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dFFOZ-TR™
Trace Level Dissolved Ozone Sensor
User Manual

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General Precautions

WARNINGS:

1. Ozone (O_3) is a toxic gas. High concentrations of ozone are dangerous and harmful to humans. Take reasonable steps to avoid exposure. The current maximum 8-hour exposure limit for ozone is 0.1 ppm (according to U.S. OSHA).
2. Install appropriate safety monitoring equipment wherever high concentrations of ozone are used. Teledyne API (TAPI) manufactures several ozone monitors for workplace safety applications.
3. Materials in contact with high concentrations of ozone should be suitable for such use. 316L Stainless, Teflon™, Chemraz™ and Kynar™ are recommended.
4. When performing any maintenance to the unit, make sure all AC power is disconnected from the unit.
5. The ozone sensor contains an ultraviolet (UV) lamp. Never remove the lamp from its housing while the unit is powered on. Eye exposure to UV light is extremely dangerous.
6. Certain components may be hot to the touch. Please allow proper cooling time before working with these components.
7. Never attempt to open ozone catalyst canisters (if supplied). The content of the canisters can be hazardous if not handled properly.
8. Use only TAPI-recommended spare parts. Substitution parts could result in damage to the equipment, may create hazardous conditions and will void the warranty.

CAUTIONS:

1. Read the operating manual before operating the unit.
2. Do not subject the unit to extreme physical or thermal shock.
3. Use care in handling the unit and any of its components.

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Sensor Description

Teledyne API's IN USA-brand dFFOZ-TR sensor is designed for measuring dissolved ozone in a liquid solvent, typically water, at low concentrations to the ppb_W level. The sensor is installed and used in side stream configuration. For optimal operation the Flow and Pressure requirements are: 0.75 to 1.5 lpm at 15 to 20 PSIG, and fluid temperature of 10 to 30 ºC.

CAUTION!!!:

Do not exceed the maximum rated of 25 PSIG (40 PSIA)

The dFFOZ-TR is a state-of-the-art smart sensor incorporating innovative dual optical path technology to provide unparalleled performance. The dFFOZ-TR sensor must be connected to one of TAPI's Sensor Control Interface (series "SCI") units.

Calibration data is stored on-board the sensor in a non-volatile memory, making controller replacement easy.

The dFFOZ-TR sensor features 3 (three) hydraulic ports (¼" Bullkhead™ type fittings). The hydraulic ports are: the Sample Stream Inlet, the Reference Stream Inlet and the Outlet Stream. The electrical interface to the dFFOZ-TR is via a 16 position circular connector.

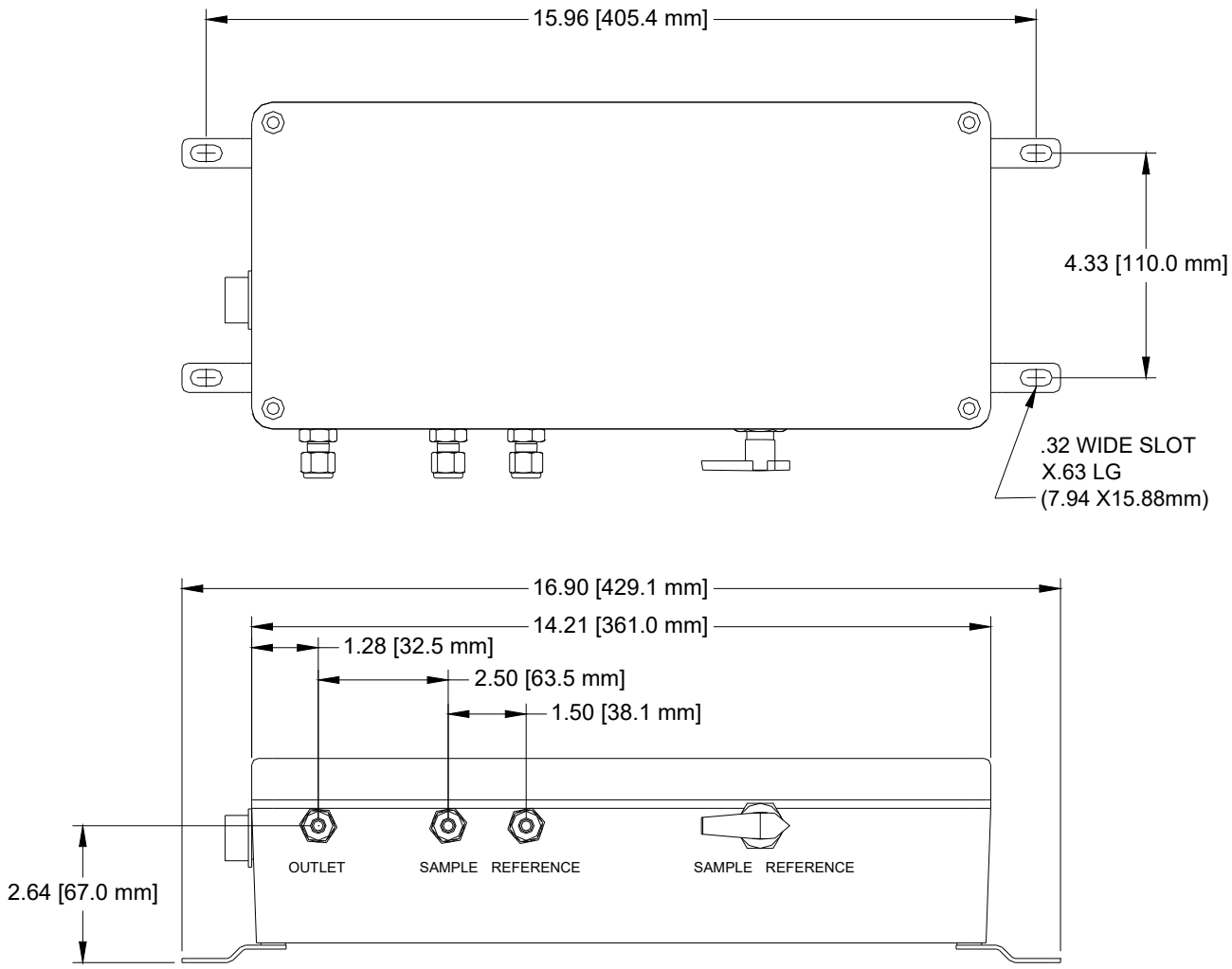

Figure 1: dFFOZ-TR, Dimensions and Mounting Hole Pattern

dFFOZ-TR Specifications

Measuring Principle	UV absorption; dual optical path sensing
Application	Continuous measurement of low concentrations dissolved ozone in liquid solvent
UV Light Source	Low pressure mercury vapor lamp
Units of Measure	PPB, PPM, MGL
Measuring Range	0-1,000PPB (Higher range units available)
Repeatability	3 ppb or 2% of reading (Higher performance units available)
Reference/Sample Flow	0.75 to 1.5 lpm
Reference/Sample Pressure	15-20 PSIG
Inlet/Outlet Ports	¼" Bulkhead Compression (Swagelok™)
Enclosure	NEMA 4X
Maintenance	UV lamp replacement every 12-24 months. No other scheduled maintenance

Installation and Connections

Mounting

The dFFOZ-TR sensor enclosure features drilled flanges for wall mounting of the unit. The hole pattern is shown in Figure 1. Use screws made of a material that is chemically compatible with the environment in which the sensor is being mounted.

The dFFOZ-TR should be mounted **vertically**, so that the electrical connector is located at the bottom (Refer to Figure 2).

Pneumatic Connections and Configuration

There are two Inlet ports and one Outlet port, all ¼" compression type (Swagelok™). Refer to Fig. 2 for installation requirements.

Recommended installation involves:

- Pressure Regulator for Sample Water
- Pressure Gauge for Sample Water
- Isolation Valve #1
- Pressure Regulator for Reference Water
- Pressure Gauge for Reference Water
- Isolation Valve #2
- Adjustable rotameter
- ¼" OD ozone compatible tubing (Teflon or Stainless Steel)

Follow the steps below to properly set-up for operation.

- Set Isolation Valves #1 and #2 to the OFF position.
- Connect the Reference Water source to Valve #1and the Sample Water source to Valve #2.
- Connect the outlet port of the rotameter to proper drainage.
- Open (fully c.w.) the valve in the adjustable rotameter
- Set the Pressure Regulators fully c.c.w.
- Using the Manual Selection Valve (in the dFFOZ-TR), select the SAMPLE position.
- Set Sample Isolation Valve #2 to the OPEN position.
- Adjust the Sample Pressure Regulator until the pressure read on the Sample Pressure Gauge is 15 to 20 PSIG (30 to 35 PSIA). Make sure that the reading in the Sample Pressure Gauge does not exceed 25 PSIG (40 PSIA).
- Adjust the valve in the Rotamenter to obtain a reading of ≈ 1.0 liter per minute (lpm).
- Using the Manual Selection Valve (in the dFFOZ-TR), select the REFERENCE position.
- Set Reference Isolation Valve #1 to the OPEN position.
- Adjust the Reference Pressure Regulator until the pressure read on the Reference Pressure Gauge is 15 to 20 PSIG (30 to 35 PSIA)
- Observe the flow rate indicated on the rotameter, and adjust the Reference Pressure Regulator to obtain a flow rate value in the 0.75 to 1.5 lpm. Make sure that the reading in the Reference Pressure Gauge does not exceed 25 PSIG (40 PSIA)
- To avoid leaks, tighten the compression fittings per the manufacturer's recommendation.
- To connect to the Controller:
    - Power OFF the Controller
    - Connect the factory provided Sensor-Controller cable to both the dFFOZ-TR and the Controller console
    - Power ON the Controller

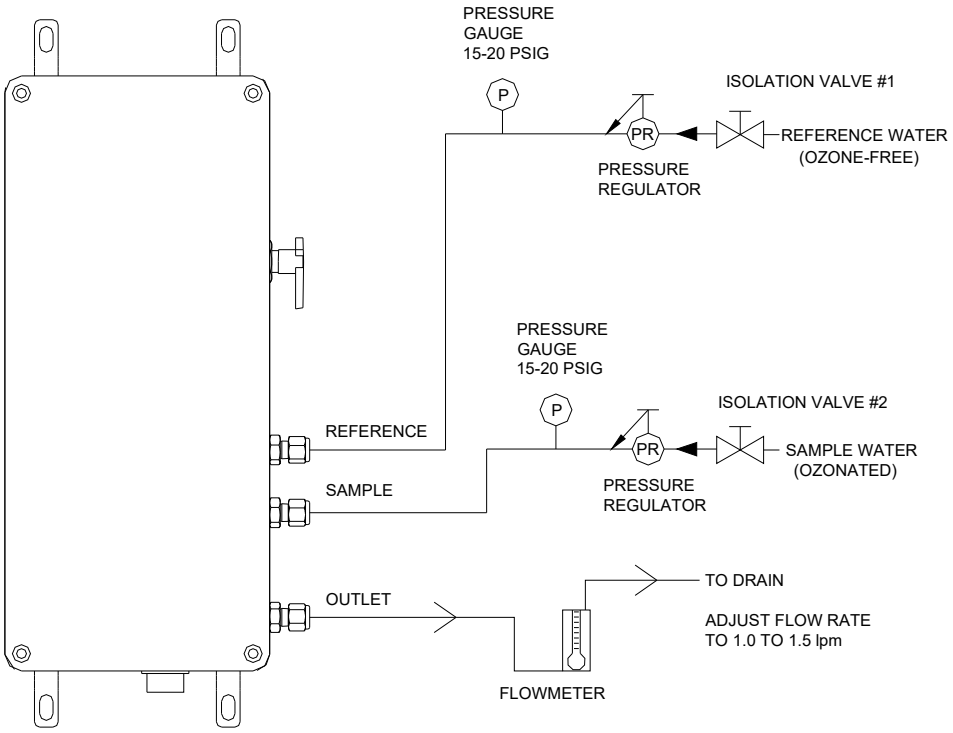

Figure 2: Recommended Mounting and Connection Configuration

Purging the sensor

Prior to Zeroing, the optical chamber of the dFFOZ-TR sensor has to be flushed from any ozone residues by using ozone-free DI. The ozone-free DI water is introduced to the optical cell by *manually* setting the Selector Valve to the Reference position.

Electrical Connections

The dFFOZ-TR sensor must be connected to a TAPI Mini SCI-N series controller. The connection to the dFFOZ-TR is through an environmentally sealed receptacle located on the sensor (see Figure 3). This connection provides power and communication links to the sensor.

NOTE: Always power down the system prior to connecting or disconnecting a dFFOZ-TR sensor to/from the SCI controller

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ELECTRICAL CONNECTOR
(REFERENCE ONLY)

Figure 3: dFFOZ-TR Electrical Connector

Operation

Initial Power-on and Warm-up

In order to achieve maximum performance and stability, it is ***recommended to allow an overnight warm up period on initial startup or on a "cold" start.*** This warm up period should preferably be done while **ozone-free** DI water is flowing through the dFFOZ-TR. After this warm up period, the unit can be zeroed as explained below.

NOTE: It is recommended that the sensor be powered on at all times (24 hours/day, 7 days/week). This will insure peak performance, minimal zero drift, and maximum system life.

Zeroing the Sensor

Because of its advanced design, the dFFOZ-TR is a highly zero-stable instrument. However, as with any similar device, the sensor must be zeroed periodically with an ozone-free reference fluid.

Zeroing always involves the following phases:

Table 1: Zeroing Phases

Phase	Purpose
Purging with ozone-free reference water	To get rid of dissolved ozone inside the optical chamber prior to zeroing
Parameter Adjustments	To make internal parameter adjustments to reflect the true zero of the sensor

Manual zeroing is initiated (after purge) through the model SCI controller, either remotely via the RS232 link or locally from the front panel via the keypad. Please refer to the SCI controller operating manual for more details.

On start-up, the unit should be warmed up and purged with a reference (ozone-free) water overnight prior to zeroing. Thereafter, if the unit is operating continuously, a reference fluid purge of about 5 minutes is adequate.

Maintenance

The dFFOZ-TR sensor is designed to operate continuously with minimal maintenance requirements. Only the UV lamp will need to be replaced on a periodic basis (every 12-24 months). Lamp replacement does not change calibration.

Removing the Sensor Cover

The UV lamp can be replaced without interrupting the flow of water through the sensor.

REMINDER: SAFETY FIRST!! Before doing any maintenance, turn off the power to the Mini SCI-N and disconnect the cable from the sensor. These simple steps protect the user from inadvertent harm due to electric shock or exposure to UV light.

Accessing the UV Lamp

WARNING: The UV Lamp housing is heated and therefore can be hot to the touch.

Once the cover is removed as described above, unplug the lamp and slide it up and out of its housing by loosening the lamp set-screw (see Figures 4 and 5 below). To re-install the lamp, follow these steps in reverse order.

NOTE: Some lamps may have marks indicating the preferred rotational position. If so, install the lamp accordingly.

Once a new UV Lamp is installed and the dFFOZ-TR is warmed up for at least 6 hours, perform a Zero operation and NORMALIZE the Lamp Index. Refer to the SCI Controller Manual for detailed instructions on how to normalize the Lamp Index

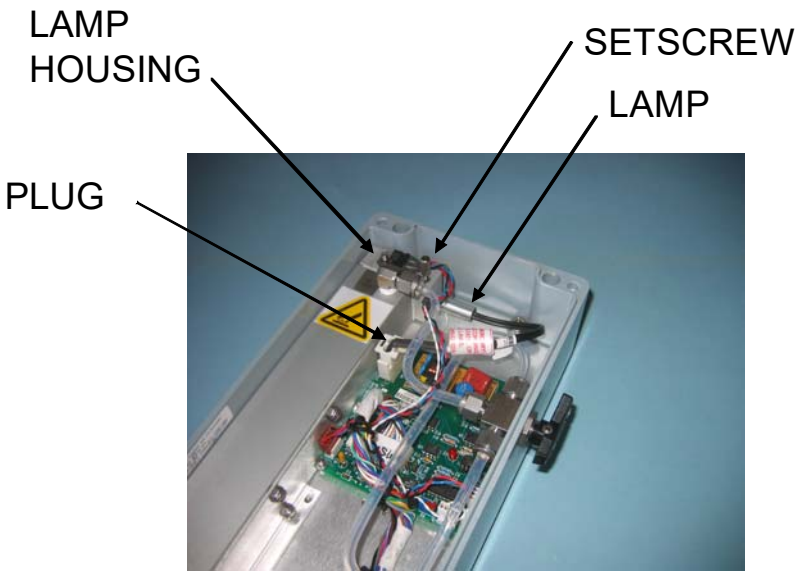

Figure 4: dFFOZ-TR, UV Lamp Location

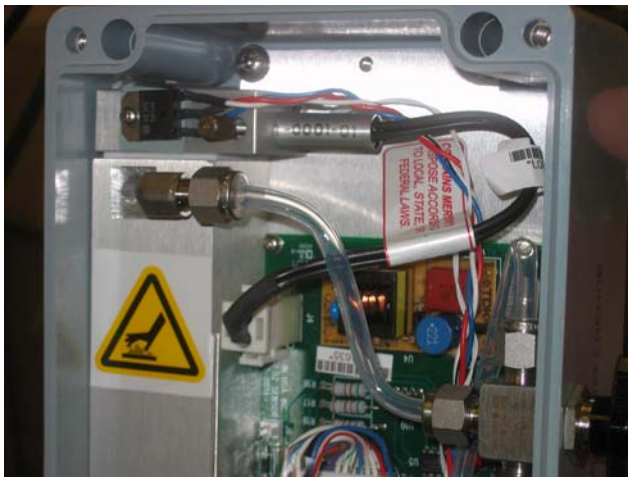

Figure 5: dFFOZ-TR, UV Lamp Access

Contacting Teledyne API (TAPI)

TAPI technical and service personnel are ready to help and can be reached by mail, e-mail, telephone, or fax.

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