

# AN INNOVATION-DRIVEN APPROACH TO DISTRIBUTION SYSTEM MONITORING

**PA AWWA ANNUAL CONFERENCE**

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# DRINKING WATER FIELD TESTING: CURRENT STATE

**Step 1: Collect Materials/Route at Lab**



**Step 2: Drive to Stop on Route & Collect Samples**

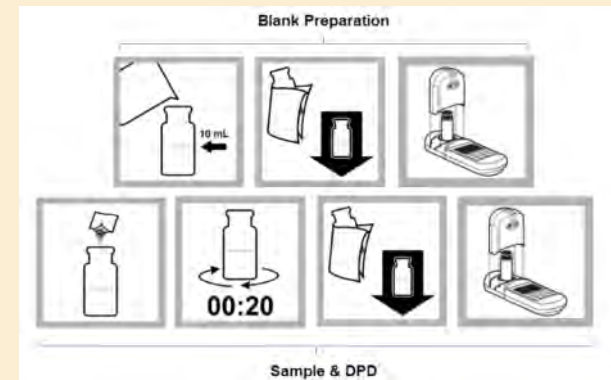


**Step 3: Perform Testing**



## Typical Colorimetric Testing Process

- Measure sample volume
  - Blank sample
  - Mix reagent
  - Wait (reaction time)
  - Reading complete
  - Log values
- Repeat for other tests (typically 2-5)  
→ Also run pH and often conductivity



# FIELD TESTING APPLICATION OVERVIEW (CONT.)

**Step 4: Handoff  
Samples to Lab**

**Step 5: Lab Testing**

**Step 6: Manually  
Collate &  
Transcribe Data**

**Step 7: Analyze  
Data and Take  
Action**



## **Common Lab Tests**

- Nitrite (reaction time)
- Monochloramine (multiple steps)
- Free Ammonia (multiple steps)



# DESIRE FOR MONITORING AND CONTROL

- Testing capacity can be a limitation
  - Not enough time for additional parameters in field
  - Too complex in field environment and/or field tech skill set
- Gap between data in the lab and action in the field

## Common Procedural Errors

Scratched sample cells

Improper reaction time

Different mixing method

Different mixing time

Improper/lack of zeroing

Sample degradation

Improper sample volume

Improper reagent amount (spill)

Incorrect program selected

Improper sample temperature

Single readings (outlier)

Transcription errors



# VOICE OF CUSTOMER: WE CAN IMPROVE FIELD TESTING

ISSUE	IMPROVEMENT AREA	DESIRE
<p>Testing of multiple parameters at multiple sites (10+ sites) is very time consuming – cannot test a high number of parameters nor parameters with lengthy time requirements in the field.</p>	<p>72% of utilities want to add the "ability to test multiple parameters in the field simultaneously in less than 10 minutes." Ideally, want "ability to test <u>in parallel</u> with chlorine".</p>	<p><b>Test more parameters in the field in less time.</b></p>
<p>Data is most useful in the field where action takes place, but confidence in results is low because the test sophistication is difficult to manage in the field environment.</p>	<p>66% want to add the "ability to easily make field measurements on parameters that traditionally are tested in the lab."</p>	<p><b>Eliminate testing errors, variability.</b></p>
<p>Currently measurement data is recorded manually leading to transcription errors and missing data. User must spend time and effort going back though data to correct mistakes or risk reporting an abnormal value.</p>	<p>61% want better data management &amp; storage than their current system provides.</p>	<p><b>Eliminate transcription errors.</b></p>
<p>The amount of equipment required (instruments, chemistries, logs, SOPs, manual) to complete tests physically limits how much testing can be completed in the field.</p>	<p>44% want to take less equipment into the field to take that same measurement.</p>	<p><b>Carry less equipment into the field.</b></p>

# FUTURE “PPA” STATE

# SL1000 ~ PORTABLE PARALLEL ANALYZER (PPA)

## PPA value communicated in a “3 Pillar approach”

- 1.) “Faster Time to Results”
- 2.) “Less Variability in results”
- 3.) “Less *hassle* to get results”



# 1.) FASTER TIME TO RESULTS

## Nitrification Current State

Total CL: 3 minutes  
Free Ammonia/Monochloramine: 12 minutes  
Nitrite: 20 Minutes  
pH/Conductivity (additional meter): 1-2 minutes

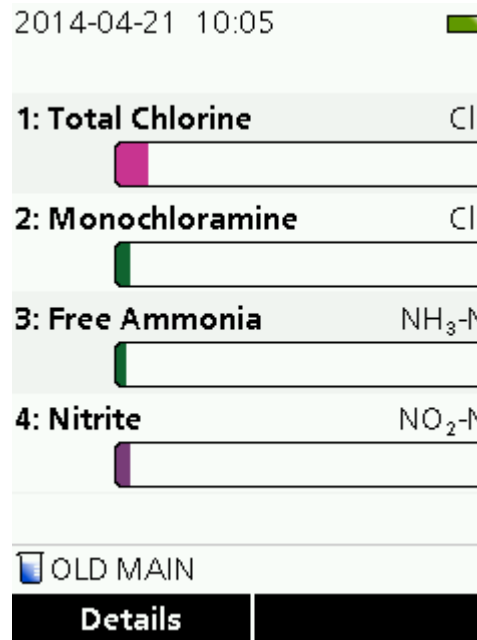
Total time: **30 + minutes**

## Nitrification PPA State

Total CL: 3 minutes  
Free Ammonia/Monochloramine: 8 minutes  
Nitrite: 7 Minutes  
pH/Conductivity (same instrument): 1 minute

Total time using **one** instrument: **8 minutes**

**One instrument, 6 parameters, tested simultaneously... in UNDER 10 minutes**





## 2.) LESS VARIABILITY

Current State Opportunity for Errors/Variation	Future State Correction
Scratched sample cells	Sample cells eliminated
Improper reaction time	All reaction time automated/standardized
Different mixing method	Mixing automated/standardized
Different mixing time	Mixing automated/standardized
Improper/lack of zeroing	Multiple "Blanks" processed automatically
Sample degradation	Ability to test on site (reduction of lab samples)
Improper sample volume	Sample volume automated/standardized
Improper reagent amount (spill)	Reagent amount automated/standardized
Incorrect program selected	Barcode allows for automatic method selection
Improper sample temperature	Individual slot heaters compensate for temperature
Single readings (outlier)	10+ readings per test, average taken, outliers discarded
Transcription errors	USB port allows for easy data transfer

**PPA removes 90%+ of human/testing variability; delivering a more accurate result**

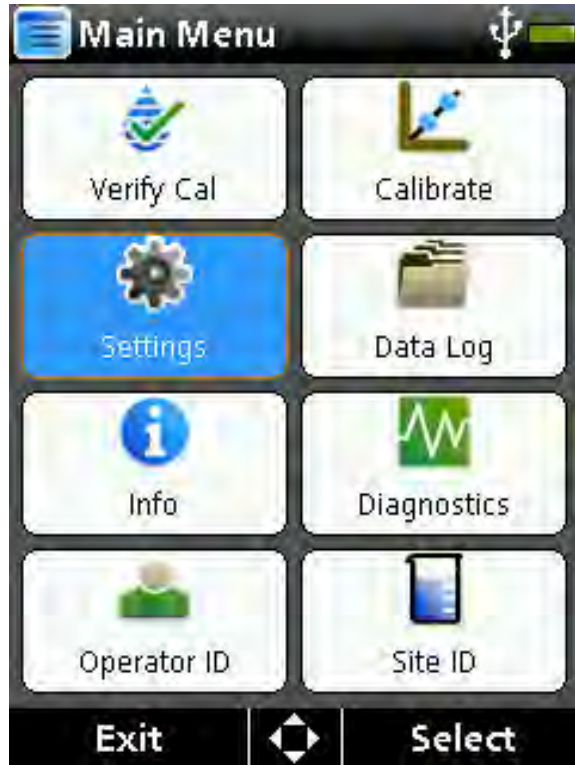


### 3.) LESS “HASSLE”



One meter for colorimetric and electrochemistry testing organized in a portable workstation with room for reagents, probes and sample cups

# MAIN MENU STRUCTURE



Verify Cal	Uses Verification Chemkeys - Validates light throughput, barcode reader and optical quality
Settings	Basic meter settings (date/time, sounds, display etc.) Also probe and chemkey settings
Info	Instrument information (battery life, software version, serial #, etc.)
Operator ID	Used for Operator designations and password capabilities
Calibrate	Used for calibrating probes
Data Log	View data log by date
Diagnostics	Disk space, Method versions etc. (primary for troubleshooting)
Site ID	Used for designating Site IDs and Routes. Also used for Notes feature

# SITE ID AND ROUTES



SL/1000 PPA Tool Set

[Start](#) | [Sites](#) | [Routes](#)

## Edit Route: MonWedFri

### Sites:

- Cherry St
- Fox Ln
- Garfield Ave
- Hampton Ave
- Jefferson Blvd
- Klondike Ave**
- Mariner St
- Nevermore Ln
- Overland Rd
- Quarry Rd
- Russel Rd
- Tesson Ferry Rd
- University Blvd
- Washington Blvd
- Xanadu St
- Yosemite St
- Ziegler Rd

[Add >>](#)  
[<< Remove](#)

### Sites in Route:

- Broadway Blvd
- Adam St
- Inca St
- Larimer St
- Evans Rd
- Dartmouth Ave
- Pensive St**
- Stansbury Blvd
- Vista View Dr

[Up](#)  
[Down](#)

Remember to click "Save". Verify that your new copy of WebConfigCache.zip is on the instrument.

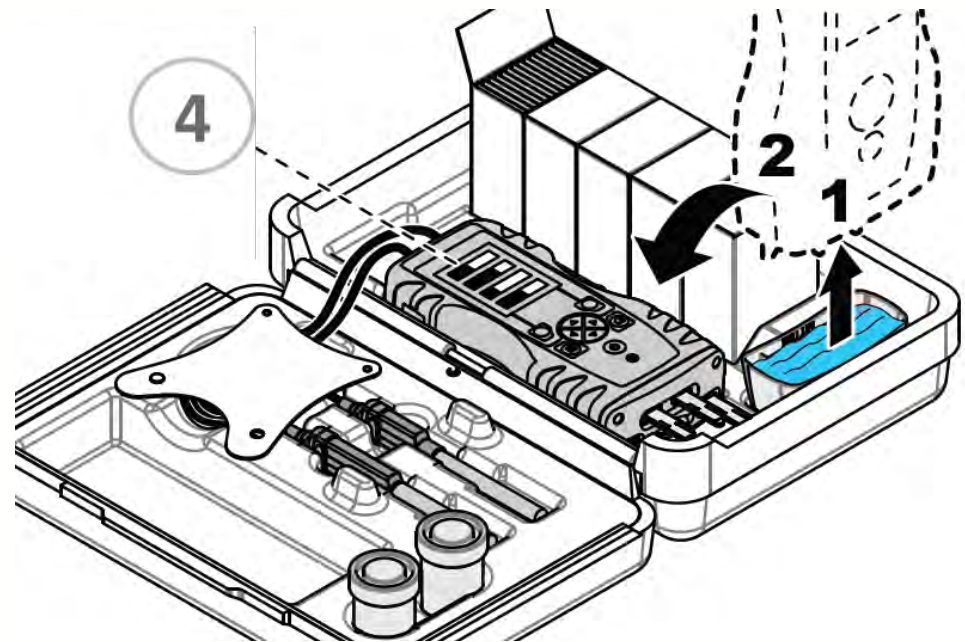
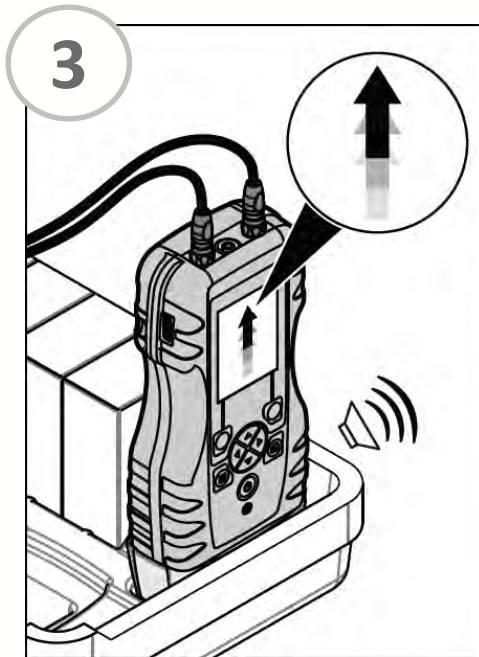
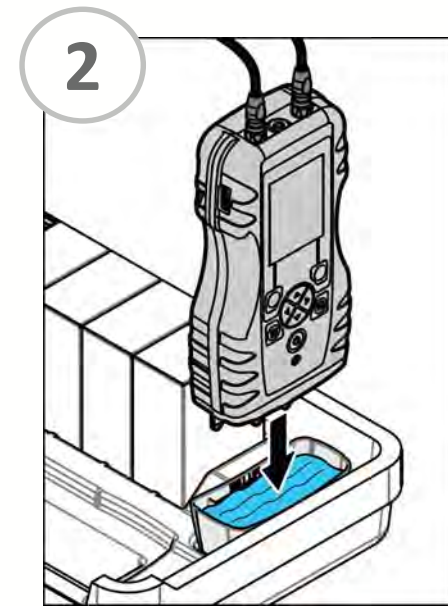
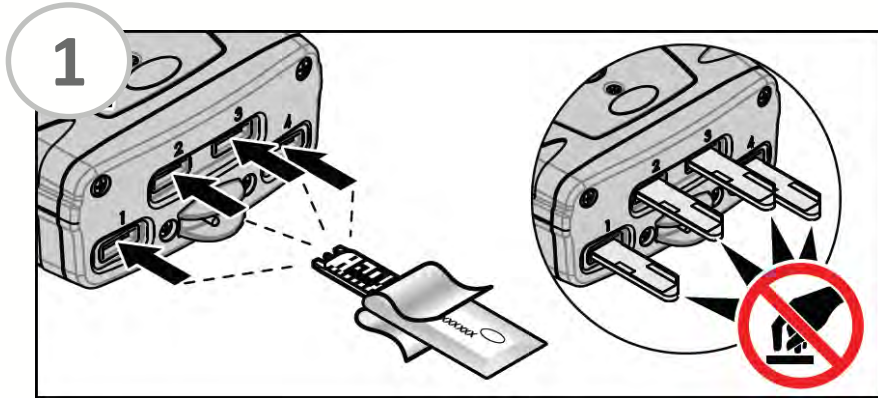


# INTRODUCTION TO PORTABLE PARALLEL ANALYSIS

- Planar cuvettes developed for Free and Total Chlorine, Monochloramine, Free and Total Ammonia, Nitrite, and Copper
  - All chemicals and processes are entirely contained inside the planar cuvette
- Method reaction and measurement times fully automated
- Meso-fluidic channel colorimetry
  - 30 to 50  $\mu\text{L}$  sample volume
  - Optical Path length: 11 mm
  - Wavelengths: 427, 510, 655 and 890 nm



# PRINCIPLE OF OPERATION



# INSTRUMENT SPECIFICATIONS

Specification	Details
Dimensions (W x D x H)	5.02in x 2.32in x 10.17in
Enclosure Rating	IP64
Weight	2.7lbs
Power Source	Lithium Ion Rechargeable Battery
Operating Temperature	5 to 50°C (41 to 122° F)
Storage Temperature	-20 to 60°C (-4 to 140° F)
Interface	USB mini
Data Memory	1000 measured values
Warranty	1 year



# INSTRUMENT OPERATION

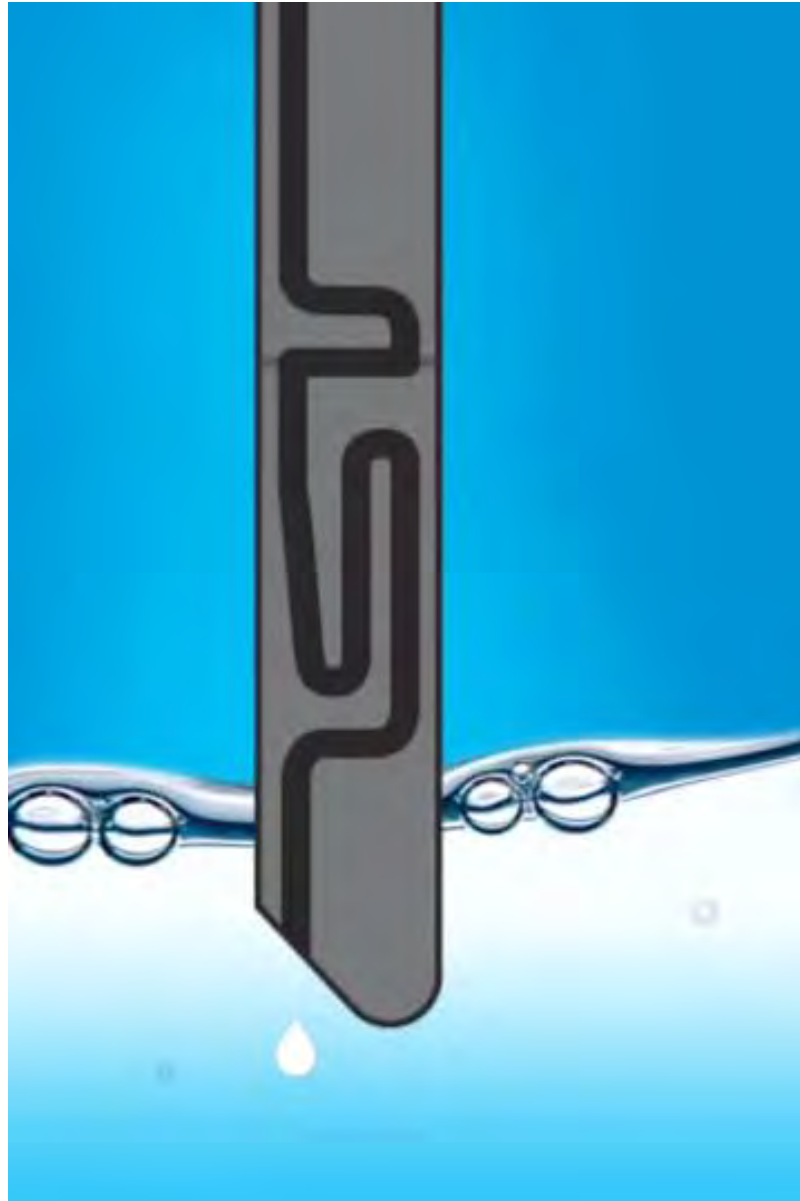


- No restrictions on port/parameter - only requirement is MonoCL in combination with Free Ammonia
- Two prongs on bottom sense when instrument is placed in sample, immediately activate individual pumps (pump life is > 25,000 cycles ~ roughly 3x instrument life)



# PRINCIPLE OF OPERATION

Disposable Planar  
Cuvettes  
(Chemkeys™)



Cuvettes include  
buffers, reagents,  
and act as the  
sample cell

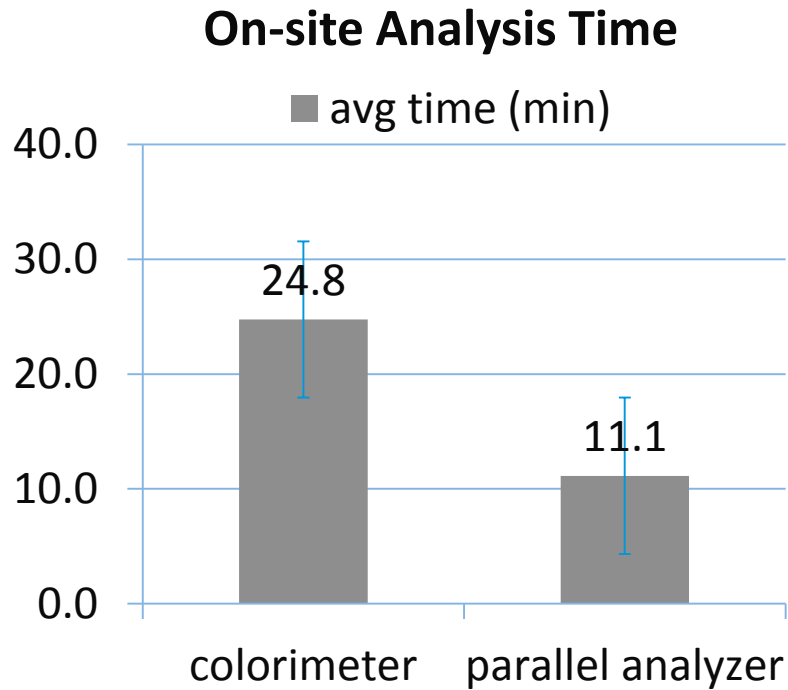
# INTRODUCTION TO PORTABLE PARALLEL ANALYSIS

- Analyst and operator desire for a streamlined measurement process
- Parallel analysis = capability for 6 channel, simultaneous measurement
  - Designed for portable measurement/distribution monitoring
  - Colorimetry and electrochemistry

Analyte	Method Range
Free Chlorine	0.12 mg/L - 4.6 mg/L
Total Chlorine	0.12 mg/L - 4.6 mg/L
Monochloramine	0.12 mg/L - 4.6 mg/L
Nitrite	0.005 mg/L - 0.600 mg/L
Copper	0.06 mg/L - 5.75 mg/L
Free Ammonia	0.05 mg/L - 0.5 mg/L
Total Ammonia	0.05 mg/L - 1.5 mg/L



# VALIDATION IN THE FIELD



## Parallel analysis solving utility and environmental challenges

- Reduction of analysis time via automation:  
1.5 hours saved on a 4 hour route

# METHOD APPROVAL STATUS

- Method 10260 “Determination of Chlorinated Oxidants (Free and Total) in Water using Disposable Planar Reagent-Filled Cuvettes and Mesofluidic Channel Colorimetry”
- Alternate test procedure to Standard Method 4500-Cl G
- Method published in 40 CFR Part 141 Appendix A to Subpart C, Alternative Test Methods. Promulgated June 19, 2014 in the Federal Register.

*“Hach Method 10260 is **equally as effective as Standard Method 4500-Cl G for the colorimetric determination of free and total chlorine in drinking water.** The basis for this determination is discussed in Smith and Wendelken (2013b). EPA is thus approving Hach Method 10260 as an alternate method to Standard Method 4500-Cl G for the analysis of free and total chlorine in drinking water.”*

## SUMMARY AND QUESTIONS

# THANK YOU FOR ATTENDING!

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