**Advanced Septic System Nitrogen Sensor Challenge, Phase II: Prototype Testing**

**Q:** Will sensor developers be able to send their sensor packages to Battelle or EPA for installation ahead of the preliminary screening tests?

**A:** No. Sensor developers will be required to install and setup their own sensor packages at the Massachusetts Advanced Septic System Testing Center (MASSTC), the Barnstable, MA testing facility. EPA, Battelle and MASSTC will be establishing specific dates for sensor setup periods for each preliminary screening test period. Each team will be expected to deliver, install their sensor on or in the test vessel, and calibrate their device during the setup period. EPA and MASSTC staff will be on hand to assist with logistics during the setup period, but will not be responsible for device set up, calibration or repair. The screening test will begin immediately following the setup period at the designated date and time.  
   
**Q:** Will sensor developers who did not participate in Phase I or previous Phase II events of the Advanced Septic System Nitrogen Sensor Challenge be eligible to participate in these rounds of Phase II testing?

**A:** Yes. Any sensor developer whose sensor package meets the logistical requirements outlined in Table A-2 of the draft Test/Quality Assurance Plan (T/QAP), completes an application, and whose application is accepted by EPA and Battelle will be eligible to participate in the one-week preliminary screening test beginning in August 21, 2019. The sensor developer does not have to have participated in Phase I or previous testing for Phase II. Both the T/QAP and the application can be found on the [VerifiGlobal website](http://verifiglobal.com/en/).

**Q:** What is the maximum allowed size of the sensor?

**A:** The overall dimensions of the sensor unit should be no larger than 6” x 6” x 20”, where the immersed portion of the device is no more than 6” x 6” x 6”. Ideally, external components accompanying the sensor would be contained in one package no more than 12” x 12” x 12”. As a note, ultimately, the sensor package will be below ground in a confined space with possible constraints on the size in final use. This is a clarification in the Test/Quality Assurance Plan (T/QAP), Revision 3, June 2019.

**Q:** What are the performance goals for the sensors?

**A:** The overall performance goals for the sensors are presented in the Table below (Table A-1 of the T/QAP). After a high level quality assurance and statistical review of our T/QAP, an EPA statistician advised the EPA sensor challenge team to restate the accuracy, precision and range in the Performance Goals Table (Table A-1 in the T/QAP). The changes made reflect practical technology considerations for an in-situ device, the intended field application of the sensor in a septic system, and quality review of the test plan.  Further changes and clarifications have been made through experience in testing and understanding stakeholders needs. Changes highlighted below have been made since the July 2018 webinar.

Table A-1 of the T/QAP. Advanced Septic System Nitrogen Sensor Performance Goals

| Attribute | Attribute Description | Performance Goals | | |
| --- | --- | --- | --- | --- |
| Minimum | Almost Ideal | Ideal |
| Parameter1 | What is being measured | NO3-, NH4+ | NO3-, NH4+, TOC | Total nitrogen (TN)2 |
| Installation Price | Price to the homeowner to install | $1,500 | $1,250 | $1,000 |
| Data Management | Ability to record and transmit data (i.e., telemetry) for real-time access by practitioners, regulators, and interested stakeholders | Record and automatically transmit data to designated server or cloud | Record and automatically transmit data to designated server or cloud | Record and automatically transmit data to designated server or cloud; include remote capability of programming variable sampling frequencies. |
| Applicability & Accessibility | Applicability of sensor(s) to various innovative/alternative system designs and ease of access to OWTS for installation and maintenance | Located in-situ to provide performance information on the OWTS; must be accessible for maintenance | Located in-situ to provide performance information on the OWTS; must be accessible for maintenance | Located in-situ to provide performance information on the OWTS; must be accessible for maintenance |
| Frequency of Sensor System Maintenance | How often the sensor(s) need to be maintained | No more than quarterly | No more than semi-annually | No more than annually |
| Accuracy | Accuracy of sensor measurements to the true measurement | Within 20% of true value3 | Within 20% of true value3 | Within 20% of true value3 |
| Precision | Repeatability of sensor measurements | ≤30% RSD | ≤20-30% RSD | ≤20% RSD |
| Range4 | Range of the detection | 2-60 mg N/L | 2-60 mg N/L  2-60 mg/L TOC | 2-60 mg N/L |
| Frequency of Sensor Readings5 | Capability of the sensor to provide parameter concentrations at time frequencies of: | Hourly5 | Hourly5 | Hourly5 |
| Sensor Operating Temperature Range | Temperature range in which the sensor can operate | 4° C to 35° C | 4° C to 35° C | 4° C to 35° C |
| Deployment | Period of deployment | Continuous | Continuous | Continuous |
| System Lifetime | Expected life of sensor | 5 years | 5 to 10 years | 10 years |

1 Refer to Section B1.4 for information on the sources of nitrate (NO3-), ammonia (NH4+), and total organic carbon (TOC).

2 Total Nitrogen (TN) is defined as the sum of total kjeldahl nitrogen (ammonia, organic and reduced nitrogen) and nitrate-nitrite.

3 True value is defined as the certified laboratory result for the parameter using approved test methods.

4 The sensors must be capable of alerting about or otherwise notifying of an over range value.

5 Frequency of sensor readings during the preliminary and 6-month testing are detailed in Section B1.2. For deployment in an actual application, sensor frequency readings will depend on end user needs and may vary from hourly to daily or more frequently than hourly. Sensors should have the flexibility for varying frequency of readings.

Accordingly, updates have also been made to the table below (Table A-3 of the T/QAP) to revise the subset of performance goals that need to be met for a sensor to advance to both the one-month preliminary screening test and to the six-month field performance test.

Table A-3 of the T/QAP. Subset of Sensor Performance Goals for Moving Forward to the Field Performance Test

| Attribute | Performance Goals to Determine Field Performance Test Invitation |
| --- | --- |
| Parameter | Measures   * NH4+ and NO3-or * NH4+, NO3-, and TOC or * TN |
| Data Management | Internal (local) sensor system data logger successfully collects time stamped data for the screen test |
| Applicability & Accessibility | Meets test size limits and performs under screen test environmental conditions |
| Maintenance | No more than one maintenance during the preliminary screening test |
| Accuracy | Within 40% of true value |
| Precision | ≤40% RSD |
| Range | 2-60 mg N/L  2-60 mg/L TOC |
| Frequency of Sensor Readings | Capable of high frequency (at least hourly) measurement for the duration of the test |

**Q**: How many tests must the sensor complete to be successful?

**A:** There are three levels of testing. The first level is a one-week preliminary screening test according to the test design defined in the first 7-days of Table B-1 of the T/QAP. If the sensor results for the one-week test meet performance criteria indicated in Table A-3 of the T/QAP, the sensor is invited to proceed to the second level, a one-month preliminary screening test according to the 30-day schedule in Table B-1 of the T/QAP. If the sensor results for the one-month test meet performance criteria indicated in Table A-3 of the T/QAP, the sensor is invited to proceed to the third level, a six-month field performance test. Note: This reflects a change since the July 2018 webinar.