Pyxis®

www.pyxis-lab.com

VALIDATION STUDY

Validation of the Pyxis Lab® ST-765SS in Drinking Water Applications

with help from Iwaki Belgium

IWAKI Belgium

Product Description

The ST-765SS series consists of multi-parameter stainless steel non membrane sensors based on unique electrochemical principles to determine oxidizer and pH levels in water. These sensors contain Pyxis Lab's advanced bare gold electrochemical detection technology that integrates oxidizer measurement in a wide variety of forms, plus pH and temperature measurement. ST-765SS series unique internal operating system performs both temperature and pH compensation for the measurement of the oxidizer based on the conditions present in the user application. This unique internal compensation results in a highly accurate and repeatable oxidizer measurement to an LDL as low as 10ppb. The compensated sensor output measurement is consistent with DPD and other wet chemistry methodologies up to a pH of 9.0+ and meets USEPA-334.0 and ISO-7393 guidelines.

The ST-765SS series sensors feature a replaceable electrode head assembly (EH-765) that contains all critical components of the sensor including pH electrode, 'working' Gold electrode, Platinum 'counter' electrode, Platinum 'RTD & ORP' electrode and Pressure-Balanced Ag/AgCl reference electrode developed by Pyxis Lab®. This unique design eliminates the shortcomings associated with membranes and gel replacement while dramatically reducing electrode polarization time at start-up. The electrode head has a 2-year lifetime. The ST-765SS series sensor body is composed of 304 stainless steel and is well suited for aggressive environments. CPVC body versions named as ST-765P series, are also available.

The ST-765SS series offers (2) 4-20mA outputs (oxidizer & pH) as well as RS-485 Modbus output. All ST-765 series sensors may be used with the optional MA-CR Bluetooth® adapter (optional accessory) for wireless data display, diagnostics, configuration, and calibration via the uPyxis 2.0 Mobile APP, reducing time in the field for sensor maintenance.

This study overviews the performance of the ST-765SS-FCL (P/N 53607) version of the sensor for measurement of free chlorine and pH, while installed in the FR-50 (P/N 50700-A01) flow reservoir specifically designed for Clean/Drinking water applications.

***Note:**

For Dirty/Industrial water applications, the ST-765SS series should be used with the FR-300-PLUS (P/N 22868) auto-brushing flow reservoir. Details of the performance in dirty/industrial water applications will be covered in a separate study overview.

Installation

The installation of the Pyxis ST-765SS sensor was smooth and efficient thanks to the pre-assembled panel and direct 4-20mA outputs from the electrode, allowing for easy integration. Use of the accompanying uPyxis 2.0 Mobile APP and MA-CR Bluetooth adapter connectivity was also smooth, although calibration via the APP took some time getting used to.

***Note:**

The APP, although functional, was in the ongoing stages of development and enhancement at the time of this study and was lacking calibration reports and log functions. Pyxis is currently adding this feature to the uPyxis 2.0 APP.

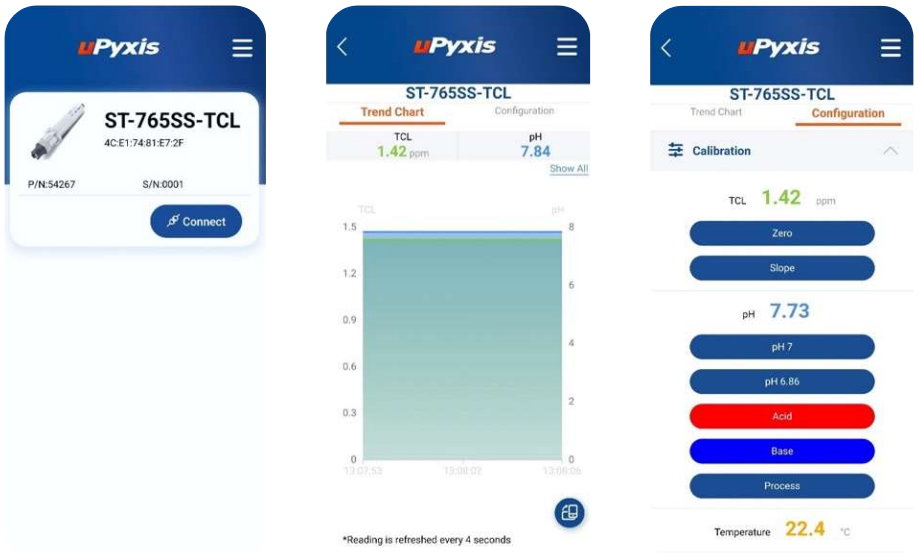
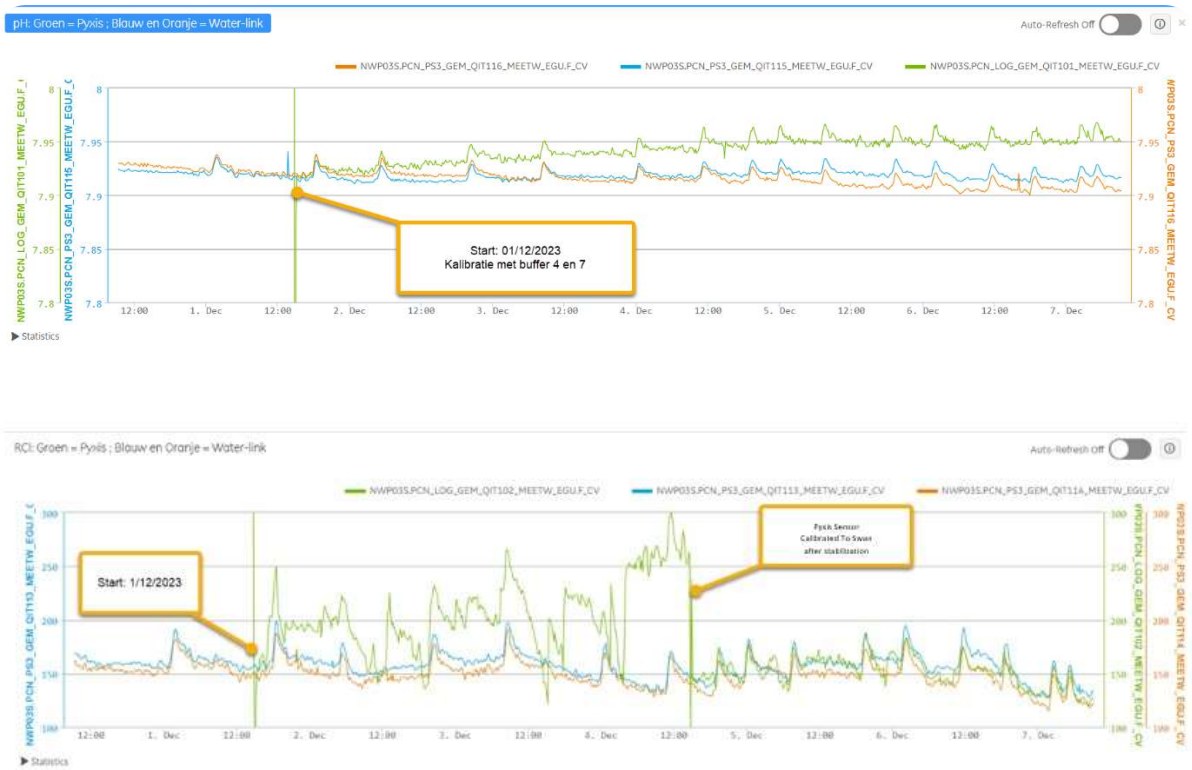


***Figure 2** – uPyxis 2.0 Mobile App for Wireless Sensor Diagnostics & Calibration.*



pH - Dependence

To investigate the possible pH dependence of the free chlorine measurement, we intentionally calibrated the pH error by calibrating a buffer 7 to 6. This resulted in a significant deviation in the pH measurement (7.01 instead of 7.98), while the free chlorine measurement remained consistent throughout the period, indicating that no significant influence by pH was observed.

Influence of Ammonium > Chloramines

There was concern that chloramines were measured along with free chlorine. If ammonium were/ are present in the drinking water, it is reacted away into chloramines. Some amperometric electrodes measure these chloramines along with it. This is obviously undesirable. To rule this out, we conducted an experiment in which drinking water was spiked with ammonium. We filled a 120L buffer vessel with drinking water. The buffer vessel was located about 6 meters above the setup to create sufficient pre-pressure. We spiked the buffer tank with drinking water with enough ammonium to convert much of the chlorine to chloramines. In the graph below, a clear decrease can be observed until finally reaching 18µg/L. Simultaneously, some manual measurements were performed (via DPD method). Despite the very low values, well below the reporting limit, the hand measurements still gave similar results 23µg/L and 29µg/L.

Note:
Y-axis as µg/L FCL. The influence of the presence of chloramines was ruled out.

Accuracy Verification

The accuracy of the sensor was checked using chlorine standards (Low range chlorine standard - Hach N026300) by making a solution of 40µg/L in a measuring cup as a measuring cell. The results showed minimal reaction of free chlorine at the electrode, indicating (as expected) that some sample flow was required for the electrode to provide accurate measurements. After consistent sample flow was established, the display gave a reading of 40µg/L ± 2µg/L, which was within the expected range. See below in graph.

***Note:**
Y-axis as µg/L FCL. Sensor reading stabilized at 40µg/L ± 2µg/L with sample flow of premade Low-Range Chlorine Standard – Hach N026300

ST-765SS Performance vs. Online DPD Measurement (Swan Ami Codes - II)

To compare the performance of the Pyxis ST-765SS-FCL sensor with traditional DPD measurements, a simultaneous measurement campaign was conducted at two different locations, over a month, using both the Pyxis sensor setup and the Swan Ami Codes-II to monitor drinking water.

1. Pump Station 3 at Notmeir: During the measurement period, the Pyxis ST-765SS-FCL sensor showed fluctuating residual chlorine values between 100-150µg/L, which was consistent with expectations for this location. These values were recorded simultaneously by the Swan Ami Codes-II, allowing a direct comparison between the sensors.

2. Headquarters in Antwerp: At this location, fluctuating residual chlorine values were again observed, albeit at a lower level of 20-100µg/L during the measurement period. Again, the Pyxis ST-765SS-FCL sensor proved capable of accurately detecting and recording these variations, which were consistent with the Swan Ami Codes-II findings.

Simultaneous measurements at both sites confirmed the consistent performance of the Pyxis ST-765SS-FCL sensor in monitoring residual chlorine levels in drinking water, with measured values matching well with those of the traditional DPD method. These findings highlight the reliability and effectiveness of the sensor in various operation environments within the water treatment industry.

Figure 4– *Swan Ami Code-II (2 each) versus Pyxis ST-765SS-FCL Sensor / FR-50 Flow Reservoir / Walchem i6*

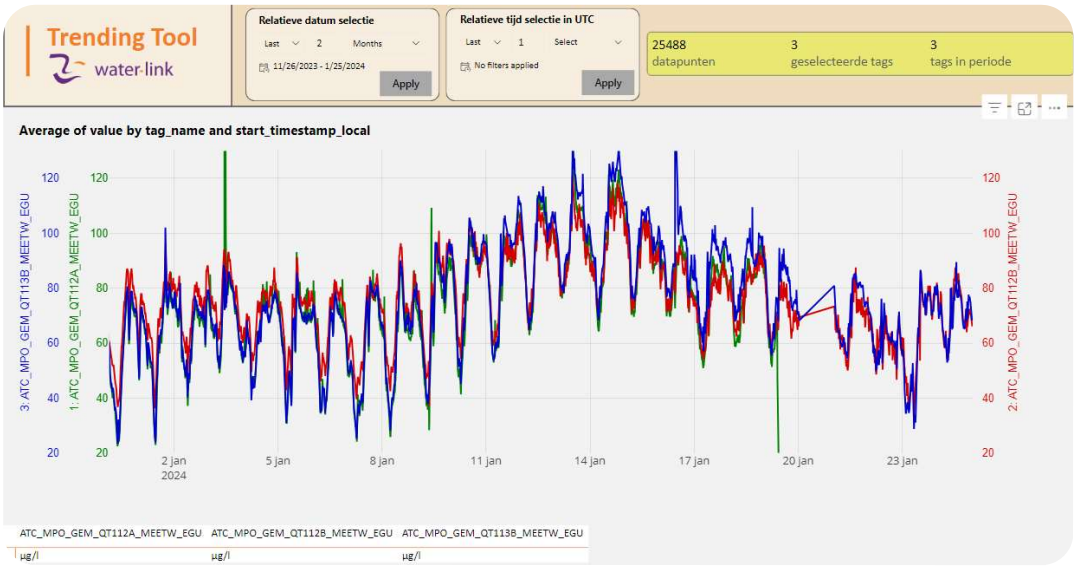
Pump Station 3

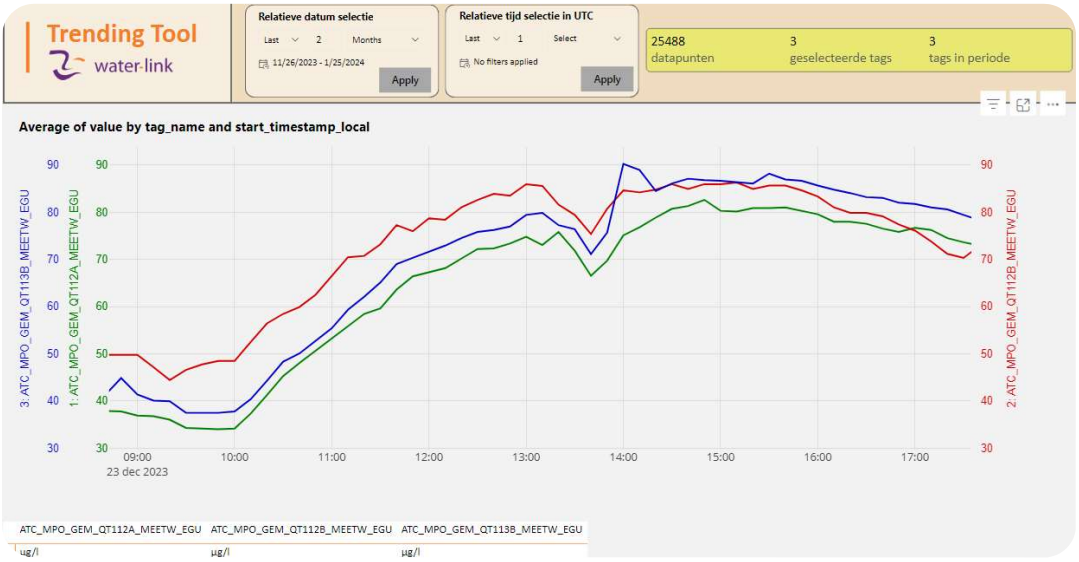
The green graph shows the Pyxis ST-765SS-FCL which was calibrated after 3 days of stablization on 4 December. The blue and orange indicate the dual SWAN setups.

Headquarters Antwerp

The green graph shows the Pyxis ST-765SS-FCL. The blue and red indicate the dual SWAN setups. The other ones indicate the SWAN setups.

Below the red graph shows the Pyxis ST-765. The blue and green indicate the dual SWAN setups.





Conclusion

Throughout the measurement period, the Pyxis ST-765SS-FCL probe was calibrated and cleaned only at the beginning of the evaluation period. (1-December-2023). No further maintenance procedures such as cleaning or calibration were performed. This contrasts with the Swan Ami Codes-II, which does require regular maintenance.

Nevertheless, the results of the Pyxis ST-765SS-FCL sensor showed excellent agreement with those of the Swan Ami Codes-II throughout the evaluation period. This indicates the robust and stable performance of the Pyxis ST-765SS series, even with minimal maintenance interventions.

These findings not only highlight the reliability of the Pyxis ST-765 series sensor, but also suggest that the sensor design and technology was well thought out and resulted in long-term stability and accuracy without frequent maintenance. This aspect of the sensor offers significant operational benefits, such as reduced maintenance costs, eliminated reagent costs and prevention of application non-conformance making it an attractive and affordable choice.

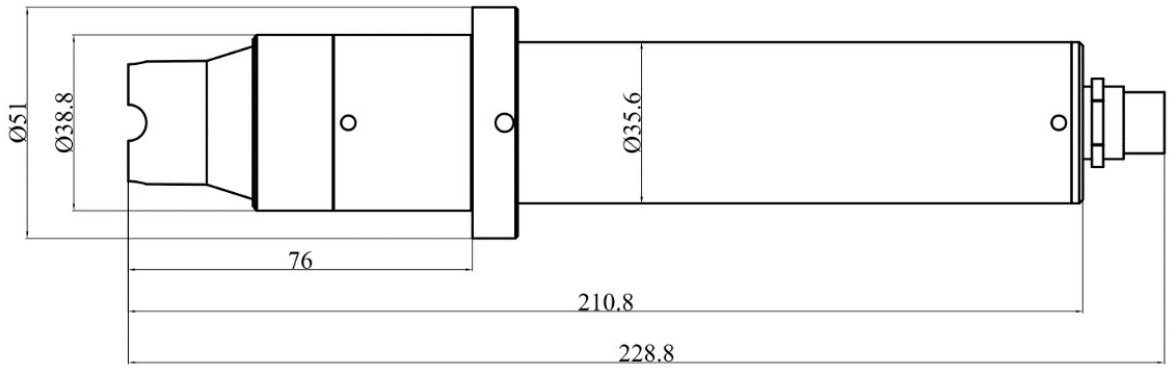
Sensor Specifications

Item	IK-765SS-FCL-B	IK-765SS-TCL	IK-765SS-CLO
P/N	42169	44074	42170
Sensor Body	304SS	304SS	304SS
Sensor Name	ST-765SS-FCL	ST-765SS-TCL	ST-765SS-CLO
Oxidizer Measured	Free Chlorine	Total Chlorine	Chlorine Dioxide
Oxidizer Range	0.00–5.00ppm		
Oxidizer Precision	± 0.01mg/L or 1% of the value w/pH compensation up to 9.0+		
pH Range	0–14		
pH Precision	±0.1pH		
FR-50			
Sample Inlet Pressure	7.25–30psi (0.05–0.2MPa)		
Installation	FR-50 Self-Regulating Flow Reservoir with Rotameter & PRV - Sold Separately		
Min. Flow Rate	600mL/minute		
Max. Flow Rate	1,800mL/minute		
Sample Inlet	1/4in - OD		
Sample Outlet	20mm - To Drain		
Overflow Outlet	20mm - To Drain		
Sewage Drain Outlet	1/2in - NPT		
Power Supply	22–26VDC, Power Consumption 2W		
Storage Temperature	-7–60 ºC (20–140 ºF)		
Outputs	Dual Isolated 4-20mA Outputs + RS-485 Modbus Digital Output		
Dimensions	8.3in (210.8mm) L, 1.4in (35.6mm) D		
Weight	530g (1.16lbs)		
Max. Sensor Pressure	100psi (6.9Bar) - Sensor Only		
Operating Temp.	4–49 ºC (40–120 ºF)		
Wet Material	UPVC		
Rating	IP67, Fully Dustproof & Waterproof		
Selectivity	Non-Selective, Cross Sensitive to other Oxidizing Species		
Compliance	EPA 334.0, ISO 7393		
Regulation	CE Marked / RoHS / UKCA		
Cables Included	MA-4.9CR Cable (8-PIN Adapters - 4.9ft), MA-1.5CR Cable (8-PIN Adapters, Flying Lead 1.5ft)		
Electrode Service Life	2 Years		
Electrode Warranty	6 Months		
Sensor Body Warranty	13 Months		

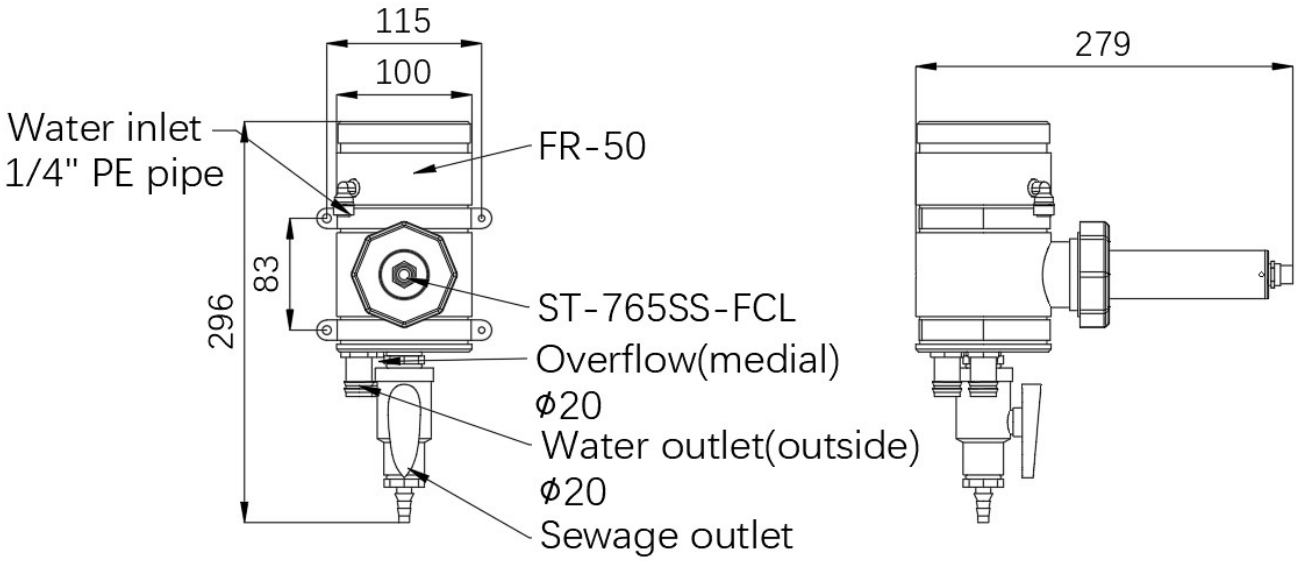
Order Information	Part Number
ST-765SS-FCL (Free Chlorine)	53607-NFR
ST-7665SS-TCL (Total Chlorine)	53616
ST-765SS-CLO (Chlorine Dioxide)	53608-NFR
FR-50 Flow Reservoir	50700-A01

Optional/Replacement Accessories Information	Part Number
EH-765 (Replaceable Electrode Head for ST-765)	53061
MA-CR Bluetooth® Adapter	MA-CR

Sensor Dimensions



Reservoir Dimensions



FR-50 Flow Reservoir Flow Path