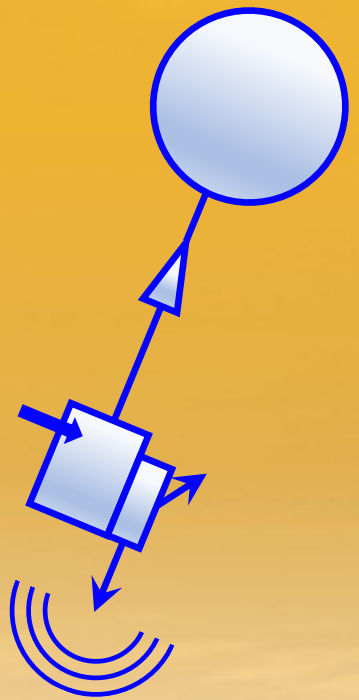
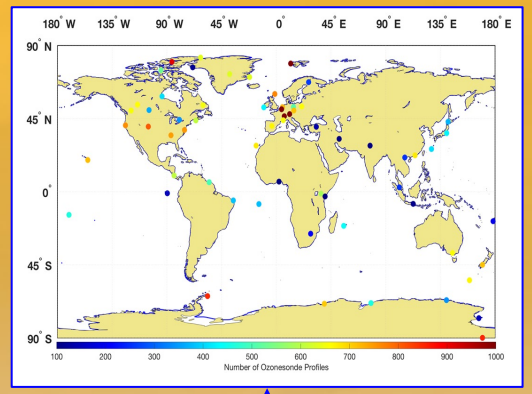
ASOPOS-Webinar Series on the Implementation of the Recommendations Made by the ASOPOS 2.0 Panel

Ozonesonde Measurement Principles and Best Operational Practices

ASOPOS 2.0 (GAW Report No. 268)

(Assessment of Standard Operating Procedures for Ozonesondes)



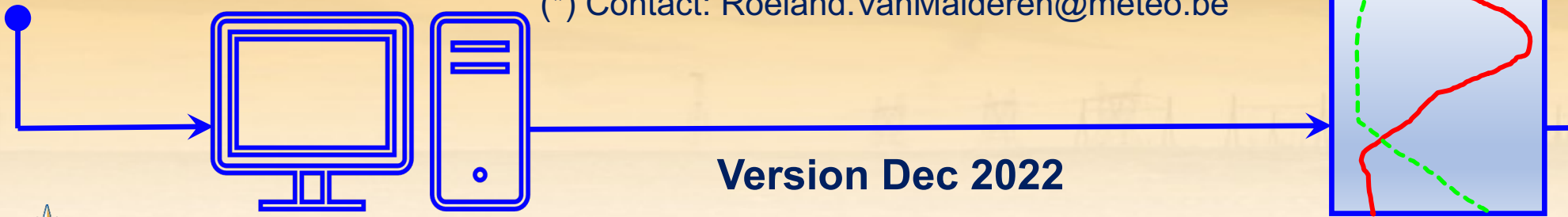


ASOPOS-Webinar No. 3

Standard Operating Procedures (SOPs) for Ozonesondes

Roeland Van Malderen (*), Peter von der Gathen, Herman Smit, Gary Morris

(*) Contact: Roeland.VanMalderen@meteo.be



Version Dec 2022

WORLD METEOROLOGICAL ORGANIZATION

GRUAN

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GLOBAL ATMOSPHERE WATCH

Outline

- Introduction
- First preparation (3 to 30 days prior to launch)
- Second preparation (0 to 1 day prior to launch)
- Issues to avoid & potential pitfalls
- Take away messages

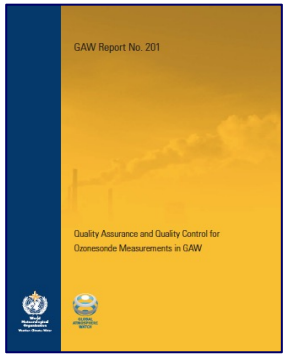
Introduction

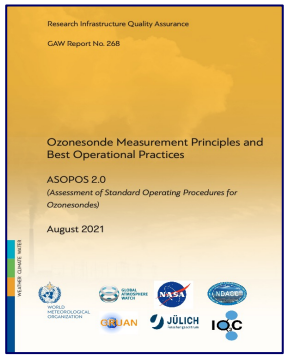
- from the JOSIE campaigns: operating and preparation procedures impact accuracy and precision from ozonesonde measurements

- Overall recommendation: DO NOT CHANGE! (i.e. don't switch to a different combination)
  - ✓ SPC-6A + SST1.0 + PFE: Komhyr 1986
  - ✓ En-Sci (2)Z + SST0.5 + PFE: Komhyr 1995
  - ✓ En-Sci (2)Z + SST0.1 + PFE: Johnson et al. 2002/Nakano & Morofuji 2022

- SOPs: only small, but important, changes proposed

- Reference to WMO GAW 201 (old) and WMO GAW 268 (new)



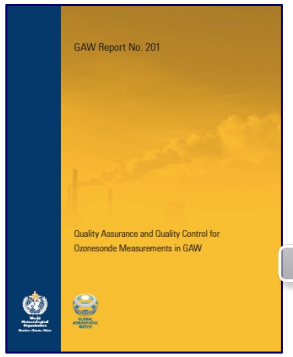


Introduction

- SOPs: only small (but important) changes proposed → WHY CHANGES?
  - ✓ Keep SOPs as simple as possible.
  - ✓ Drop manipulations without proven added value (e.g. back pressure of pumps).
  - ✓ Avoid unnecessary manipulations with cells opened (e.g. refreshing solutions).
  - ✓ Build in some quality checks/limiting values to avoid launch of bad ozonesondes.
  - ✓ Get ready for future reprocessing based on current knowledge (Vömel et al., 2020; Tarasick et al., 2021; Smit et al., in preparation): I_{B0}, I_{B1}, sensor response time.

- HOW/WHY doing the preparation steps:
  - ✓ video on Preparation of an ECC-Ozonesonde: https://vimeo.com/niwanz/asopospreP
  - ✓ GAW Report No. 268, particularly Chapter 4 (WHY) and Annex A (HOW)

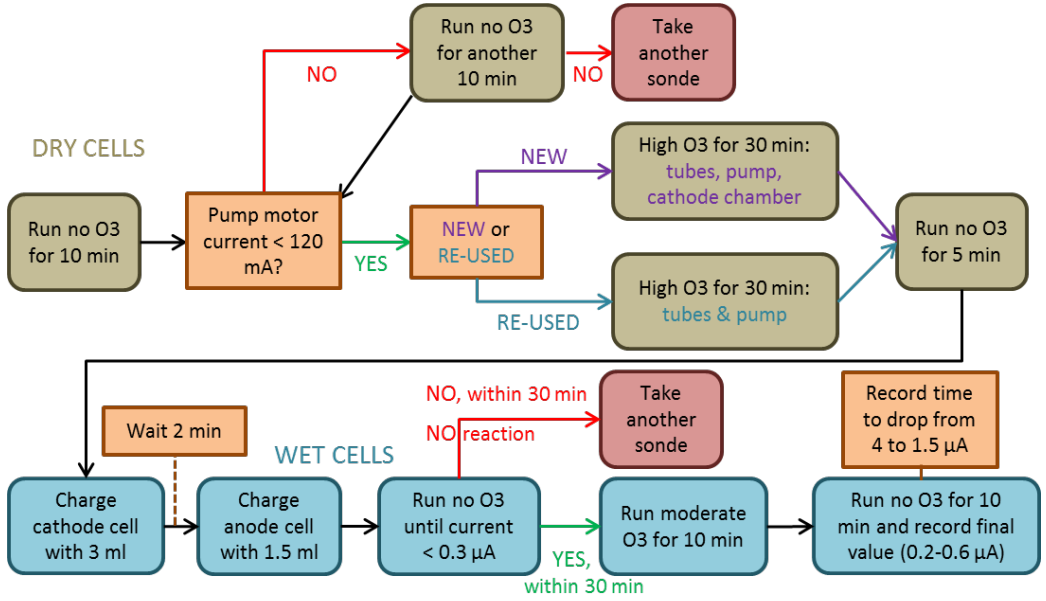
➔ Here: key messages + most important changes w.r.t. WMO GAW 201!



First preparation (3 to 30 days prior to launch)

PURPOSE:

- cleaning some parts of the ozonesonde
- first pre-check of overall performance of the ozonesonde
- charging the ozonesonde with sensing solutions for the first time



First preparation (3 to 30 days prior to launch)

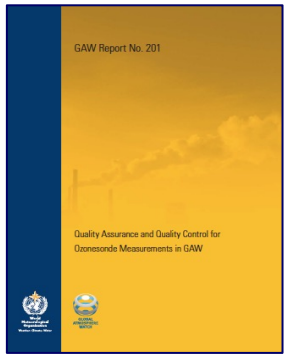
WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

Initial Pump Current	_____ mA (~< 100 mA)	
Pump Head Pressure	_____ psi (~>10 psi)	
Pump Suction	_____ inches Hg (~< 20 in Hg)	
Condition with High Ozone for 30 min (tubing, pump, cathode chamber)		[ ]
Condition with Zero Ozone (filter) for 5 min		[ ]
Fill with Cathode Solution (3 ml). Wait 2 min		[ ]
Fill with Anode Solution (1.5 ml)		[ ]
Condition with Zero Ozone for 10 min		[ ]
Run on high ozone (5 µA) for 10 min		[ ]
Ozone free air for 10 min. Check that O_3 decreases by 70-80% in 1 min		[ ]
Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

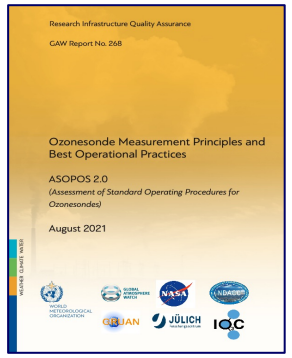


WMO GAW 268 (new)

A-9.2 ASOPOS 2.0 ECC Ozonesonde Blank Checklist Sheet
Version June 2021

Pre-conditioning (prepared 3 to 30 days before flight)

1. Date of pre-conditioning (YYYYMMDD): __
2. Operator Initials: __
3. Station ID: __
4. ECC serial number: __
5. Manufacture Date (YYYYMMDD): __
6. Manufacturer pump voltage (V): __
7. Manufacturer pump current (mA): __
8. Manufacturer flowrate (s/100ml): __
9. Sensing Solution/Buffer: __
10. Sensing Solution Identifier: __
11. Run 10 min of NO-Ozone air: __
12. Bypass Cathode chamber: Yes __ No __
13. Run 30 min on High Ozone: __
14. Run 5 min on NO-Ozone air: __
15. Add 3.0 cm^3 Cathode solution (wait 2 min): __
16. Add 1.5 cm^3 Anode solution: __
17. Run on no-Ozone air until the current drops below 0.3µA: __
18. Run 10 min at 5 µA Ozone: __
19. Switch to no-Ozone air and record time to drop from 4 to 1.5 µA (s): __
20. Run 10 min on NO-Ozone air: __ Record Ozone Current (µA): __
21. Short cell leads: __
22. Store in sonde box, with tissue under the cells: __



First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

Initial Pump Current	_____ mA (~< 100 mA)	
Pump Head Pressure	_____ psi (~>10 psi)	
Pump Suction	_____ inches Hg (~< 20 in Hg)	
Condition with High Ozone for 30 min (tubing, pump, cathode chamber)		[ ]
Condition with Zero Ozone (filter) for 5 min		[ ]
Fill with Cathode Solution (3 ml). Wait 2 min		[ ]
Fill with Anode Solution (1.5 ml)		[ ]
Condition with Zero Ozone for 10 min		[ ]
Run on high ozone (5 µA) for 10 min		[ ]
Ozone free air for 10 min. Check that O_3 decreases by 70-80% in 1 min		[ ]
Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

1. First preparation period extended

➔ no need to refresh solutions after 1 week

WMO GAW 268 (new)

A-9.2 ASOPOS 2.0 ECC Ozonesonde Blank Checklist Sheet
Version June 2021

Pre-conditioning (prepared 3 to 30 days before flight)

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20. Run 10 min on NO-Ozone air: __ Record Ozone Current (µA): __
21. Short cell leads: __
22. Store in sonde box, with tissue under the cells: __

First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

~~Initial Pump Current~~	_____ mA (~< 100 mA)	
Pump Head Pressure	_____ psi (~>10 psi)	
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Condition with High Ozone for 30 min (tubing, pump, cathode chamber)		[ ]
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Fill with Cathode Solution (3 ml). Wait 2 min		[ ]
Fill with Anode Solution (1.5 ml)		[ ]
Condition with Zero Ozone for 10 min		[ ]
Run on high ozone (5 µA) for 10 min		[ ]
Ozone free air for 10 min. Check that O_3 decreases by 70-80% in 1 min		[ ]
Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

2. Pump Head Pressure/Suction no longer needed
   - ✓ note manufacturer measurements
   - ✓ measured pump current < 120mA!

WMO GAW 268 (new)

A-9.2 ASOPOS 2.0 ECC Ozonesonde Blank Checklist Sheet
Version June 2021

Pre-conditioning (prepared 3 to 30 days before flight)

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17. Run on no-Ozone air until the current drops below 0.3µA: __
18. Run 10 min at 5 µA Ozone: __
19. Switch to no-Ozone air and record time to drop from 4 to 1.5 µA (s): __
20. Run 10 min on NO-Ozone air: __ Record Ozone Current (µA): __
21. Short cell leads: __
22. Store in sonde box, with tissue under the cells: __

There should be also“measured”!

First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

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Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

WMO GAW 268 (new)

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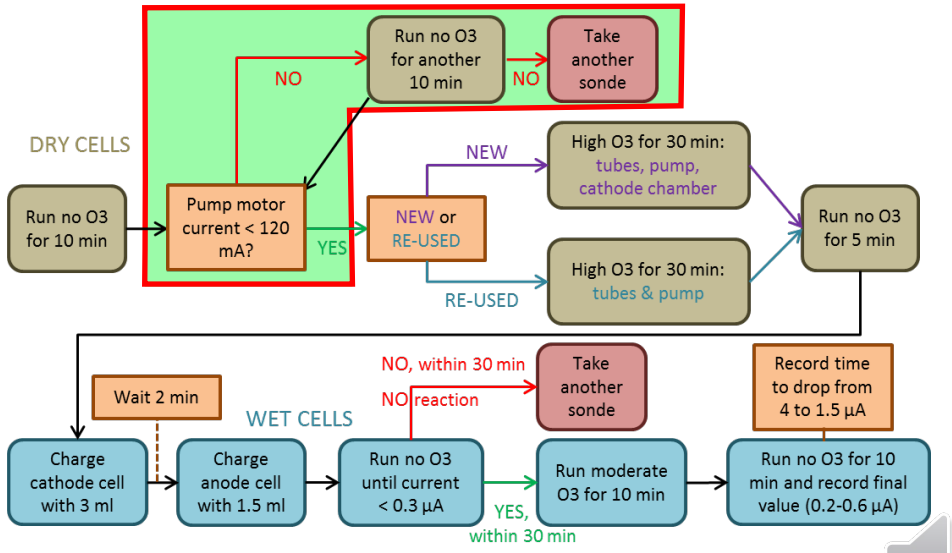

2. Pump Head Pressure/Suction no longer needed
   - ✓ note manufacturer measurements
   - ✓ measured pump current < 120mA!

First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

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Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

3. Conditioning with high ozone amounts
   - ✓ NEW sondes: tubing, pump & cathode chamber (i.e. **NO** BYPASS)
   - ✓ RE-USED sondes: tubing, pump & *only* cathode chamber *cap* (i.e. **BYPASS** cathode chamber)

WMO GAW 268 (new)

A-9.2 ASOPOS 2.0 ECC Ozonesonde Blank Checklist Sheet
Version June 2021

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17. Run on no-Ozone air until the current drops below 0.3µA: __
18. Run 10 min at 5 µA Ozone: __
19. Switch to no-Ozone air and record time to drop from 4 to 1.5 µA (s): __
20. Run 10 min on NO-Ozone air: __ Record Ozone Current (µA): __
21. Short cell leads: __
22. Store in sonde box, with tissue under the cells: __

First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

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Ozone free air for 10 min. Check that O_3 decreases by 70-80% in 1 min		[ ]
Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

WMO GAW 268 (new)

A-9.2 ASOPOS 2.0 ECC Ozonesonde Blank Checklist Sheet
Version June 2021

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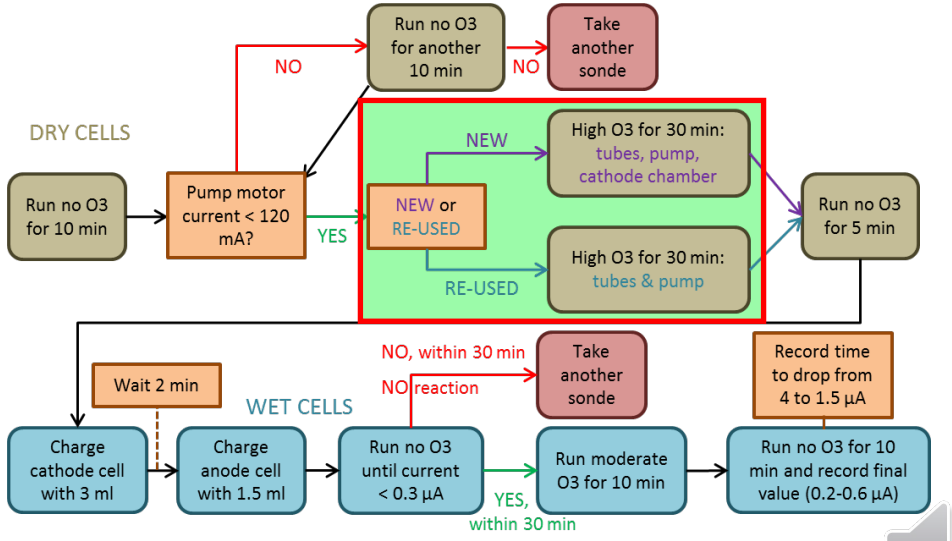

3. Conditioning with high ozone amounts
   - ✓ NEW sondes: tubing, pump & cathode chamber (i.e. **NO** BYPASS)
   - ✓ RE-USED sondes: tubing, pump & *only* cathode chamber *cap* (i.e. **BYPASS** cathode chamber)

First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

Initial Pump Current	_____ mA (~< 100 mA)	
Pump Head Pressure	_____ psi (~>10 psi)	
Pump Suction	_____ inches Hg (~< 20 in Hg)	
Condition with High Ozone for 30 min (tubing, pump, cathode chamber)		[ ]
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Fill with Cathode Solution (3 ml). Wait 2 min		[ ]
~~Fill with Anode Solution (1.5 ml)~~		[ ]
Condition with Zero Ozone for 10 min		[ ]
~~Run on high ozone (5 µA) for 10 min~~		[ ]
Ozone free air for 10 min. Check that O_3 decreases by 70-80% in 1 min		[ ]
Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

4. When first charged with solutions, run zero ozone air through the cells for a longer time (< 30 min)

   ✓ There should be a reaction (high ozone currents) **first**!

   ✓ Ozone current should **then** drop below 0.3 µA within 30 min.
   (longer for En-Sci than SPC)

WMO GAW 268 (new)

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Version June 2021

Pre-conditioning (prepared 3 to 30 days before flight)

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8. Manufacturer flowrate (s/100ml): __
9. Sensing Solution/Buffer: __
10. Sensing Solution Identifier: __
11. Run 10 min of NO-Ozone air: __
12. Bypass Cathode chamber: Yes __ No __
13. Run 30 min on High Ozone: __
14. Run 5 min on NO-Ozone air: __
15. Add 3.0 cm³ Cathode solution (wait 2 min): __
16. Add 1.5 cm³ Anode solution: __
17. Run on no-Ozone air until the current drops below 0.3µA: __
18. Run 10 min at 5 µA Ozone: __
19. Switch to no-Ozone air and record time to drop from 4 to 1.5 µA (s): __
20. Run 10 min on NO-Ozone air: __ Record Ozone Current (µA): __
21. Short cell leads: __
22. Store in sonde box, with tissue under the cells: __

First preparation (3 to 30 days prior to launch)

WMO GAW 201 (old)

OZONE SONDE CONDITIONING AND PRE-FLIGHT PREPARATIONS

3-7 Days Prior to Launch

Date _____ Ozone Unit Number _____ Initials _____

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Ozone free air for 10 min. Check that O_3 decreases by 70-80% in 1 min		[ ]
Background current may be 0.2 - 0.5 µA at this time. It will decrease in the next days		
Add 3 ml to cathode. Short ECC-cell Leads. Replace in Plastic Storage Bag		[ ]

5. Store prepared ozonesonde in Styrofoam box, with tissue under the cells

➔ leaking of cells can then be checked after storage (brown stains from KI)!

WMO GAW 268 (new)

A-9.2 ASOPOS 2.0 ECC Ozonesonde Blank Checklist Sheet
Version June 2021

Pre-conditioning (prepared 3 to 30 days before flight)

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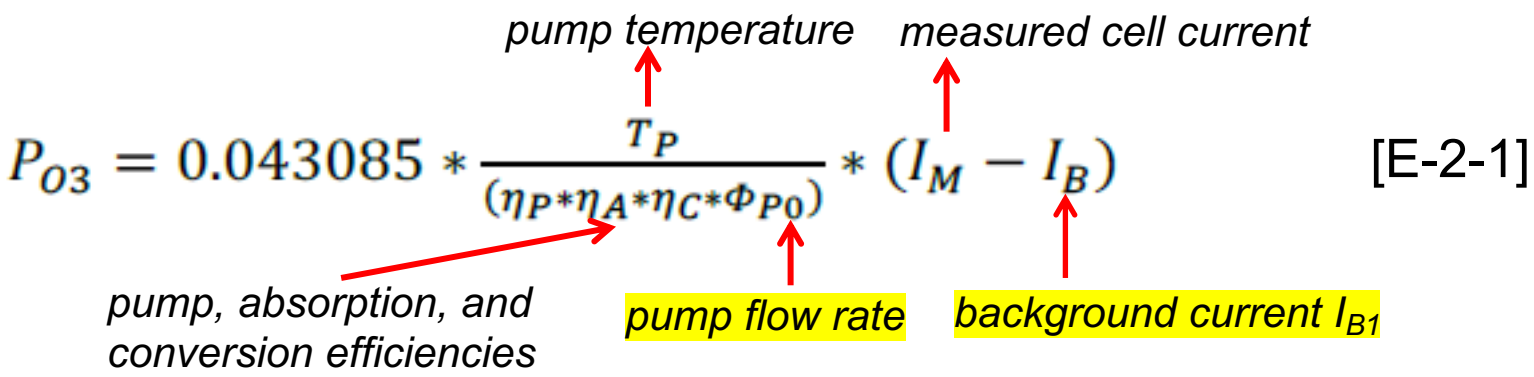
19. Switch to no-Ozone air and record time to drop from 4 to 1.5 µA (s): __
20. Run 10 min on NO-Ozone air: __ Record Ozone Current (µA): __
21. Short cell leads: __
22. Store in sonde box, with tissue under the cells: __

Second preparation (0 to 1 day prior to launch) – “day of flight”

PURPOSE:

- final check of overall performance of the ozonesonde
- measure the variables that enter in the basic equation of the ozonesonde measurement:



- measure variables that *(might)* enter *(in the future)* in the ozonesonde data processing code (lab conditions at flow rate measurement, background current I_{B0}, fast response time)

Second preparation (0 to 1 day prior to launch)

WMO GAW 201 (old)

1 - 24 hours prior to flight (multiple columns/rows allow for multiple tests of same ozonesonde)

Date	_____	_____	_____
Initials	_____	_____	_____
Rinse Cathode and Anode cells	[ ]	[ ]	[ ]
Replace Cathode (3 ml)	[ ]	[ ]	[ ]
Replace Anode (1.5 ml)	[ ]	[ ]	[ ]
Attach cell leads to ozone generator	[ ]	[ ]	[ ]
Ozone free air on pump intake	[ ]	[ ]	[ ]
Pump motor current (~<100 mA)	_____	_____	_____ mA
Background /~time to bkg	_____	_____	_____ µA

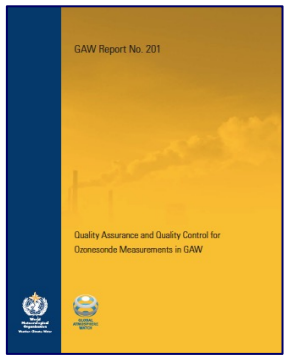
Replace solutions if background is ~≥0.10 µA (~0.35 mPa).

Moderate ozone (~5 µA) for 10 minutes [ ] [ ] [ ]

Switch to ozone free air and record (µA) at:

0.0	0.5	1	3	5	10 min	
_____	_____	_____	_____	_____	_____	(1)
_____	_____	_____	_____	_____	_____	(2)
_____	_____	_____	_____	_____	_____	(3)

Flow rate (ml min^{-1})	_____	_____	_____	
Record P/T/RH				
Ozone Background in lab:	_____	_____	_____	hex/mPa
Background before release:	_____	_____	_____	hex/mPa
Surface ozone before release:	_____	_____	_____	hex/mPa
Ozone pump temp:	_____	_____	_____	°C



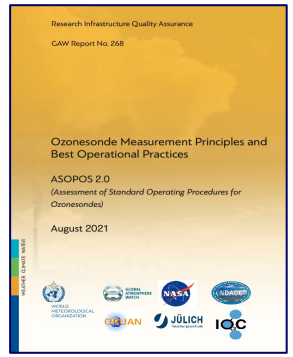
WMO GAW 268 (new)

Final conditioning for 0–1 day prior to launch

1. Date (YYYYMMDD): _____
2. Operator Initials: ___
3. Check tissue under the cells for any leakage: __
4. Remove original Cathode and Anode solution: __
5. Add 3.0 cm^3 cathode solution (wait minimum 2 min): __
6. Add 1.5 cm^3 anode solution: __
7. Run 10 min of no-Ozone air: __
8. Record Ozone current (I_{B0}) (µA): __
9. Run 10 min at 5 µA Ozone: __
10. Switch to NO-Ozone air and record time to drop from 4 to 1.5 µA (s): __
11. Run on NO-Ozone air: __
12. Record 5 times t_{100} inverse flow rates (s/100ml):
    01. _____
    02. _____
    03. _____
    04. _____
    05. _____
13. Average t_{100} time (s/100ml) inverse flowrate: _____
14. Lab Temperature T_{Lab} (°C): ____
15. Lab Relative Humidity RH_{Lab} (%): ____
16. Lab Pressure P_{Lab} (hPa): _____
17. After 10 min on NO-Ozone air, record Ozone Current (I_{B1}) (µA):_____
18. Pump Motor Current (mA): _____
19. *End time of preparation* (**UTC**): HH:MM

If the sonde package is not flown during final conditioning procedures:

20. Short cell leads: ___
21. Store in sonde box: ___



Second preparation (0 to 1 day prior to launch)

WMO GAW 201 (old)

1 - 24 hours prior to flight (multiple columns/rows allow for multiple tests of same ozonesonde)

Date			
Initials			
Rinse Cathode and Anode cells	[ ]	[ ]	[ ]
Replace Cathode (3 ml)	[ ]	[ ]	[ ]
Replace Anode (1.5 ml)	[ ]	[ ]	[ ]
Attach cell leads to ozone generator	[ ]	[ ]	[ ]
Ozone free air on pump intake	[ ]	[ ]	[ ]
Pump motor current (~<100 mA)			mA
Background /~time to bkg			µA
Replace solutions if background is ~≥0.10 µA (~0.35 mPa).			
Moderate ozone (~5 µA) for 10 minutes	[ ]	[ ]	[ ]

Switch to ozone free air and record (µA) at:

0.0	0.5	1	3	5	10 min
					(1)
					(2)
					(3)

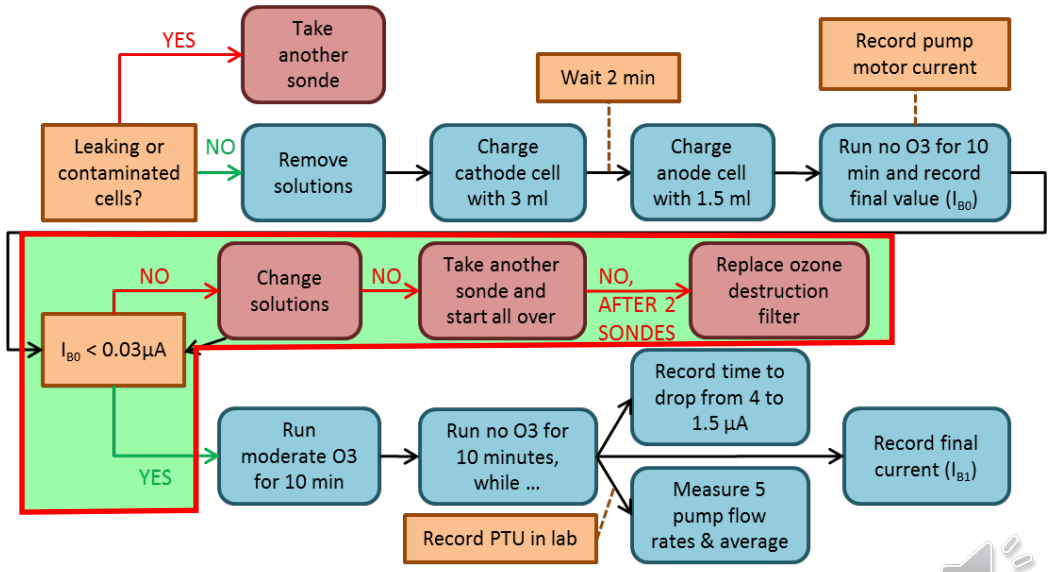
Flow rate (ml min^{-1})			
Record P/T/RH			
Ozone Background in lab:			hex/mPa
Background before release:			hex/mPa
Surface ozone before release:			hex/mPa
Ozone pump temp:			°C

1. background current measurements
   - ✓ I_{B0} < 0.03 µA + actions
   - ✓ I_{B1} < 0.07 µA + timing
   - ✓ **No** I_{B2} (at launch site)!

WMO GAW 268 (new)

Final conditioning for 0–1 day prior to launch

1. Date (YYYYMMDD): _____
2. Operator Initials: ___
3. Check tissue under the cells for any leakage: __
4. Remove original Cathode and Anode solution: __
5. Add 3.0 cm^3 cathode solution (wait minimum 2 min): __
6. Add 1.5 cm^3 anode solution: __
7. Run 10 min of no-Ozone air: __
8. Record Ozone current (I_{B0}) (µA): __ < 0.03 µA
9. Run 10 min at 5 µA Ozone: __
10. Switch to NO-Ozone air and record time to drop from 4 to 1.5 µA (s): __
11. Run on NO-Ozone air: __
12. Record 5 times t_{100} inverse flow rates (s/100ml):



Second preparation (0 to 1 day prior to launch)

WMO GAW 201 (old)

1 - 24 hours prior to flight (multiple columns/rows allow for multiple tests of same ozonesonde)

Date _____ _____ _____
Initials _____ _____ _____
Rinse Cathode and Anode cells [ ] [ ] [ ]
Replace Cathode (3 ml) [ ] [ ] [ ]
Replace Anode (1.5 ml) [ ] [ ] [ ]
Attach cell leads to ozone generator [ ] [ ] [ ]
Ozone free air on pump intake [ ] [ ] [ ]
Pump motor current (~<100 mA) _____ _____ _____ mA
Background /~time to bkg _____ _____ _____ µA
Replace solutions if background is ~≥0.10 µA (~0.35 mPa).

Moderate ozone (~5 µA) for 10 minutes [ ] [ ] [ ]
Switch to ozone free air and record (µA) at:

0.0	0.5	1	3	5	10 min	
_____	_____	_____	_____	_____	_____	(1)
_____	_____	_____	_____	_____	_____	(2)
_____	_____	_____	_____	_____	_____	(3)

Flow rate (ml min^{-1}) _____ _____ _____

Record P/T/RH
Ozone Background in lab: _____ _____ _____ hex/mPa

Background before release: _____ _____ _____ hex/mPa
Surface ozone before release: _____ _____ _____ hex/mPa
Ozone pump temp: _____ _____ _____ °C

2. sensor (fast) response test
   ➔ response time of the drop from 4.0 to 1.5 µA to be preferred, as it corresponds to direct measurement of the exp. decrease 1/e ≈ 0.368 ≈ 1.5/4.0

WMO GAW 268 (new)

Final conditioning for 0–1 day prior to launch

1. Date (YYYYMMDD): _____
2. Operator Initials: ___
3. Check tissue under the cells for any leakage: __
4. Remove original Cathode and Anode solution: __
5. Add 3.0 cm^3 cathode solution (wait minimum 2 min): __
6. Add 1.5 cm^3 anode solution: __
7. Run 10 min of no-Ozone air: __
8. Record Ozone current (I_{B0}) (µA): __
9. Run 10 min at 5 µA Ozone:
10. Switch to NO-Ozone air and record time to drop from 4 to 1.5 µA (s): __
11. Run on NO-Ozone air: __
12. Record 5 times t_{100} inverse flow rates (s/100ml):
    01. _____
    02. _____
    03. _____
    04. _____
    05. _____
13. Average t_{100} time (s/100ml) inverse flowrate: _____
14. Lab Temperature T_{Lab} (°C): ____
15. Lab Relative Humidity RH_{Lab} (%): ____
16. Lab Pressure P_{Lab} (hPa): _____
17. After 10 min on NO-Ozone air, record Ozone Current (I_{B1}) (µA):_____
18. Pump Motor Current (mA): _____
19. *End time of preparation* (**UTC**): HH:MM

If the sonde package is not flown during final conditioning procedures:

20. Short cell leads: ___
21. Store in sonde box: ___

Second preparation (0 to 1 day prior to launch)

WMO GAW 201 (old)

1 - 24 hours prior to flight (multiple columns/rows allow for multiple tests of same ozonesonde)

Date _____ _____ _____
Initials _____ _____ _____
Rinse Cathode and Anode cells [ ] [ ] [ ]
Replace Cathode (3 ml) [ ] [ ] [ ]
Replace Anode (1.5 ml) [ ] [ ] [ ]
Attach cell leads to ozone generator [ ] [ ] [ ]
Ozone free air on pump intake [ ] [ ] [ ]
Pump motor current (~<100 mA) _____ _____ _____ mA
Background /~time to bkg _____ _____ _____ µA
Replace solutions if background is ~≥0.10 µA (~0.35 mPa).

Moderate ozone (~5 µA) for 10 minutes [ ] [ ] [ ]
Switch to ozone free air and record (µA) at:

0.0	0.5	1	3	5	10 min	
_____	_____	_____	_____	_____	_____	(1)
_____	_____	_____	_____	_____	_____	(2)
_____	_____	_____	_____	_____	_____	(3)

Flow rate (ml min^{-1}) _____ _____ _____
Record P/T/RH
Ozone Background in lab: _____ _____ _____ hex/mPa

Background before release: _____ _____ _____ hex/mPa
Surface ozone before release: _____ _____ _____ hex/mPa
Ozone pump temp: _____ _____ _____ °C

3. When performing pump flow rate measurements (→ "Hardware webinar"), accurately record PTU lab conditions for humidification correction (i.e., "dry flow rate" correction)

WMO GAW 268 (new)

Final conditioning for 0–1 day prior to launch

1. Date (YYYYMMDD): _____
2. Operator Initials: ___
3. Check tissue under the cells for any leakage: __
4. Remove original Cathode and Anode solution: __
5. Add 3.0 cm^3 cathode solution (wait minimum 2 min): __
6. Add 1.5 cm^3 anode solution: __
7. Run 10 min of no-Ozone air: __
8. Record Ozone current (I_{B0}) (µA): __
9. Run 10 min at 5 µA Ozone: __
10. Switch to NO-Ozone air and record time to drop from 4 to 1.5 µA (s): __
11. Run on NO-Ozone air:
12. Record 5 times t_{100} inverse flow rates (s/100ml):
    01. _____
    02. _____
    03. _____
    04. _____
    05. _____
13. Average t_{100} time (s/100ml) inverse flowrate: _____
14. Lab Temperature T_{Lab} (°C): ____
15. Lab Relative Humidity RH_{Lab} (%): ____
16. Lab Pressure P_{Lab} (hPa): _____
17. After 10 min on NO-Ozone air, record Ozone Current (I_{B1}) (µA):_____
18. Pump Motor Current (mA): _____
19. *End time of preparation* (**UTC**): HH:MM

If the sonde package is not flown during final conditioning procedures:

20. Short cell leads: ___
21. Store in sonde box: ___

Issues to avoid & potential pitfalls

- We are maintaining a Google Spaces chat/blog group for ozonesonde station operators and technicians. Contact Gary.Morris@noaa.gov to join the space.

- Some important pitfalls or guidelines:
  - ✓ do not spill any of the anode into the cathode!
  - ✓ check pump temperature (through interface) just before launch
  - ✓ avoid evaporation (T_P >20°C) or freezing (T_P < 10°C for En-Sci, < 5°C for SPC) of solutions at lower pressures (P_{Air} < 50 hPa) → "Hardware" Webinar (#2)
  - ✓ maintain and check the hardware used for the preparation → "Hardware" Webinar (#2)
  - ✓ carefully archive all the metadata gathered during the preparation → "Metadata" Webinar (#6)
  - ✓ follow guidelines for data processing → "Processing" Webinar (#4)

Take away messages

- NOT treated here: SOPs for cleaning recovered sondes, new data format. Please see the report + more news from data archives in near future.

- **MOST IMPORTANT TAKE HOME MESSAGE**: Do **NOT** change your SOPs, unless seriously deviating from the SOPs in the report AND after discussing with an ASOPOS member.

- Most important proposed changes w.r.t. previous report:
  - ✓ use I_{B1} for background current subtraction, do not measure I_{B2} anymore
  - ✓ I_{B0} < 0.03 µA and I_{B1} < 0.07 µA should be feasible with good zero ozone air sources
  - ✓ (fast) time response measurement between 4 and 1.5 µA drop
  - ✓ During high ozone conditioning: distinction between new (no bypass) and recovered (bypass) ozonesondes

Closing Remarks

- This webinar no. 3 is part of a series of ASOPOS Webinars:
  1. Introduction to ASOPOS 2.0: An Overview *(Anne Thompson & Herman Smit)*
  2. Hardware *(Herman Smit & Roeland Van Malderen)*
  3. SOP: Standard Operating Procedures *(Roeland Van Malderen, Peter von der Gathen, Gary Morris & Bryan Johnson)*
  4. Data Processing *(Herman Smit & David Tarasick)*
  5. Data Quality Indicators (DQI) *(Ryan Stauffer & Holger Vömel)*
  6. Meta Data and Software *(Ryan Stauffer & Roeland Van Malderen)*
- The webinars do not replace the Report or associated video clips, but only highlight the most important topics and updates from the previous ASOPOS 1.0 report (WMO/GAW Report No. 201).
- **Whenever you have questions or need advice, consult the authors of this webinar or any of the ASOPOS Team members listed above !!!**

Thank you for your attention. We look forward to future collaborations!!!