The system shall be Royce Technologies SERIES 8000 Multi-Parameter and Multi-Channel, Channel Dissolved Oxygen and Suspended solids Analyzer with a compatible Royce Technologies Suspended Solids and Dissolved Oxygen sensor. It shall consist of at least four major parts for monitoring Dissolved Oxygen on a continuous basis in wastewater treatment plants & similar applications.

1. The Monitor
2. The Sensors
3. The Mounting Hardware
4. The Electrolyte and Membranes

THE MONITOR

The monitor shall have a power input of 115, or 230 VAC 50/60Hz or 24VDC. The monitor shall be housed in a polycarbonate NEMA 4X enclosure with brackets for wall or standard round handrail mounting. It shall have a 20 character, 4-line LCD backlit display controlled by microprocessor circuitry.

Model 8120 - For one DO (not Model 96A) and one TSS sensor.
Model 8130 - For two DO (not Model 96A) and one TSS sensor or two TSS sensors and one DO sensor (not Model 96A)
Model 8140 - For two DO (not Model 96A) and two TSS sensors..

DISSOLVED OXYGEN

For DO measurement, the monitor shall NOT require any charts or manual inputs of any kind to determine the Dissolved Oxygen or to calibrate the system. All program memory and features of the instrument will be unaffected by power interruptions and will not require any type of battery backup. All run, programming, and calibration functions shall be accessible without having to open the enclosure.

The monitor shall have the following general electronic capabilities:

1. A four line backlit display that continuously displays the DO being monitored.
2. An easy to follow, menu driven, instrument setup on a four line backlit display.
3. One button air calibration or in-situ calibration (to a known value), selectable by program mode.
4. Unit will display parts per million dissolved oxygen with one decimal place for readings greater or equal to 10.0 ppm and two decimal places for readings less than 10.0 ppm
5. Programmable to display percent of saturation.
6. Sensor and analyzer self-diagnostics
7. Either two isolated analog 4 to 20 milli-amp outputs for dissolved oxygen and temperature or an RS485 serial communication port and an optional Profibus PA or DP protocol.
8. Two programmable relays with unlimited individual programmable hysteresis on each.

The monitor shall have built in self-diagnostic functions, which at least will include:

In the Operate Mode: Specific error messages indicating:

1. Higher or lower than normal sensor output voltage.
2. Temperature input outside the 0 - 50 Degree Centigrade range.
3. The instrument's circuitry is unstable, drifting with time.

In The Air Calibration Mode: Specific error messages indicating:

1. The temperature of the sensor was not found to be stable after a 5 minute wait.
2. The D.O. output of the sensor was not found to be stable after a 5 minute wait.
3. The output level of the sensor is too weak.

The monitor shall have the following specific programming capabilities:

1. Type of calibration method.
   A. In Air.
   B. In situ to a known value without removing sensor.
2. Elevation offset above sea level in 500 foot increments up to 10,000 feet.
3. Constant salinity value offset programmable from 0 to 45 parts per thousand.
4. Membrane thickness in .5 mil increments. Instrument to automatically adjust for the diffusion rate of oxygen through the membrane for the sensed temperature during air calibration.

SENSOR OPTIONS

MODEL 95A  (Field Rechargeable Type)

The sensor shall be Royce Technologies MODEL 95A. It shall be a self-generating, galvanic cell type having a Platinum Cathode and lead anode. It shall have a zero output, repeatable at zero D.O. The probe shall be of the membrane type, utilizing a one to five mil Teflon membrane and shall be equipped with a thermistor circuit providing continuous, automatic,
active temperature compensation in the range from 0 to 50 degrees centigrade. The sensor shall be constructed of polyurethane, epoxy, non-corrosive metal parts and supplied with a specified length of polyurethane jacketed cable. The membrane, electrolyte and lead anode shall be field replaceable if required.

MODEL 99  (Replaceable Cartridge Type)

The sensor shall be Royce Technologies MODEL 99 or approved equal. It shall be a self-generating, galvanic cell type. It shall have a zero output, repeatable at zero D.O. The probe shall be of the membrane type, utilizing a one or two mil Teflon membrane and shall be equipped with a thermistor circuit providing continuous, automatic, active temperature compensation in the range from 0 to 50 degrees centigrade. The sensor will be made in two parts: (1) the backshell, which contains the thermistor and sensor connection electronics; and (2) the Cartridge, which is disposable once it has reached its normal life expectancy of one year. The cartridge shall not have a shelf life prior to being placed in service. The cartridge shall be replaceable into the back shell without the use of any tools.

THE DO SENSOR ELECTROLYTE AND MEMBRANES

Each system (Monitor & Sensor) supplied with the MODEL 96A shall also be supplied with at least 24 replacement membranes and 16 ounces of the gelled electrolyte solution.

THE DO SENSOR MOUNTING HARDWARE

The mounting hardware shall be either Royce Technologies STANDARD design or similar method for mounting the sensor at least a fifteen degree angle off the handrail, perpendicular in the tank. All the components shall be either anodized aluminum or 316 stainless steel.

SUSPENDED SOLIDS

For Suspended Solids the monitor shall be capable of operating any one of the Royce Suspended Solids sensors. The system shall be capable of being calibrated to a known value without removing the sensor from the process. The system shall be capable of being calibrated to a known value without removing the sensor from the process.

The analyzer shall have the following minimum features:

1. An alphanumeric LCD backlit display of 20 characters and 4 lines. This display shall be visible without opening the analyzer cover and shall have the capability of displaying:-
   
   A. The reading in either milligrams per liter or density percentage as applicable.
   B. Individual Menu driven text "Help Screens" for each program parameter.
C. Individual "Help Screens" for each step of the calibration process.
D. Error messages for the self-diagnostic functions.

2. The analyzer shall have built in self-diagnostic features to alert:
   A. Sensor light detector failure.
   B. Abnormal conditions during calibration.
   C. Internal program failure.

3. The analyzer shall have built in "Test" features including:
   A. Constant current output on demand for the 4 and 20 milliamp output.
   B. Relay activation test parameter to latch and unlatch the relays on demand.

4. Two individually programmable SPDT relays rated Form C, 10 amps resistive.
5. A 4 - 20 mA isolated output. Completely programmable by the end user. The zero and span values can be set individually across 100% of range of sensor.
6. A Digital Serial RS-485 Interface
7. Optional Profibus DP communication protocol.
8. The analyzer shall be Auto-Ranging.
10. Automatic color compensation for the Models 73B and 73P.
11. Automatic ambient light compensation for the Model 72A sensor.

SENSOR OPTIONS

The Model 72A Low Range Sensor:-

The Model 72A Sensor shall contain the light source and photo detector. It shall be automatically compensated for ambient light conditions and have the following minimum specifications.

Type: Single-gap optical light absorption sensor.
Range: 0 – 20 mg/l up to 0 - 1500 mg/l
Accuracy: +/- 5% of reading or +/- 3 mg/l, (1.0 NTU), whichever is greater.
Repeatability: +/- 1% of reading or +/- 2 mg/l (0.5 NTU), whichever is greater.
Resolution: 1 mg/l
Temperature Limit: 0-50 Deg. C.
Pressure: 0-50 PSIG
Cable Termination: Tinned Ends or connector for quick disconnect.
Cleaning: Air or Water Jet included. Self contained air or house air/water to be specified.
Mounting: Brackets included to mount to Standard two-inch diameter handrail or as required. The sensor mounting shall be slip fit 1-1/2" PVC pipe. This is to match a suitable length of pipe supplied by the installer.

**The Model 72P Low Range Pipe Insertion Sensor:**
The Model 72P Sensor shall contain the light source and photo detector. It shall be automatically compensated for ambient light conditions and have the following minimum specifications.

- **Type:** Single-gap optical light absorption sensor.
- **Range:** 0 – 20 mg/l up to 0 - 1500 mg/l
- **Accuracy:** +/- 5% of reading or +/- 2 mg/l, (1.0 NTU), whichever is greater.
- **Repeatability:** +/- 1% of reading or +/- 2 mg/l (0.5 NTU), whichever is greater.
- **Resolution:** 1 mg/l
- **Temperature Limit:** 0-50 Deg. C.
- **Pressure:** 0-20 PSIG
- **Flow:** 800 GPM to Drain (Not to exceed 20 PSI)
- **Cable Termination:** Tinned Ends or connector for quick-disconnect.
- **Cleaning:** Air or Water Jet included. Self contained air or house air/water to be specified.

Mounting: Sensor Incorporates 3” ANSI Flange.

**The Model 73B Medium Range Sensor:**
The Model 73B Sensor shall contain the phased array light source, and photo detector. It shall be completely submersible. It shall be air or water jet self-cleaning with automatic color compensation and have the following minimum specifications.

- **Type:** Single-gap optical light absorption sensor.
- **Range:** 0 – 400 mg/l up to 0 - 30,000 mg/l, or 0 – 3.00%
- **Accuracy:** +/- 5% of reading or +/- 50 mg/l, whichever is greater.
- **Repeatability:** +/- 1% of reading or +/- 20 mg/l whichever is greater.
- **Temperature Limit:** 0-50 Deg. C.
- **Pressure:** 0-50 PIG
- **Cleaning:** Air or Water Jet included. Self contained air or house air/water to be specified.
- **Cable Termination:** Tinned Ends or connector for quick disconnect.

Mounting: Handrail Brackets included to mount to Standard two-inch diameter handrail or as required. The sensor mounting shall be slip fit 1-1/2" PVC pipe. This is to match a suitable length of pipe supplied by the installer.
The Model 73P Low Range Pipe Insertion Sensor:

The Model 73P Sensor shall contain the phased array light source, and photo detector. It shall be air or water jet self-cleaning with automatic color compensation and have the following minimum specifications.

- Type: Single-gap optical light absorption sensor.
- Range: 0 – 400 mg/l up to 0 - 30,000 mg/l, or 0 – 3.00%
- Accuracy: +/-5% of reading or +/- 50 mg/l, whichever is greater.
- Repeatability: +/-1% of reading or +/- 20 mg/l whichever is greater.
- Temperature Limit: 0-50 Deg. C.
- Pressure: 0-20 PIG
- Flow: 800 GPM to Drain (Not to exceed 20 PSI)
- Cable Termination: Tinned Ends or connector for quick-disconnect
- Cleaning: Air or Water Jet included. Self contained air or house air/water to be specified.
- Mounting: Sensor Incorporates 3” ANSI Flange.

The Model 74A High Range In-Line Sensor:

The Model 74A Sensor shall contain the light source, photo detector, and self-cleaning actuator mechanism. It shall be self-cleaning with the following minimum specifications.

- Type: Single-gap optical light absorption sensor.
- Range: 0 – 3,000 mg/l up to 0 - 80,000 mg/l or 0 – 8.00%
- Accuracy: +/-5% of reading or +/- 150 mg/l, whichever is greater.
- Repeatability: +/-1% of reading or +/- 30 mg/l whichever is greater.
- Temperature Limit: 0-50 Deg. C.
- Pressure: 0-50 PIG
- Cleaning: Air or Water Jet included. Self contained air or house air/water to be specified.
- Cable Termination: Tinned Ends or connector for quick disconnect.
- Mounting: Shall be into a pipe through a two-inch female NPT saddle or similar arrangement provided by the installer. A two-inch male NPT insertion nipple shall be provided as part of the sensor assembly.

The Model 75A Medium/High Range Sensor:

The Model 75A Sensor shall contain a light source, and photo detector. It shall be completely submersible. It shall be air or water jet self-cleaning and have the following minimum specifications.

- Type: Single-gap optical light absorption sensor.
- Range: 0 – 2,000 mg/l up to 0 - 50,000 mg/l or 0 – 5.00%
- Accuracy: +/-5% of reading or +/- 100 mg/l, whichever is greater.
Repeatability: +/- 1% of reading or +/- 20 mg/l whichever is greater.
Temperature Limit: 0-50 Deg. C.
Pressure: 0-50 PSIG
Cleaning: Air or Water Jet included. Self contained air or house air/water to be specified.
Cable Termination: Tinned Ends or connector for quick disconnect.

Mounting: Brackets included to mount to Standard two-inch diameter handrail or as required. The sensor mounting shall be slip fit 1-1/2" PVC pipe. This is to match a suitable length of pipe supplied by the installer.

**The Model 76A Medium Range In-Line Sensor:**

The Model 76A Sensor shall contain the light source and photo detector. It shall be completely submersible. It shall be air or water jet self-cleaning and have the following minimum specifications.

- **Type:** Single-gap optical light absorption sensor.
- **Range:** 0 – 400 mg/l up to 0 - 30,000 mg/l  0 – 3.00%
- **Accuracy:** +/- 5% of reading or +/- 150 mg/l, whichever is greater.
- **Repeatability:** +/- 1% of reading or +/- 30 mg/l whichever is greater.
- **Temperature Limit:** 0-50 Deg. C.
- **Pressure:** 0-50 PSIG
- **Cable Termination:** Tinned Ends or connector for quick disconnect.
- **Cleaning:** Air or Water Jet included. Self contained air or house air/water to be specified.

Mounting: Shall be into a pipe through a two-inch female NPT saddle or similar arrangement provided by the installer. A two-inch male NPT insertion nipple shall be provided as part of the sensor assembly.

**JET CLEAN SELF-CLEANING**

All Royce sensors can be supplied with an optional Jet self-cleaning. This cleaning can operate from plant air or water of at least 30 PSI with a maximum of 60 PSIG for Immersion sensors and 20 PSIG greater than line pressure for in-line sensors. Simply specify the Jet Self-Cleaning assembly. If plant air or water is not available, Royce can supply a complete self-contained compressor package MODEL JC-1, JC-2 or JC-4, that can be supplied to clean up to 4 individual sensors, each individually programmed. The solenoid or compressor package shall be operated by the Royce instrument for the sensor being cleaned to deliver an air or water jet blast across the sensor optics at timed intervals.

- **Type:** Air Compressor, high volume, high pressure.
- **Pressure Supplied:** 40 to 60 PSIG.
- **Channels:** 1-2 or 4 channels.
Temperature Limits: 0 to 50° C.
Enclosure: NEMA 4X, (2 – sizes) 14” x 12” x 6”D.
Input Power: 115/230VAC, 60/50 Hz, 325 Watts
Options: Heater (Recommended for –10° C).
Mounting: Royce Rail Mounting Kit