.99987	199.9999	0.0000	0.00029	2.00

The End of Certificate

Certificate of Calibration

Equipment: SPECTROPHOTOMETER Certificate No. C06190376
Model: 732C Issued Date: 27 August 2019
Serial No. (or ID.): 2C41301043 (MEC-LAB11) Job No.: KCAL1911198
Manufacturer: KWF Page: 1 of 3
Condition: In Condition

Customer: MINE ENGINEERING CONSULTANT CO., LTD.
 2/1115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
 Soi. Rangsit-Nakhon Nayok 34/1, Prachathipat,
 Thanyaburi, Pathum Thani 12130 Thailand.

Environment Condition: Temperature 24.5 °C ± 0.0 °C
 Humidity 50.2 %RH ± 0.4 %RH

Calibration Place MINE ENGINEERING CONSULTANT CO., LTD. (Laboratory)
 2/1115 JSP City Rangsitklong 1, Rangsit-Nakhon Nayok Rd,
 Soi. Rangsit-Nakhon Nayok 34/1, Prachathipat,
 Thanyaburi, Pathum Thani 12130 Thailand.

Calibration By: Mr. Nattapat Rungrueang

Calibration Date: 22 August 2019

The Method used: In house method, SPCC-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and

Technology (NIST) through Stama Scientific Limited.

The standard for Wavelength Certificate No. 72569 and 72568

The standard for Photometric Certificate No. 72571



(Mr. Nattapat Rungrueang)

Person in charge

(Mr. Dumrong Boonsopon)

Authorized signatory

This certificate is issued in the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

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Certificate No. : C06190376 Page 2 of 3

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 4 nm and UUC at 4 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
361.26	359.7	1.56	0.13
418.48	417.2	1.28	0.13
536.90	535.6	1.30	0.13
513.70	512.2	1.50	0.13
528.72	527.3	1.42	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5903	0.586	0.0043	0.0045
	0.7630	0.759	0.0040	0.0045
	1.0280	1.023	0.0050	0.0052
440 nm	0.0000	0.000	0.0000	0.0045
	0.5799	0.578	0.0019	0.0045
	0.7454	0.743	0.0024	0.0045
	1.0056	1.003	0.0026	0.0052
465 nm	0.0000	0.000	0.0000	0.0045
	0.5302	0.531	-0.0008	0.0045
	0.6878	0.687	0.0008	0.0045
	0.9549	0.956	-0.0011	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5479	0.547	0.0009	0.0045
	0.6970	0.695	0.0020	0.0045
	0.9998	0.998	0.0018	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5863	0.585	0.0013	0.0045
	0.7249	0.722	0.0029	0.0045
	1.0961	1.095	0.0011	0.0052



Calibration Results:

Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
635 nm	0.0000	0.000	0.0000	0.0045
	0.5702	0.569	0.0012	0.0045
	0.6921	0.689	0.0031	0.0045
	1.0885	1.089	-0.0005	0.0052

The End of Certificate



Avio200 Preventive Maintenance Report

Company Name: บจก. เสิร์นไฮเนจเนียร์จิคอนซัลแตนท์
Instrument Location: ต. ประชาราษฎร์ ต. ชลบุรี จ. ชลบุรี

Instrument Serial No.: 079S18071903

Date: 12-Nov-2019

ICP-OES/Avio200 Preventive Maintenance (PM)

Company Name: ບ.ບ. ບາດເພີດອາວະກາດສະຫວັນນະ	
Address (Instrument Location): ໜ. ບ້ານນາວິນ ດ. ສີບຸນຊຳ ບ. ຫົວພາດ	
Serial Number:	PM Number:
079518071903	
Customer Name (if applicable):	Telephone Number:
079518071903	
Service Engineer Name:	Service Order Number:
Thanawat Tirakotai	WO-00437496
Date PM Performed: (DD-MMM-YYY)	Next PM Due Date: (DD-MMM-YYY)
12-Nov-2019	11-May-2020
Standard Labor Hours to Complete PM : 4 hours	

Part Number	Release	Publication Date
09370140 Rev.4	B	January 2018

Scope

The purpose of this PM is to ensure the continued functionality of the PerkinElmer/Avio200 by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes
-	-	-

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
0995098	Air Filter-Spectrometer	Clean
N077520	Air Filter-RF Generator	Clean
09992731	Axial Window	Clean
80810377	Radial Window	Clean
N0770438	O-ring kit, injector support adapter	Clean
N0780437	O-ring kit, torch	Clean

Additional Reagents and Standards Required for PM

Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date: (MM/YY)
N0691579	Multi-Element Standard (N069-1579 diluted 10X)	1	2-30WGX1	30-Apr-2020
N9300221	Instrument Calibration-4 (N9300221 diluted 100X)	1	5-97MKY1	30-Dec-2019

Procedure Checklist

- Use (✓) to check off those steps in the checklist that have been completed.
1. General:
- ✓ Ask customer about unit's performance since last visit.
 - ✓ Check incoming AC line voltage under load for proper levels and grounding.
 - ✓ Is the instrument operational?

2. Mechanical:

- ✓ Inspect and clean all fans and filters.
 - ✓ Inspect and replace torch components and necessary.
- Torch Components Replaced: ☐Yes ☒No
If yes, list components replaced:
- ✓ Inspect all tubing for signs of cracking or leaking and replace as necessary.
- Tubing Replaced: ☐Yes ☒No
If yes, list tubing replaced:

- ✓ Inspect the peristaltic pump for proper operation.
- ✓ Check and adjust if necessary, the external nitrogen, argon shear gas and water supply pressures.
- ✓ Check and adjust if necessary, the internal nitrogen, main argon, torch argon and shear gas pressures

Regulator	Measured Pressure	Set Pressure
Nitrogen	N/A	NA (calibrated in Factory)
Main Argon	76	76psig
Torch Argon	67	67psig
Shear Gas	65	65psig
Water	35	35psi

- ✓ Check the shear gas nozzle for blockages and proper, uniform flow.
- ✓ Inspect nitrogen H/Low purge and shear gas solenoids for proper function.
- ✓ Inspect the function of all spectrometer motors. Drive the motors from the Spectrometer DCM. Check all motors, couplings, set screws, gears or drive assembly located on the spectrometer (prism/grating wavelength drives, slits, shutter, DV mirror, X/Y mirror) If problems are found.
- ✓ Perform preventative maintenance on the chiller as required. Make the customer aware of the importance of maintaining the chiller fluid level and filter replacement.
- ✓ Drain air compressor surge tank.
- ✓ Clean exterior of instrument.

3. Electrical:

- ✓ Visually inspect all PC boards for cleanliness and signs of corrosion.
- ✓ Check all RF generator and spectrometer power supply voltages.
- ✓ Run instrument diagnostic checks from the appropriate Device Control Module.

RF Generator:

- ✓ Check the RF generator status screens.
- ✓ Check the function of all interlocks.

Spectrometer:

- ✓ Check the spectrometer status screens.
- ✓ Check for proper function of all motors from the Motor Control window.

4. Optical:

- ✓ Check the neon lamp for proper operation.
- ✓ Ensure that neon initialization passes at power up.
- ✓ Ensure that there is a single, well defined peak of sufficient intensity (approximately 15,000 to 60,000 cts.) for the 703.241nm neon line viewed in the DCM Collect Spectra window. Re-generate the neon correction table if problems are encountered. If problems are still exhibited after the table is re-generated, replace the neon lamp assembly.

Neon Lamp Replaced: ☐Yes ☒No

- ✓ Perform the Initialize Optics routine from the Spectrometer Control window.
- ✓ Ensure that the routine passes with no error codes. If it fails, run a manual prism scan from the spectrometer DCM.
- ✓ Insure the Dark Current measurement (Detector Calibration) passes at initialization.
- ✓ Check the shutter home sensor position.
- ✓ Check prism/electronics temperature sensor readback values from the DCM. It is normal for these readings to be shown in red. A typical prism temperature is approximately 29.5 degree C. A typical electronics temperature is approximately 35 degree C.
- ✓ Check the detector temperature from the DCM for -7.0 to -8.5 degree C. If outside of this range the detector cooling fan may not be operational. Further inspection may be necessary.
- ✓ Inspect for proper function of the transfer optics. 1) shutter 2) DV mirror 3) X/Y mirror.
- ✓ Clean or replace the axial and radial view windows as necessary.

Axial Window Replaced: ☐Yes ☒No
Radial Window Replaced: ☐Yes ☒No

5. Post PM Performance Tests:

- ✓ Perform View Align.

5.1 Spectral Resolution:

- ✓ Measure the spectrometers ability to separate two adjacent wavelengths.

Parameter	Specification	Test Result	Pass/Fail
As 193.696 - Resolution	≤0.009	0.007	Passed
Ni 231.604 - Resolution	≤0.011	0.008	Passed
Ni 341.476 - Resolution	≤0.015	0.012	Passed
Ba 455.403 - Resolution	≤0.020	0.016	Passed

5.2 Precision:

- ☒ Test for reproducibility of a set of measurement.

Parameter	Specification	Test Result	Pass/Fail
Zn 213.856	%RSD \leq 1 %	0.29	Passed
Mg 280.856	%RSD \leq 1 %	0.20	Passed
Mg 285.207	%RSD \leq 1 %	0.41	Passed
Ba 455.403	%RSD \leq 1 %	0.26	Passed

5.4 Mn BEC:

- ☒ Run Axial and Radial BEC according to the A&T spec, or the commissioning test procedure.

Mn Background Equivalent Concentration:

Method "MnBEC" For Samples "IB (2% HNO_3)" and "IS (N069-1579/10)", record intensities.

Calculated BEC: $\text{BEC} = (\text{IB} * \text{Conc of Std}) / (\text{IS} - \text{IB})$. Where Conc of Std = 1,000 PPB

Element	Mode	Conc.	IB	IS	Pass/Fail
Mn 257.610	Radial	1,000 ppb	30424.3	3984830.9	Passed
	Axial	1,000 ppb	58059.2	12858731.3	
Mn 257.610	IB*Conc.	IS - IB	BEC	Spec	Passed
	Radial	30424300	3954406.6	7.69	
Axial	58059200	12800672.1	4.53	<30 PPB	Passed

6. Review:

- ☒ Review with the customer PM work performed.
☒ Discuss recommended customer supplied materials to have on hand.
☒ Attach PM sticker.

Additional Comments



Additional Comments Regarding the PM

Review

The preventive maintenance checks and if applicable performance tests for ICP-OES/Avio200 have been completed.

This ICP-OES/Avio200 Passes ☒ Fails ☐ the preventive maintenance.

Review of Preventive Maintenance

Authorized PerkinElmer Representative:		Date: 12-Nov-2019 (DD-MMM-YYYY)
Authorized Customer Representative:		Date: 12-Nov-2019 (DD-MMM-YYYY)