OpreX™ Measurement

YOKOGAWA
Co-innovating tomorrow™

DO72-T Outperforms Leading Competitor Probe

Up to 3× better repeatability

For customers who require tight measurement control in the ppb range—such as power plants seeking to protect assets and manage corrosion risk—DO72-T offers a trusted, proven solution.

Background

Yokogawa released the DO71 and DO72 optical dissolved oxygen sensors in April 2023 to meet growing demand for lower maintenance dissolved oxygen measurement solutions. One of the primary applications for the trace-range DO72-T sensor is the power industry, where customers closely control dissolved oxygen levels in the steam-water cycle to help prevent corrosion in critical piping. In these power applications, dissolved oxygen is typically maintained below 5 ppb to support asset protection and reliable operation.

When DO72-T was first released, its accuracy and repeatability specifications were conservatively stated as +/- 3 ppb. While appropriately cautious, this specification did not fully align with stringent power industry requirements, where many customers aim to control dissolved oxygen between 3–6 ppb. In actual use, however, DO72-T has demonstrated accuracy much closer to +/- 0.5 ppb. To validate this real-world performance and provide customers with transparent, data-based specifications, Yokogawa conducted a field test comparing DO72-T to a competing sensor. Based on these results, Yokogawa has updated the published accuracy and repeatability specifications for DO72-T.

Field Test

The field test was carried out in the water shed of a power plant. The DO72-T sensor was installed in a K1598AC flow-through fitting on a boiler feedwater process line, in series with an optical dissolved oxygen probe from a competitor so that both devices measured the same process stream. A flow meter was added on the process line to manage and stabilize the flow rate to the two probes. The test ran continuously for seven weeks, from July 25, 2023, through September 14, 2023, under actual plant operating conditions.

Field Test Results Overview

Throughout the test, two data traces were recorded: the red trace represents the Yokogawa DO72-T measurement, and the blue trace represents the competitor probe. The unit was initially operated at a steady 15 ppb setpoint for several weeks, from July 25, 2023, through September 3, 2023, as shown in Figures 1 and 2. On September 3, a unit start-up occurred, producing a large spike in readings visible in Figures 3 and 4.

After this start-up event, oxygen injection remained off until September 4, when it was switched back on with a 15 ppb setpoint. On September 8, the setpoint was increased to 25 ppb and maintained for four days until September 12. On September 12, the unit was shut down and restarted multiple times with a 40 ppb setpoint, and these events are captured in the data range shown in Figure 4. It is important to note that the competitor probe was used to control all setpoints, so any offset of the DO72-T reading from the setpoints can reasonably be attributed to calibration differences rather than process control.

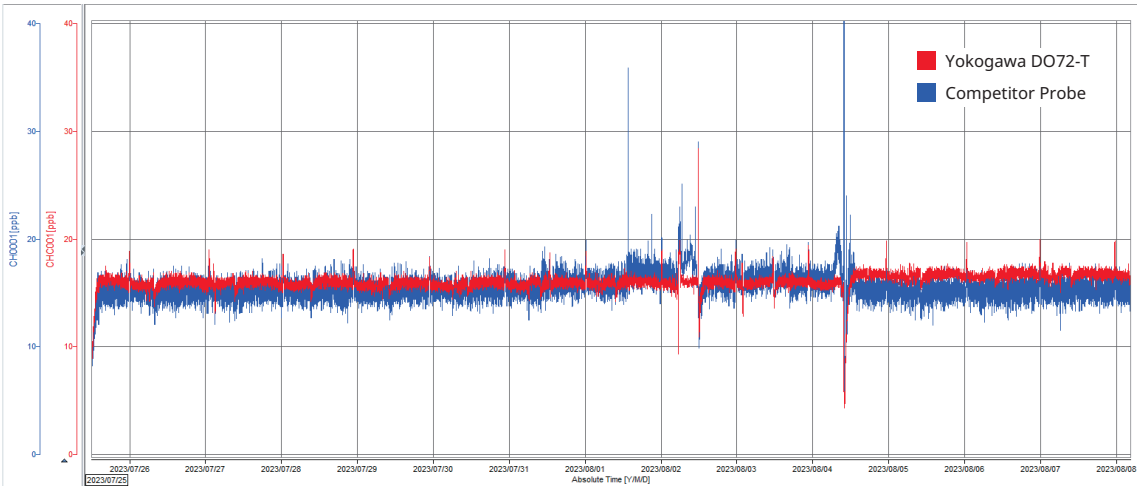

Figure 1. Data from 7/25/23 through 8/8/23. O2 setpoint at 15 ppb.

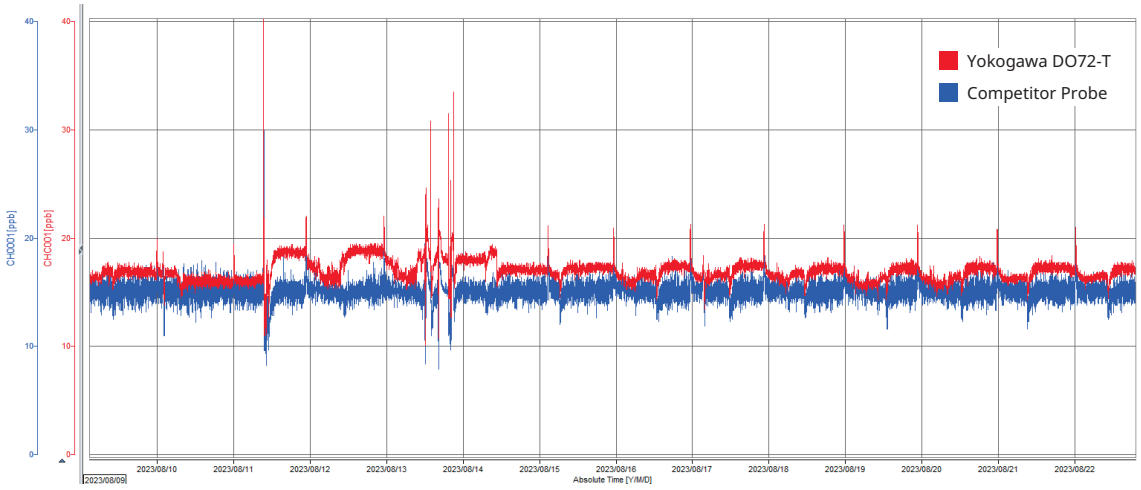

Figure 2. Data from 8/9/23 through 8/22/23. O2 setpoint at 15 ppb.

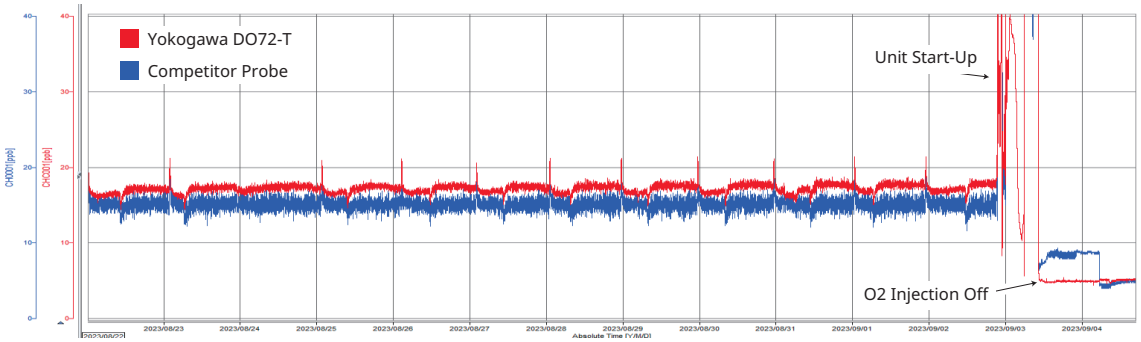

Figure 3. Data from 8/22/23 through 9/4/23. O2 setpoint at 15 ppb until unit startup on 9/3/23.

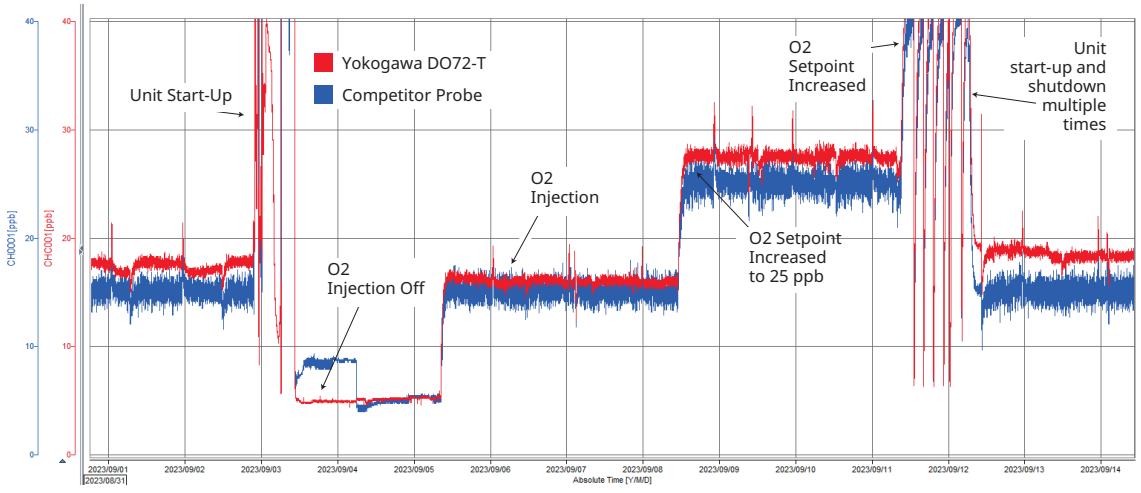

Figure 4. Data from 9/1/23 through 9/14/23.

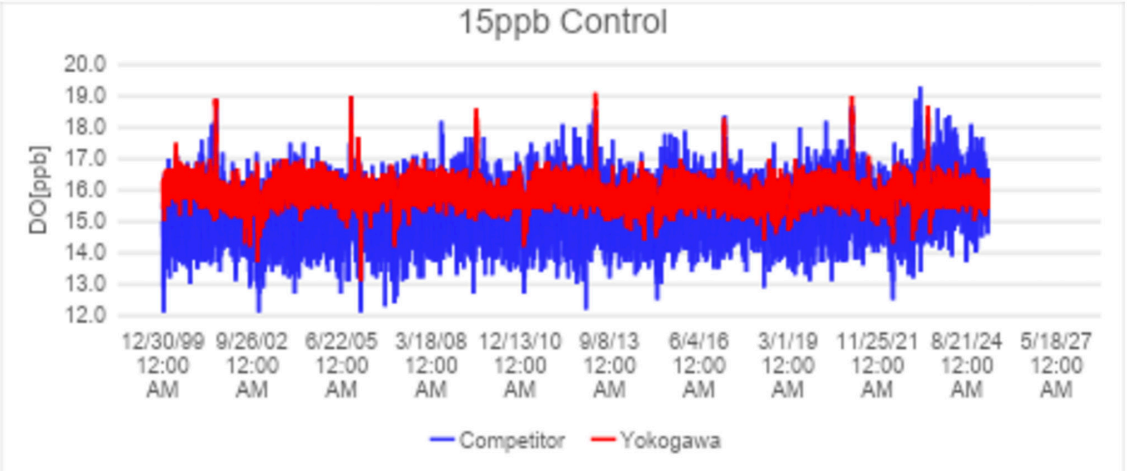

Figure 5. Graph of data used for 15 ppb control statistics.

Parameter	Yokogawa DO72-T	Competitor
Standard Deviation (95% Confidence Interval)	0.894 ppb	1.706 ppb
Standard Deviation (99.9% Confidence Interval)	1.502 ppb	2.865 ppb
Range	6.0 ppb	7.2 ppb

Table 1. 15ppb control statistics.

Another view of Yokogawa's performance relative to the competitor is presented in Figure 6. The lower measurement deviation in the DO72-T readings is clearly visible, and the smoother curve can be attributed to superior repeatability rather than artificial damping of the signal.

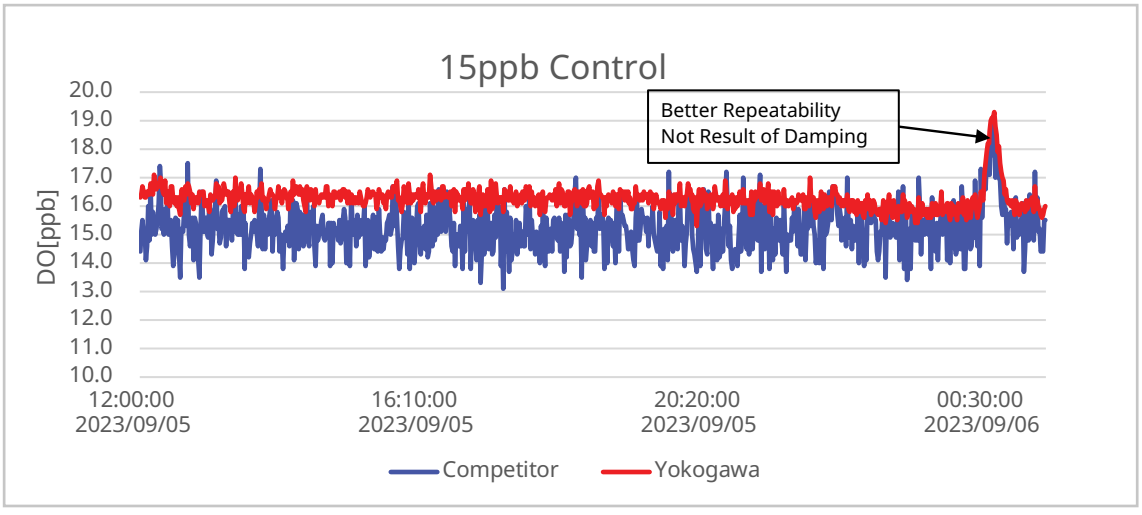

Figure 6. A closer look at 15 ppb control readings.

5 ppb Measuring Range Statistics

The same statistical approach was applied to a data set in a lower measuring range. Analysis of this low-range data yielded even more compelling results than the 15 ppb control. At the lower range, DO72-T exhibited a standard deviation of 0.421 ppb at a 99.9% confidence interval, compared to 1.182 ppb for the competitor probe. The DO72-T measurement range was only 0.6 ppb versus 1.6 ppb for the competitor, representing a 2.67 times smaller total range. This further highlights the superior reliability and stability of the DO72-T signal, especially at low measuring ranges where performance is most critical. The overall data graph and statistical comparison are shown in Figure 7 and Table 2.

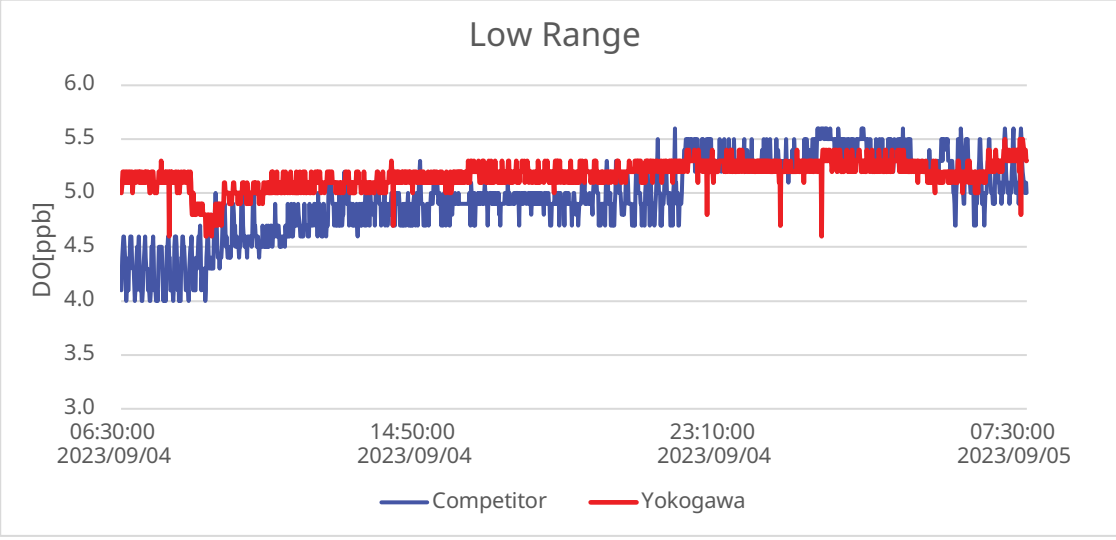

Figure 7. Low range graph.

Parameter	Yokogawa DO72-T	Competitor
Standard Deviation (95% Confidence Interval)	0.251 ppb	0.704 ppb
Standard Deviation (99.9% Confidence Interval)	0.421 ppb	1.182 ppb
Range	0.6 ppb	1.6 ppb

Table 2. Low Range Statistics

Step Changes

Another key observation from the trial is that DO72-T responded to step changes just as quickly as the competitor probe. As shown in Figure 8, the Yokogawa sensor closely tracks the competitor's readings during repeated changes to the setpoint. The rapid response, combined with the smoother trend, confirms that the reduced noise in DO72-T data is due to a more stable measurement, not signal damping or sluggish behavior.

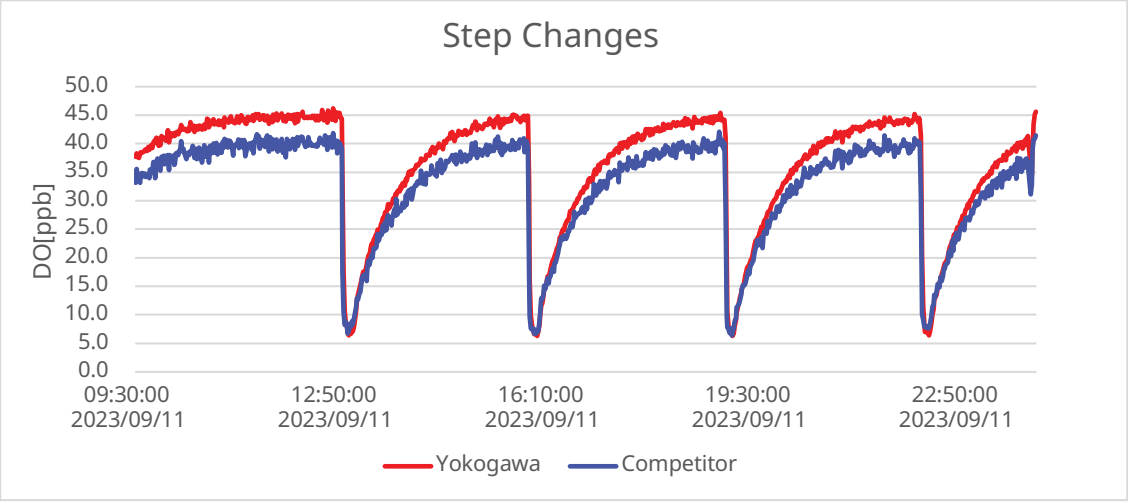

Figure 8. Graph of step change response for Yokogawa vs. competitor probe.

Limit of Blank Test

In addition to the field trial, a limit of blank (LOB) test was conducted at the Yokogawa Corporation of America factory to determine the lower limit of detection (LOD) for DO72-T. LOD is defined as the lowest concentration that can be distinguished from a blank sample. For this test, 99.99% pure nitrogen gas was passed through the K1598AC flow-through fitting with the DO72-T installed. A one-point zero calibration was performed using the same 99.99% pure nitrogen gas before collecting the LOB data. The test ran for approximately two hours, and data was captured using a GX20 data logger. Based on the empirical data, the LOD for DO72-T was calculated to be 0.382 ppb at a 99.9% confidence interval.

Calculated Specifications for DO72-T

Using the combined results from the field test and the limit of blank test, Yokogawa calculated new accuracy specifications for DO72-T at a 99.9% confidence interval. These results are summarized in Table 3, alongside the published specifications for the competitor probe. Statistical analysis of the field data suggests that the competitor's specifications are based on a 95% confidence interval.

Parameter	Yokogawa DO72-T	Competitor Published Specification
Accuracy	+/- 0.5 ppb or +/- 2% of reading, whichever is greater	+/- 0.8 ppb or +/- 2% of reading, whichever is greater
Repeatability/LOD	+/- 0.4 ppb	+/- 0.6 ppb

Table 3. Accuracy specifications of DO72-T (99.9% confidence interval) and competitor (assumed 95% confidence interval).

Conclusion

Beyond this primary field trial, two additional field evaluations were conducted in similar power applications to gather customer feedback. In these trials, customers reported that DO72-T delivered more stable and accurate readings than their existing measurement systems. They also noted the benefits of low maintenance and straightforward calibration associated with Yokogawa's optical technology compared to traditional galvanic and polarographic sensors. Each of these trials resulted in customers purchasing multiple DO72-T measuring loops to replace their installed systems, underscoring their confidence in the solution.

The Yokogawa DO72-T trace-range dissolved oxygen sensor is well suited for ppb-level applications. In practice, DO72-T significantly outperforms its original accuracy and repeatability specifications. When tested side-by-side in the same application, DO72-T also delivers accuracy and repeatability two to three times better than a leading competitor's optical dissolved oxygen sensor.

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