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# **ANTI-DEGRADATION STUDY QUALITY ASSURANCE SAMPLING PLAN**

## **PLUMSTED TOWNSHIP WASTEWATER TREATMENT FACILITY WITH DISCHARGE TO THE CROSSWICKS CREEK PLUMSTED TOWNSHIP, OCEAN COUNTY, NEW JERSEY**

**APRIL 29, 2011**

REVISED  
JUNE 14, 2011  
JUNE 27, 2011  
JULY 1, 2011  
JULY 7, 2011  
JULY 15, 2011  
JULY 18, 2011

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PROPOSED PLUMSTED TOWNSHIP  
WASTEWATER TREATMENT FACILITY

ANTI-DEGRADATION STUDY  
QUALITY ASSURANCE SAMPLING PLAN

Applicant:

Ronald Dancer, Mayor  
Township of Plumsted

Signature

date

Michael McCue; Chairman  
Township of Plumsted Municipal Utilities Authority

Signature

date

Peter Ylvisaker; Executive Director  
Township of Plumsted Municipal Utilities Authority

Signature

date

Project Officer:

Gregg W. Barkley, P.E.  
Van Cleef Engineering Associates

Signature

date

QA Officer:

Christopher B. Jepson, P.E.  
Van Cleef Engineering Associates

Signature

date

NJDEP:

Jason T. Lonardo, Principal Environmental Specialist  
Bureau of Surface Water Permitting

Signature

date

Amy Bowman  
Mare Forko, Research Scientist 3  
Office of Quality Assurance

Signature

date

1. PROJECT NAME: Township of Plumsted Proposed Wastewater Treatment Facility, Discharge to the Crosswicks Creek
2. PROJECT REQUESTED BY: Township of Plumsted Municipal Utilities Authority
3. DATE OF REQUEST: April 1, 2011
4. DATE OF PROJECT INITIATION: April 1, 2011
5. PROJECT OFFICER; Gregg W. Barkley, P.E.
6. QUALITY ASSURANCE OFFICER: Christopher B. Jepson, P.E.
7. INTRODUCTION/PROJECT NEED  
(from Plumsted MUA recommendation to the Plumsted Twp. Committee)

The Redevelopment Plan adopted by the Township Committee in 2004 as amended in 2005 provides the mechanism for the Township to realize a coordinated program of redevelopment and rehabilitation in the area of New Egypt designated by the State of New Jersey as our Town Center. The purpose of the Redevelopment Plan is to provide a more vibrant, culturally interesting and attractive downtown to serve as a growth center to retain and attract new businesses and shoppers from within Plumsted and its surrounding environs. At the heart of the Redevelopment Plan is the need to provide sewer service and to expand water supply to support the revitalization effort. Among the stated goals and objectives of the Redevelopment Plan for the sewerage of the New Egypt Town Center (NETC) are to: 1) create a public sewer system within the Town Center to address public health and welfare issues caused by failing, inadequate or improperly designed septic systems or cesspools; and 2) to reverse the significant ongoing economic decline of the downtown as the direct result of the absence of public sewer.

The provision of public sewer is required to remove the economic barriers to new and expanded growth and to improve the environmental quality of the Crosswicks Creek. Most of the downtown is within the 100 year flood hazard area of the Crosswicks Creek. The related shallow depth to groundwater and small lot sizes make it difficult to support and sustain septic systems and cesspools. Approximately 60% of existing septic systems and cesspools pre date 1969 when Ocean County began keeping records. As such, most of the septic systems and cesspools are old and will require in the future significant and costly

repair or replacement. Added to this, many of the existing buildings were created before current health codes that would have required much larger lot sizes. In fact, it is likely that downtown New Egypt and much of the surrounding environs as it exists today would not have been permitted at anywhere near the existing density if modern health codes and zoning had been in place at that time without a public sewer system. The provision of public sewer will provide an economic boost to the downtown, support the “Smart Growth initiative for Plumsted Township” by channeling growth to the NETC and will eliminate the costly need for the repair or replacement of failing septic systems and cesspools. For these reasons, the provision of public sewer in the NETC continues to be a high priority for Plumsted Township and the PMUA.

To fund the sewer improvements, the Township hoped to utilize the Redevelopment Plan to enable a public/private partnership with a designated redeveloper(s) to pay for the sewer infrastructure. In the absence of a PRRC, or to stimulate re interest in a PRRC or other private reinvestment, the Township has the option to publicly finance the sewer infrastructure improvements through bonds issued by the New Jersey Environmental Infrastructure Trust.

## 8. PROJECT DESCRIPTION

### A. PURPOSE

The purpose of this sampling plan is to characterize ambient water quality of the Crosswicks Creek at the proposed discharge location of a new sanitary wastewater treatment facility. In addition, the plan includes the monitoring to be conducted to satisfy the data needs associated with modeling the future dissolved oxygen (DO) impacts of the proposed discharge.

### B. PROPOSED FACILITIES

A site has been identified as a potential location for the wastewater treatment facility. This site is located on County Route 537 where it crosses over the Crosswicks Creek. Although this site is located approximately 1¼ miles from the New Egypt Town Center, its location appears well suited for wastewater treatment and disposal due to its proximity to the county road for access and the Crosswicks Creek for discharge. The site is located in an area zoned for commercial/industrial uses with only two (2) residential properties located within ¼ mile of the proposed wastewater treatment facility.

### C. STREAM CLASSIFICATION

The Crosswicks Creek is classified by the NJDEP as a Fresh Water Category 2 – Non Trout stream (FW2-NT) for its entire length. As such its designated uses are:

1. Maintenance, migration and propagation of the natural and established biota

2. Primary contact recreation
3. Industrial and agricultural water supply
4. Public water supply after conventional filtration treatment
5. Any other reasonable uses

#### D. DATA USAGE

The data collected during this study will be used in addressing the anti-degradation provisions at N.J.A.C. 7:9B-1.5(d) associated with the proposed discharge. Utilization of this data will include

1. Characterization of existing water quality levels in the Crosswicks Creek
2. Characterization of the likely future water quality levels in Crosswicks Creek after initiation of the proposed effluent discharge, and
3. Assistance to the Department in establishing effluent limitations for the proposed discharge that comply with the provisions of N.J.A.C. 7:14A and N.J.A.C. 7:9B.

#### E. WATER QUALITY MODEL SELECTION

The water quality model selected for the evaluation of the future dissolved oxygen impacts of the proposed discharge on Crosswicks Creek is QUAL2E, the EPA-supported, one-dimensional, steady-state stream model. QUAL2E is used extensively as a water quality evaluation tool by the Department and permittees, and is described as follows:

1. One dimensional. The channel is well-mixed vertically and laterally.
2. Branching. The system can consist of a mainstem river with branched tributaries.
3. Stream can be divided into reaches characterized by constant hydraulic, physical, chemical and biological parameters. Each reach can be considered to be a string of completely mixing reactors; as called computational elements.
4. Diel heat budget. The heat budget and temperature are simulated as a function of meteorology on a diel time scale.
5. Diel water-quality kinetics. All water quality variables are simulated on a diel time scale.
6. Heat and mass inputs. Point and non-point loads and withdrawals are simulated.

Reference: Brown, L. C. and T. O. Barnwell. 1987. The enhanced stream water quality models QUAL2E and QUAL2E-UNCAS: documentation and user manual. Env. Res. Laboratory. US EPA, EPA /600/3-87/007, Athens, GA.

QUAL2E was selected as the appropriate model framework during the May 26, 2011 site visit by NJDEP personnel including Tom Jenq, the Department's modeling expert. The decision is based on the observed conditions in the stream including the relatively simple geometry with little observed biological activity (little floating algae, rooted aquatics or periphyton). The field parameters of dissolved oxygen, temperature and conductivity measured during the site visit indicated minimal spatial variation along the study area length from the Rt. 537 Crossing downstream to Extonville which gives further support to the choice of QUAL2E.

#### F. SAMPLING AND FLOW MEASUREMENT LOCATIONS

Five (5) sampling locations for this study are depicted on the USGS Map on Page 5. The locations were inspected by NJDEP representatives during a study area site visit conducted on May 26, 2011. Sample Location #1 is the location for water quality characterization. Sampling Locations #1 through #5 are the locations for data collection including ambient water quality and flow to support the Crosswicks Creek Dissolved Oxygen Model calibration and validation.

To identify locations #1, #2, #3 & #4, marker stakes will be placed on both sides of the stream above the water line. Location #5, being the USGS gauging station location, is identified by the weir across the stream. All sampling and measurement of flow will be performed between the location markers or immediately upstream of the weir in the case of Location #5.

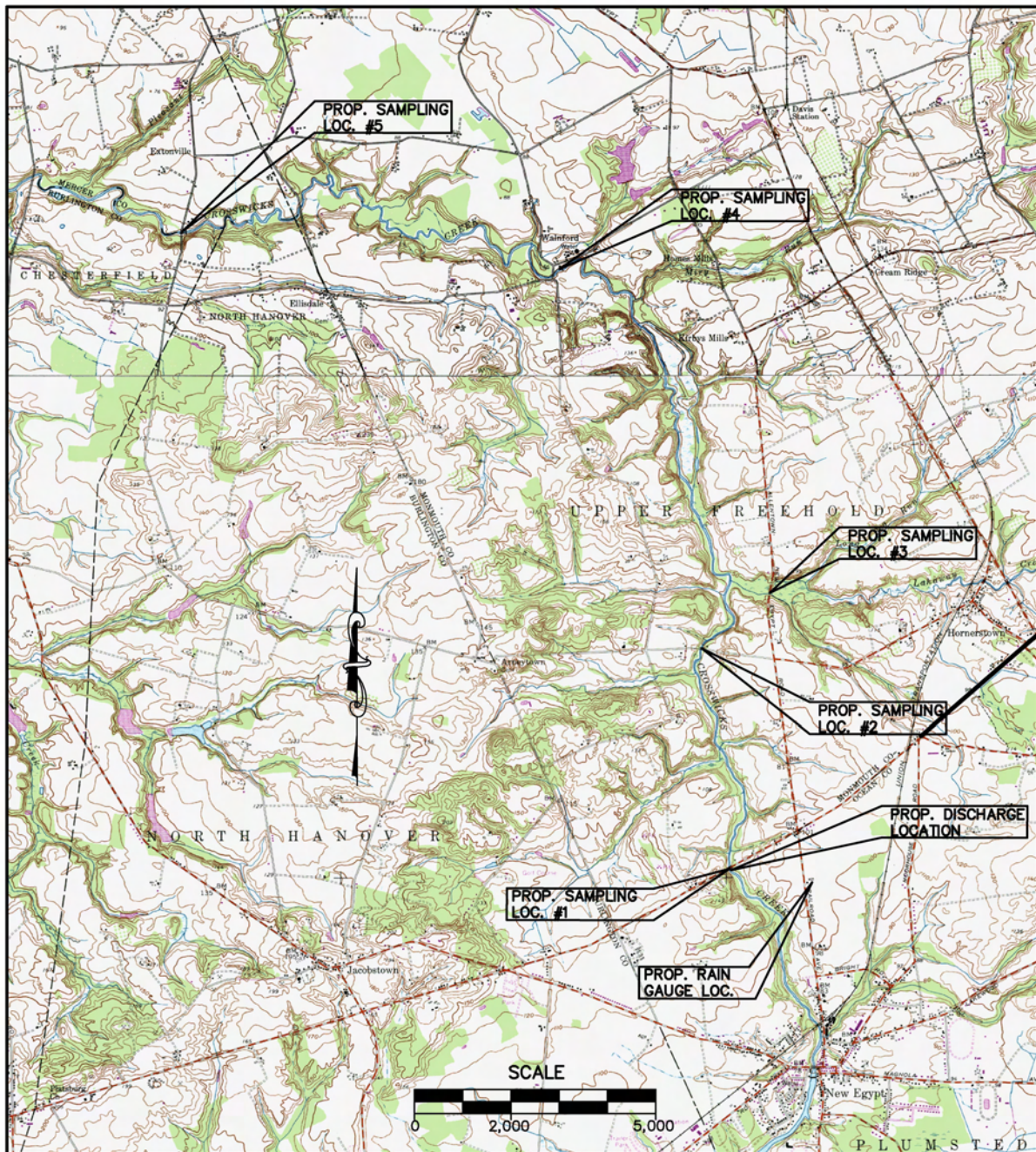
The locations are as follows:

Sample Location #1: This location is also the anticipated discharge location for the proposed wastewater treatment facility. The location is approximately 100 feet upstream of the Rt. 537 Bridge. Coordinates and elevation of the location are 40°05'02.80"N - 74°32'26.70"W and approximately 58' above mean sea level.

Sample Location #2: This location is on the Crosswicks Creek approximately 1.36 miles downstream from the proposed discharge location (Location #1). The location is approximately 200 feet downstream from the Arneytown-Hornerstown Bridge over the Crosswicks Creek. Coordinates and elevation of the location are 40°06'10.05"N - 74°32'37.55"W and approximately 50' above mean sea level.

Sample Location #3: This location is on the Lahaway Creek which is a significant tributary to the Crosswicks Creek. The sampling location is immediately downstream from the Holmes Mill Road (a.k.a. Allentown – New Egypt Road) bridge over the Lahaway Creek. Coordinates and elevation of the location are 40°06'25.40"N - 74°32'11.50"W and approximately 50' above mean sea level.





# **LOCATION MAP - STREAM STUDY SAMPLING PLAN** **U.S.G.S. ALLENTOWN & NEW EGYPT QUADRANGLES**

- Location #1 - Crosswicks Creek/Rt. 537 Bridge
- Location #2 - Crosswicks Creek/Arneytown-Hornerstown Rd. Bridge
- Location #3 - Lahaway Creek/Holmes Mill Road Bridge
- Location #4 - Crosswicks Creek at Walnford Park Gristmill
- Location #5 - Crosswicks Creek at Extonville Road (USGS Gauge)

PLUMSTED MUA  
 PLUMSTED TOWNSHIP  
 OCEAN COUNTY, NEW JERSEY





Sample Location #4: This location is on the Crosswicks Creek approximately 4.6 miles downstream from the proposed discharge location. The sampling location is immediately downstream from the Walnford Road Bridge over the Crosswicks Creek. Coordinates and elevation of the location are 40°08'00"N - 74°33'36.70"W and approximately 49' above mean sea level.

Sample Location #5: This location is on the Crosswicks Creek approximately 8.0 miles downstream from the proposed discharge location. This location is also the site of Gauging Station #01464500, Crosswicks Creek at Extonville, which is maintained by the USGS. Samples will be obtained immediately upstream of the weir structure associated with the gauging station. Coordinates and elevation of the location are 40°08'14"N - 74°36'00"W and approximately 28' above mean sea level.

#### G. SAMPLE ANALYSIS

1. Ambient Water Quality Characterization: The following testing and sampling will be performed at Sample Location #1 on up to 20 occasions as outlined in subsequent Item 11. C. Sampling Protocol for Ambient Water Quality of this plan.

In-situ testing will be performed for the following parameters:

- pH
- Temperature
- Conductivity
- Dissolved Oxygen (DO)

Laboratory testing will be performed for the following parameters:

- Carbonaceous Biochemical Oxygen Demand (CBOD5)
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Fecal Coliform
- E. Coli
- Oil and Grease
- Ammonia, as N
- Nitrate, as N
- Total Phosphorus
- Hardness, as CaCO<sub>3</sub>
- Alkalinity
- Turbidity
- Arsenic, total Recoverable
- Barium, total
- Cadmium, total recoverable
- Chromium, total recoverable
- Chromium, Trivalent & Hexavalent

***Ambient Water Characterization Testing Continued***

Copper, total recoverable  
Cyanide, total  
Lead, total recoverable  
Mercury, total  
Nickel, total recoverable  
Selenium, total recoverable  
Silver, total recoverable  
Thallium, total  
Zinc, total recoverable  
Sulfate  
Bis (2-ethylhexyl) phthalate  
Chlorine Produced Oxidants (CPO)

**Volatiles (from N.J.A.C. 7:14A-4.10, Table II)**

Acrolein	1,2-Dichloropropane
Acrylonitrile	1,3-Dichloropropylene
Benzene	Ethylbenzene
Bromoform	Methyl Bromide
Carbon Tetrachloride	Methyl Chloride
Chlorobenzene	Methylene Chloride
Chlorodibromomethane (Dibromochloromethane)	1,1,2,2-Tetrachloroethane
Chloroethane	Tetrachloroethylene
2-Chloroethylvinyl Ether	Toluene
Chloroform	1,2-trans-Dichloroethylene
Bromodichloromethane	1,1,1-Trichloroethane
1,1-Dichloroethane	1,1,2-Trichloroethane
1,2- Dichloroethane	Trichloroethylene
1,1-Dichloroethylene	Vinyl Chloride

2. Dissolved Oxygen Model Development: The following testing and sampling will be performed at Sample Locations #1 through #5 during the two intensive sampling events over a 3 day period as outlined in subsequent item 11. C. Sampling Protocol for Intensive Surveys of this plan.

In-situ testing will be performed for the following parameters:

pH  
Temperature  
Conductivity  
Dissolved Oxygen (DO)

Laboratory testing will be performed for the following parameters:

Carbonaceous Biochemical Oxygen Demand (CBOD5)  
Carbonaceous Biochemical Oxygen Demand (CBOD20)  
Total Suspended Solids (TSS)  
Total Volatile Suspended Solids (TVSS)

***Dissolved Oxygen Model Development Testing Continued***

Total Dissolved Solids (TDS)

Turbidity

Hardness

Alkalinity

Ammonia

Total Kjeldahl Nitrogen

Nitrate

Nitrite

Total Phosphorus

Organic Phosphorus

Inorganic (ortho) Phosphorus

Chlorophyll a

Sampling for the ambient water quality characterization tests that are performed at the laboratories will be performed by QC Laboratories or Accutest Laboratories. The in-situ testing will be performed by QC Laboratories, Certification #PA166 or Accutest Laboratories, Certification #12129. Collected samples will be tested by QC Laboratories; Accutest Laboratories; and NJ Analytical Laboratories, Certification #11005. **See the Appendix F** Table for a listing of the tests to be performed by each Laboratory.

Sediment oxygen demand (SOD) samples will be obtained by a representative of HDR/HydroQual at locations #1, #2, #4 and #5 on one of the three days of the first intensive sampling event. Laboratory analysis will be performed by HDR Engineering. (NJ Laboratory Certification No. 02594 for dissolved oxygen testing)

The list of laboratory parameters for model development was guided by “Guidance on Dissolved Oxygen Study Monitoring Program Requirements in Unidirectional Streams”, NJDEP, March 7, 2011 and the EPA’s Users Manual for QUAL2E surface water modeling programs.

## 9. SCHEDULE OF TASKS AND PRODUCTS

A. The following project schedule is proposed for this work:

- May 1, 2011 – Date of this Quality Assurance Sampling Plan and submittal for plan review
- July 15 through October 30, 2011 – Dates of field sampling, sample submission to the laboratory and laboratory analysis. (unless extended due to insufficient sampling conditions)
- October, 2011 – Submission of interim report, Dissolved Oxygen model calibration and validation.
- December 31, 2011 – Project Officer receipt of final results of laboratory analysis.
- January 31, 2012 – Date of final report and submission to NJDEP

- B. Following the completion of the sampling and analysis of the stream flow data, a final report will be prepared outlining the anti-degradation analysis. Existing water quality will be determined at the proposed discharge location and site-specific in-stream metals criteria will be calculated. If in-stream criteria are satisfied then effluent limits will be calculated such that the existing water quality is maintained or it is demonstrated that there is important social and economic justification for allowing some degradation of the existing water quality.

## 10. PROJECT ORGANIZATION AND RESPONSIBILITY

Sampling Coordination:	(Project Officer, VCEA)	Gregg Barkley
Rainfall Measurement	(MUA Director)	Peter Ylvisaker
Sampling QC:	(Field Supervisor, QC Labs) (Field Supervisor, Accutest)	Rich Wheeler Harold Meissner
Laboratory Analysis:	(Director, QC Labs ) (Director, Accutest) (Director, NJ Analytical)	John Ruane David Speis Alan Thomas
Laboratory QA:	(Officer, QC Labs) (Officer, Accutest ) (Officer, NJ Analytical)	Oommen V. Kappil Phillip Worby George Latham
Performance/Systems Auditing:	(QA Officer, VCEA)	Chris Jepson
Data Processing/ Data Quality Review:	(QA Officer, VCEA)	Chris Jepson
Overall QA	(QA Officer, VCEA)	Chris Jepson
Overall Coordination	(Project Officer, VCEA)	Gregg Barkley

## 11. SAMPLING PROCEDURES

### A. CRITERIA FOR SAMPLING

Water quality sampling and flow measurement will be performed only on days when low flow conditions exist. Low flow is defined as when the flow is below the stream flow that is exceeded 70% of the time, (d70) and a minimum of 2 days after a rainfall event of 0.5 inches or greater within a 24 hour period.

The continuous USGS stream flow gage at the Crosswicks Creek on Extonville Road (USGS Gage #01464500) will be used to plan sampling events in order to satisfy the flow conditions. This gage station is located approximately 8.0 miles down stream from the proposed sampling point.

According to correspondence from the US Geological Survey (USGS), the flow value at gauging station #0146500 that is exceeded 70% of the time is 65 cubic feet per second (cfs) for the historical record from 1941 to 2010. Due to a noticeable decrease in flow since the 1990's, the USGS also assessed the flow value at the gauging station that is exceeded 70% of the time for the period of 1990 to 2010 to be 59 cfs. It is our intent to utilize the lower value of 59 cfs as the target flow rate for determination of low flow conditions. See **Appendix A** for the USGS correspondence.

The measurement of the rainfall will be performed with a Stratus Rg202 rain gauge which will be located at the Plumsted Township Municipal Building which is approximately ½ mile from stream sampling location #1 as depicted on the map on page 4. Daily recordings of the precipitation from Monday to Friday will be made between 8:00 am and 9:00 am. When possible, precipitation measurements will be made on weekends (Saturday & Sunday) during the same time periods. When a measurement cannot be made on Saturday and/or Sunday and precipitation is observed the following day, it will be assumed that the precipitation occurred during the previous 24 hour period.

The proposed Stratus Rg202 rain gauge is constructed of clear butyrate plastic with a 4" diameter outer funnel which directs the collected rainfall into a smaller diameter inner cylinder with a capacity of 1". The inner cylinder is graduated at 0.01" increments. Excess rainfall overflows to the outer cylinder for a total capacity of 11 inches. To measure flow over 1", the inner cylinder is emptied and the water in the outer cylinder is poured into the smaller for a direct reading. This can be repeated any number of times to obtain the full rainfall volume. Information regarding the proposed gauge is included in **Appendix B**.

During the course of the study, rainfall will be monitored on a daily basis with a written log of the rainfall recorded. See **Appendix C** for the proposed rainfall data log. The recording of the rainfall data will be performed by the Executive Director of the Plumsted Municipal Utilities Authority, Peter Ylvisaker. In the event that Mr. Ylvisaker is unavailable to perform this task, it will be performed by the QC Officer or a capable designee.

The Project Officer will review the stream flow data available from the USGS online and precipitation data on a daily basis throughout the sampling period. If the low flow and precipitation conditions are met, the laboratory will be notified that sampling may proceed. In addition, weather

forecasts will be considered when the 3 day intensive sampling periods are selected.

If insufficient flow/precipitation conditions preclude the initiation and completion of a weekly sampling event, the sampling event can be made up in subsequent weeks. See Section 11.C for sampling protocol

## B. STREAM FLOW

At the sampling locations #1 through #4 as described previously, stakes will be driven in the upper portion of the bank on each side of the stream channel to identify the location for all measurements. Between the 2 stakes, the elevation of the stream channel will be determined so that a cross section profile can be prepared. During each flow measurement event, the water level elevation and the stream velocity at several locations across the stream profile will be measured so that a volumetric flow rate can be calculated. All flow measurements will be made by representatives of Van Cleef Engineering Associates.

Stream flow will be determined at sampling location #1, #2, #3 & #4 on the first day of each 3-day intensive sampling event. If, on the 2<sup>nd</sup> day of each intensive sampling event, the flows recorded at the USGS gauge at the Crosswicks Creek on Extonville Road (USGS Gage #01464500) vary by more than 5% from the flows recorded on the 1<sup>st</sup> day, a flow measurement will be taken on the 2<sup>nd</sup> day. If, on the 3<sup>rd</sup> day of each intensive sampling event, the flows recorded at the USGS gauge at the Crosswicks Creek on Extonville Road (USGS Gage #01464500) vary by more than 5% from the flows recorded on either the 1<sup>st</sup> or 2<sup>nd</sup> days, a flow measurement will be taken on the 3<sup>rd</sup> day.

Flow at sampling location #5, Crosswicks Creek at Extonville, is available real-time from the USGS web-site and will be recorded daily between 7:00 to 9:00 am.

At Stations #1, 2, 3 & 4 measurement of the stream velocity will be made at numerous points (typically 1 – 2 foot horizontal increments) across the stream profile.

The depth of the velocity measurement will be as follows:

Profile depth <2.5 feet – measure at 60% of the depth

Profile depth >2.5 feet – measure at 20% & 80% of the depth, then average the 2 readings

The velocities obtained and the incremental depth and spacing of the measurement locations will be used to determine the flow for that section. The total stream flow will be the sum of the individual rates for each section.



The measurement of the stream velocity will be made with a Marsh-McBirney hand held Flow Mate 2000 portable velocity meter. This unit utilizes electromagnetic induction created by the moving liquid to determine velocity. The unit is capable of instantaneous measurement of velocity from 0 – 20 ft/sec with a  $\pm 2\%$  accuracy. Information regarding the flow meter is included in **Appendix D**.

## C. SAMPLING PROTOCOL

### 1. Ambient Water Quality

Samples for all of the parameters listed previously will be collected at Location #1 on twenty (20) occasions.

For the first four (4) weeks of the monitoring program, sampling events will be conducted at a frequency of twice per week (2 / week) and will not be conducted on consecutive days. For the remaining sixteen (16) weeks of the ambient water quality monitoring program, sampling events will be performed at a frequency of once per week through October 31, 2011. All samples will be collected during low-flow conditions as defined in Section 11A and daylight hours.

If insufficient flow/precipitation conditions preclude the initiation and completion of a weekly or twice weekly sampling event(s), the sampling event(s) can be made up in subsequent weeks. However, multiple-sampling event weeks will only be utilized to make-up sampling events in past weeks that were unable to be performed due to flow/precipitation conditions. (i.e. a multi-sampling event week will not be used to satisfy the need for future weekly sampling events) In addition, if the twenty (20) sampling events cannot be completed by October 31, 2011 (due to insufficient flow/precipitation conditions) the ambient water quality monitoring program may be extended into subsequent months provided that the low flow conditions are met. In both of these situations, no more than three (3) sampling events can occur in a one week (7 day) period and samples shall not be taken on consecutive days.

All samples will be obtained between markers placed on the stream embankments.

If non-detectable results are recorded in each of the first 10 sampling events for any of the parameters associated with characterizing existing water quality in Crosswicks Creek (with the exception of ammonia and alkalinity), sampling and analysis for those parameters may be discontinued upon approval from all

Department signatories of this Work/QAPP (i.e. notification to, and subsequent approval from, all Department signatories is required before sample and analysis may be discontinued for a parameter).

2. Intensive Surveys

Intensive Surveys for model development will be conducted at all five (5) locations on two (2) occasions for three (3) consecutive days under low flow conditions as defined in Section 11A. Temperature, pH, conductivity, and Dissolved Oxygen (DO) will be measured in-situ once per day during each of the three days of an Intensive Survey.

Samples will be obtained for laboratory analysis for CBOD<sub>5</sub>, CBOD<sub>20</sub>, TSS, TVSS, TDS, turbidity, hardness, alkalinity, total inorganic carbon, ammonia, TKN, nitrate, nitrite, total phosphorus, organic phosphorus, ortho-phosphorus, and chlorophyll a. will be conducted once per day during each Intensive Survey day.

In-situ testing and sampling for laboratory analysis during each Intensive Survey day will be scheduled on a staggered basis such that over the three day survey, samples at each location are obtained during the early morning (~7:00 am-10am), mid-day (~11 am to 2pm) and afternoon (~2 pm- 5 pm)

Measurements of the stream depth and velocity at the locations will also be obtained as previously outlined under Item 11B. Stream Flow, so that the flow can be calculated.

Sediment oxygen demand will be measured once at each Crosswicks Creek main stem location (Sampling Locations 1, 2, 4 and 5) during Intensive Survey 1.

Diurnal variation of temperature, pH, conductivity, and DO will be measured for one day during each Intensive Survey at Sampling Locations 1 through 5 by measurement of these parameters from one hour prior to sunrise to one hour after sunset. At least 6 measurements will be made at each sampling location over the diurnal time frame.

The first of the two intensive surveys will be conducted prior to August 12<sup>th</sup> and the second intensive survey will be conducted at least 2 weeks following the first survey and prior to September 15<sup>th</sup>.

#### D. SAMPLING FOR LABORATORY ANALYSIS:

During sampling events, a composite of 3 quarter point grab samples will be collected across the stream cross section. The samples will be taken at a point no lower than mid-depth in the water column by the technician. If the technician must wade into the stream to obtain the samples; the technician will be down stream while the sample bottle is filled.

The individual samples will be transferred to a larger volume container to provide a composite sample. The appropriate amounts of this composite sample will be transferred to the sample bottles for transport to the laboratory. Prior to the sampling event, the large volume container will be decontaminated according to the following procedure: (1) distilled/deionized water rinse, (2) non-phosphate detergent wash, (3) distilled/deionized water rinse, (4) air dry, and (5) distilled/deionized water rinse.

The respective laboratory performing the tests will provide new and unused sample bottles for each sampling event. QC Laboratories will provide the large volume container for compositing. If multiple sampling sites are visited, a separate container will be provided for each site.

Stream sediment sampling for Sediment Oxygen Demand (SOD) will be obtained by extracting duplicate core tube samples from the Crosswicks Creek at Locations #1, 2, 4 & 5. These samples will be approximately two (2) inches in diameter and three inches deep into the loose sediment at or near the center of the stream channel.

The cores for Sediment Oxygen Demand (SOD) will be obtained by direct push of the SOD tube into the sediment, capping the tube and removing it from the sediment. The tube bottom will then be capped. The tubes will be stored away from light for transport to the HDR|HydroQual laboratory for processing. **See Appendix G** for the SOD sampling and testing procedure including information regarding the dissolved oxygen meter to be utilized.

#### E. IN-SITU TESTING

The analysis for pH, temperature, conductivity and dissolved oxygen will be performed at the site by representatives of the QC Laboratories or Accutest Laboratories.

QC Labs will utilize a YSI 556 MPS Multi-Meter which performs all of the tests with a single unit. Accutest Labs utilizes separate units which include a YSI Model 55 Meter for Dissolved Oxygen; YSI EC300 Meter for Conductivity and YSI Model 100 Meter for pH. Any of the units will provide

a Temperature measurement. The sample probe(s) will be inserted directly into the stream at mid-width and mid-depth. **See Appendices H through K** for information on the Meters.

## 12. CHAIN OF CUSTODY

Chain of Custody procedures will be followed for all samples collected. This chain will document the name of every individual who was in physical possession of the sample from the time of the sample to the time of the analysis. A sample Chain of Custody form is included in **Appendix E**.

## 13. TEST PROCEDURES

Included in **Appendix F** is a table outlining all of the test parameters to be performed as well as the sample type, test method, laboratory performing the test, holding time, container, sample preservation, laboratory MDL, reporting units, laboratory recommended limit and NJDEP recommended quantitative limits (RQLs).

Sediment oxygen demand (SOD) sampling and analysis will be performed by HDR/HydroQual in accordance with the protocol included in **Appendix G**.

Any deviations in the sampling or test procedures will be reported to and approved by the NJDEP prior to implementing the change and so noted in the final report.

## 14. CALIBRATION AND PREVENTATIVE MAINTENANCE

Calibration and preventative maintenance of laboratory equipment will be the responsibility of QC Laboratories, HDR/HydroQual and NJ Analytical Labs. as NJ Licensed Laboratories and will be in accordance with N.J.A.C. 7:18-1.1 et seq. and 40 CFR §136.

## 15. DOCUMENTATION, DATA REDUCTION AND REPORTING

The laboratory will supply all QA/QC data with the summary of results. All data will be kept on file by the applicant for a minimum of five years and all data will be included in the reports to the NJDEP.

## 16. QUALITY ASSURANCE AND QUALITY CONTROL

The NJ Licensed Laboratory will be responsible for all quality assurance/quality control (QA/QC) which will be in conformance with N.J.A.C. 7:18-1.1 et seq. and 40 CFR §136.

## 17. PERFORMANCE AND SYSTEMS AUDITS

All NJDEP certified laboratories participate in the Office of Quality Assurance proficiency testing program, in accordance with NJAC 7:18-2.13 for each category of certification. Laboratories are required to pass the testing program in order to maintain the certification. The NJDEP Office of Quality Assurance periodically conducts a field audit of sampling operations and procedures.

## 18. DATA VALIDATION

Data validation will be performed by the respective Laboratories as required by the NJDEP to maintain their certification. This includes actions to be followed if method blanks or laboratory blanks fall outside of the prescribed limits. Corrective action procedures will be followed in the event that a calibration standard, duplicate, performance evaluation result, etc. are outside of the acceptable range or control limit as follows:

- a) Method Blank: The method blank cannot show the presence of the parameter of interest above the reported detection limit. Analysis of the batch should not continue until the source of the problem has been corrected.
- b) Laboratory Fortified Blank: Where appropriate, must fall within the Quality Control (QC) limits. If the laboratory fortified blank is outside the limits, the following corrective actions shall be taken:
  - a. Check data and recovery calculations
  - b. Check reference QC standard.
  - c. Re-analyze sample batch.
- c) QC Matrix Spike: Should fall within the QC control limits established for each methodology. The corrective actions should be as follows:
  - i. Check data and recovery calculations.
  - ii. Check if laboratory fortified blank and reference standard is acceptable.
  - iii. If only matrix spike is not within control limits, check other constituents present for possible matrix interference as detailed in the specific method. IF sample matrix is identified as the problem, this may be footnoted. If the matrix spike is consistently outside for

- a particular parameter, another methodology may be suggested for sample analysis.
- iv. Check reference QC standard if one was performed for that batch.
- v. If matrix spike is not within control limits, check for presence of that parameter at a high value which may be greater than the spike amount causing invalid spike recovery.
- d) Precision evaluated by control charts which are continuously maintained and updated at quarterly intervals. Matrix spike duplicates must have a relative percentage difference equal to or lower than the calculated relative percentage difference. If reproducibility cannot be achieved and sample matrix interferences are not apparent, batch re-analysis will be necessary. Calculations and dilutions should be checked prior to re-analysis.
- e) Accuracy shall be evaluated by:
  - i. Initial and continuing calibration standards within the acceptable criteria.
  - ii. Laboratory fortified blank acceptance by control limits is to be continuously maintained, updated and within control limits.
  - iii. Recovery control charts continuously maintained and updated.

## 19. CORRECTIVE ACTION

All NJDEP certified laboratories must have written corrective action procedures that they adhere to in the event that calibration standards, performance evaluation results, blanks, duplicates and spikes are out of the acceptable range or control limits. If the acceptable results cannot be obtained during any given day, sample analysis must be repeated when the QA/QC limits are within the acceptable range.

Any deviation from this approved Work/QAPP will be reported to and approved by the NJDEP signatories prior to implementing the change. These changes will be noted in the final report with the appropriate justification. In addition, any data that needs to be rejected will be presented in the final report along with an explanation of the justification.

## 20. REPORTS

- A. Interim Report: An interim report which includes the following information will be prepared and submitted to the Department for review and approval.
  - The raw analytical data collected and compiled for the purposes of modeling dissolved oxygen in the receiving stream;
  - The model inputs utilized in calibration and validation of the selected water quality model;
  - The model calibration and validation outputs; and



- The proposed model inputs utilized for the model projections to evaluate the future impacts of the proposed discharge.
- B. Final Report: The final report will present the data collected and all calculations utilized in determining the stream flow and impact assessment of the proposed discharge on the stream. At a minimum, the report will include the following:
- A summary of sampling locations and procedures utilized in the study;
  - All of the raw analytical data including sample blank data with supporting QA/QC information;
  - Precipitation data from the rain gauge for the 72 hours during and preceding all sampling events;
  - Flow data from the USGS gage #0164500 for the dates of all sampling events;
  - Numerical flow for the USGS gage #0164500 that is exceeded 70% of the time.
  - All information contained in the interim report;
  - Inputs and outputs of the model projection conducted to evaluate future impacts of the proposed discharge.

Three (3) copies of the final report will be submitted for review and approval to the Bureau of Surface Water Permitting. Each hard copy will include a CD that contains a Microsoft Excel version of all raw data collected during the study.

## APPENDIX A

U.S.G.S. Correspondence  
Regarding  
70<sup>th</sup> Percentile flows for the Crosswicks Creek

**Gregg Barkley**

---

**From:** Amy R McHugh [amchugh@usgs.gov]  
**Sent:** Friday, May 27, 2011 8:59 AM  
**To:** gbarkley@vcea.org  
**Cc:** R. Edward Hickman  
**Subject:** Re: Crosswicks Creek Flow

Greg,

Sorry for the delay, and thank you for the reminder.

The 70th percentile in the last 20 years vs. the entire period of record wasn't as different as I had expected. It appears that the decreasing flows greatest effect are more on the far left tail of the data (eg. 7-day minimum), whereas the annual mean hasn't varied much at all.

The 70th percentile flows for Crosswicks Creek are as follows.

At the gage, 01464500 Crosswick Creek at Extonville:  
1941-2010 - 65 cfs  
1990-2010 - 59 cfs

At Route 537:  
1941-2010 - 37 cfs  
1990-2010 - 33 cfs

Thank you for your patience. If you need anything else, let me know.

Amy

-----  
Amy McHugh  
Hydrologist  
USGS, New Jersey Water Science Center  
810 Bear Tavern Road, Suite 206  
West Trenton, NJ 08628  
(609) 771-3967  
-----

From: "Gregg Barkley" <gbarkley@vcea.org>  
To: <amchugh@usgs.gov>  
Date: 05/17/2011 11:44 AM  
Subject: Crosswicks Creek Flow

---

Amy

As I outlined in our discussion this morning, this office is preparing an Antidegradation Study Work Plan for the Crosswicks Creek in Plumsted Township. The data collected in this study will be used to establish discharge limits for a proposed wastewater treatment facility.

Could you please provide the stream flow volume that is exceeded 70% of the time (d70) at the Crosswicks Creek gauging station on Extonville Road (Gage #01464500). Additionally, calculated statistics for the Crosswicks Creek stream flow at the Rt. 537 bridge would be helpful as well. (See attached map)

You indicated that the stream baseflow decreased somewhat in the 1990's and has remained lower than the previous historical record since that time. As a result you will provide data for the entire historical record and well as data from the 1990's forward to the present.

Please contact me with any questions.

Gregg W. Barkley, P.E.  
Van Cleef Engineering Associates  
4 AAA Drive, Suite 102  
Hamilton, NJ 08691  
ph 609-689-1100  
fax 609-689-1120  
[gbarkley@vcea.org](mailto:gbarkley@vcea.org)

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[attachment "USGS Plumsted Stream Disch Map .pdf" deleted by Amy R McHugh/WRD/USGS/DOI]

## APPENDIX B

Stratus RG202  
Rain Gauge



## Stratus RG202 Long Term Professional Rain and Snow Gauge



Keep track of how much rain, snow, hail or sleet falls in your area with this innovative measuring gauge. The outer cylinder collects snow, hail and sleet while the inner tube measures melted water content of frozen precipitation and rain. The inner tube is graduated to the nearest inch with .01" intervals and an overflow slot for downpours up to 11". Clear plastic construction provides a see-through design so the gauge is very easy to read. Mounting bracket is included.

Are you a business, school, government or co-operative? Take advantage of our [Purchase Order](#) Terms, and [Volume Discounts](#).

[Click here for Shipping Calculator...](#)

Sku: RG202 **\$29.95**

Quantity:



**This item is IN-STOCK**

### Features:

- Rain collector = 4.25" Wide x 14" Tall
- Collects and measures all precipitation types
- Easy to install and read
- Mounting hardware included
- Graduated to nearest inch with .01" intervals
- Funnel top catches rain and delivers it to one-inch measuring tube (lets you instantly measure commonly occurring amounts of rain)
- Extra-large outer cylinder captures rain volumes over 1 inch up to 11 inches (use without measuring tube for snow, hail or sleet)
- No metal parts to rust
- Easy-to-install Quick Connect bracket lets you quickly remove cylinder for measurement or cleaning
- Easy to clean design
- Constructed of heavy-duty, UV resistant polycarbonate that won't fade even after years in the sun
- Easy to read measurement increments of 1/100 of an inch
- Comes with a free one-year log sheet for recording rainfall data
- "The most accurate professional rain gauge money can buy..." Bruce Thomas, Chief Meteorologist, Texas Weather Bureau



## APPENDIX C

Log Sheet for  
Rainfall Data

PLUMSTED TOWNSHIP

MONTH \_\_\_\_\_

RAINFALL DATA

DAY	TIME	RAINFALL (NEAREST 0.01 INCH)	COMMENTS	INITIALS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
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## APPENDIX D

Marsh – McBirney  
Flow Mate 2000 Velocity Meter

# Marsh-McBirney Flo-Mate™ Portable Velocity Flow Meter



*The Flo-Mate 2000 is a hand held, battery powered point velocity meter. It is lightweight yet rugged with no moving parts, water resistant with data storage/recall capabilities and fixed period averaging.*

## Features and Benefits

### Flo-Mate—the Industry Standard for Over 35 Years

Determine volumetric flow in rivers, streams, irrigation ditches, sanitary pipes, or wherever water flows. Check the calibration of existing flow meters, as well as performance of weirs and flumes. Features that make Flo-Mate your clear choice of velocity meters include instantaneous readout, lightweight, rugged field construction with no moving parts, water resistant enclosure, and battery operation.

Flo-Mate's proven electromagnetic velocity sensor assures you of unsurpassed accuracy and dependability.

When the sensor is placed in flowing water, its magnetic field creates a voltage. This voltage is sensed by electrodes embedded in the sensor and is transmitted through the cable to the meter. The voltage amplitude, representing the rate of water flowing around the sensor, is electronically processed and displayed on the instrument panel. Turbulent/noisy flows are also easily metered with Flo-Mate's two user-selectable data averaging features—Fixed Period Averaging or Time Constant Mode.

### Applications

- Streams & Rivers
- Weir/Flume/Flow Meter Calibration
- Sewers
- Mining Channels
- Irrigation Channels
- Most Open Channels

### Features That Make the Difference

- Instantaneous readout of flow velocity
- Ideal for performance verification of flumes, weirs and other primary devices
- Check calibration of existing flow meters
- Proven electromagnetic sensor
- Water resistant electronics
- Lightweight — only 3.5 pounds
- Data Storage/Recall
- Rugged case made of high impact molded materials
- Measures low flows
- Direct replacement for USGS type mechanical meters
- Adjustable filter modes: Time constant or fixed period averaging
- System self-check function
- Battery saver mode/auto shut-off
- Battery powered—rechargeable or disposable
- Bar graph displays timing information
- Optional disconnectable sensor available

DW = drinking water WW = wastewater municipal PW = pure water / power  
IW = industrial water E = environmental C = collections FB = food and beverage



Be Right™

WW

E

C

## Specifications and Ordering Information

### FLO-MATE FLOW METER VELOCITY MEASUREMENT

#### Range

-0.5 to +20 ft./s (-0.15 to 6 m/s)

#### Zero Stability

±0.05 ft./s

#### Accuracy

±2% of reading plus zero stability

#### Method

Electromagnetic

#### Output

Display: 3 1/2 digit

#### Materials

Sensor: Polyurethane  
Cable: Polyurethane jacket  
Electronic Case: High impact molded plastic—NEMA 4X

#### Environmental

Sensor: 0 to 72°C (32 to 160°F)  
Electronics: 0 to 50°C (32 to 122°F)

#### Power Requirements

Batteries: Two D Cells  
Alkaline Battery Life: 25-30 continuous ON hours

#### Weight

With sensor and 20 ft. of cable:  
1.6 kg (3.5 lbs.)  
Without sensor: 1.1 kg (2.5 lbs.)

### Engineering Specifications

- The flow meter shall be capable of providing an instantaneous readout of flow velocity.
- The method of velocity measurement shall be electromagnetic.
- The range of velocity measurement shall be -0.15 to 6 m/s (-0.5 to +20 ft./s).
- The flow meter shall measure low flows.
- The flow meter shall be capable of storage and recall of up to 19 data points while profiling in the field.
- The flow meter shall have an external charging capability.
- The flow meter shall have adjustable filter modes of time constant or fixed period average.
- The flow meter shall have a system self-check function.
- The flow meter shall have a battery saver mode/auto shut-off.
- The flow meter shall be battery powered using rechargeable or disposable batteries.
- The flow meter shall have a bar graph that displays timing information.
- The flow meter shall have an optional disconnectable sensor available.
- The flow meter shall have no moving parts.
- The flow meter shall be water resistant.
- The flow meter shall be portable.
- The weight of the flow meter shall be no greater than 1.1 kg (2.5 lbs.) without the sensor and no greater than 1.6 kg (3.5 lbs.) with the sensor and 20 feet of cable.
- The flow meter shall be the Marsh-McBirney Flo-Mate Portable Velocity Flow Meter.

Flo-Mate	Model 2000-	Sensor Cable Connector	Sensor	Sensor Cable
No Sensor Connector		1		
Sensor with Disconnect		5		
Open Channel Velocity Sensor-Std			1	
20 Ft. Cable (Std)				0
Cable as needed Max Cable 100 Ft.				9

### Accessories

- 75002** Standard Wading Rod Kit, English—consists of four 2-foot long sections marked in tenth foot increments, double end hanger, and base plate.
- 75002M** Standard Wading Rod Kit, Metric—same as 75002 but marked in metric units.
- 75013** Top-Setting Wading Rod Kit, English—permits convenient setting of sensor. Marked in tenth foot increments.
- 75013M** Top-Setting Wading Rod Kit, Metric—same as 75013 but marked in metric units.
- 75003** Suspension Cable Kit - consists of a 15 lb. Finned weight, and hanger. Specify length of stainless steel cable required.

NOTE: Additional cable cannot be added after order is entered. Contact factory for lengths greater than 100 ft.

Lit. No. 2636 Rev 1

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*Keep it pure.*

*Make it simple.*

*Be right.*

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**www.flow-tronic.com**



**Be Right™**

## APPENDIX E

QC Laboratories  
Chain of Custody Sheet





## APPENDIX F

Table of Analytical Tests, Methods, MDLs and RQLs

## CROSSWICKS CREEK WATER QUALITY SAMPLING

Parameter	Laboratory	Sample Type	Test Code	Method	Holding Time	Container	Preservation	Lab MDL	Project Quantification Level	Units	----- Laboratory Limits -----		
											Accuracy MS/D % Rec	Precision % RPD	LCS Accuracy % Rec
METALS													
Arsenic, Total Recoverable	QC	Field Composite	As - Low	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.549	2,000	ug/L	70-130	20	85-115
Barium, Total	QC	Field Composite	Ba	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.126	2,000	ug/L	70-130	20	85-115
Cadmium, Total Recoverable	QC	Field Composite	Cd	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.0649	2,000	ug/L	70-130	20	85-115
Chromium, Total Recoverable	QC	Field Composite	Cr	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.491	2,000	ug/L	70-130	20	85-115
Chromium, Trivalent (+3)	QC	Field Composite	Cr+3	Calculation	NA	NA	NA	NA	[1]	ug/L	NA	NA	NA
Copper, Total Recoverable	QC	Field Composite	Cu	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.221	2,000	ug/L	70-130	20	85-115
Lead, Total Recoverable	QC	Field Composite	Pb	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.07	2,000	ug/L	70-130	20	85-115
Mercury	QC	Field Composite	Hg	EPA 245.1	28 days	250 mL Plastic	HNO3, pH< 2	0.047	0.200	ug/L	70-130	20	85-115
Nickel, Total Recoverable	QC	Field Composite	Ni	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.139	2,000	ug/L	70-130	20	85-115
Selenium, Total Recoverable	QC	Field Composite	Se	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.752	2,000	ug/L	70-130	20	85-115
Silver, Total Recoverable	QC	Field Composite	Ag	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.652	2,000	ug/L	70-130	20	85-115
Thallium, Total Recoverable	QC	Field Composite	Tl	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	0.239	2,000	ug/L	70-130	20	85-115
Zinc, Total Recoverable	QC	Field Composite	Zn	EPA 200.8	180 days	250 mL Plastic	HNO3, pH< 2	1.48	5,000	ug/L	70-130	20	85-115
Hardness, Total as CaCO3	QC	Field Composite	Hard	EPA 200.7	180 days	250 mL Plastic	HNO3, pH< 2	5000	5000	ug/L	70-130	20	85-115
Conventional Chemistries													
Chromium, Hexavalent (+6)	QC	Field Composite	Cr+6	SM 3500CR D	24 Hours	1/2 Pt Plastic	Cool 4°C	5	10	ug/L	71-121	7.49	90-110
Cyanide, Total	Accutest	Field Composite	CN-total	EPA 335.4	14 days	1/2 Pt Plastic	Caustic, NaOH	2.8	10	ug/L	90-110	35	90-110
Carbonaceous BOD-5	NJ Analyt	Field Composite	CBOD5	SM 5210B	48 Hrs	1 QT Plastic	Cool 4°C	1	1	mg/l	NA	20	84.6-115
Carbonaceous BOD- 20 Day	NJ Analyt	Field Composite	CBOD-20	SM 5210B	48 Hrs	1 QT Plastic	Cool 4°C	1	1	mg/l	NA	20	84.6-115
Total Suspended Solids	QC	Field Composite	TSS	SM 2540C	7 Days	1/2 Pt Plastic	Cool 4°C	2	2	mg/l	N/A	+/-5 % D	75.9-111
Total Dissolved Solids	QC	Field Composite	TDS	SM 2540C	7 Days	1/2 Pt Plastic	Cool 4°C	20	20	mg/l	N/A	+/-5 % D	87.7-108
Total Volatile Suspended Solids	QC	Field Composite	TVSS	SM 2540D	7 Days	1/2 Pt Plastic	Cool 4°C	10	10	mg/l	N/A	+/-5 % D	75.9-111
Fecal Coliform (MF)	QC	Grab	FC-MF	SM 9222D	6 hours	100 mL Sterile, Sodium thiosulfate	Cool 4°C	1	1 col/100 mL	col/100 mL	NA	NA	NA
E.coli (MF)	QC	Grab	E.coli MF	EPA 1603	6 hours	100 mL Sterile, Sodium thiosulfate	Cool 4°C	1	1 col/100 mL	col/100 mL	NA	NA	NA
Phosphorus, Total (Low)	QC	Field Composite	T Phos-Low	SM 4500P B.5 E	28 Days	1/2 Pt Plastic	H2SO4, pH<2	0.006	0.009	mg/l	91-113	3.24	93.2-108
Phosphorus, ORGANIC by Calculation	QC	Field Composite	Organic Phos	Calculation (total - ortho)	28 Days	1/2 Pt Plastic	H2SO4, pH<2	0.006	0.009	mg/l	NA	NA	NA
Phosphorus, INORGANIC (Low)	QC	Field Composite	OPDA Low	SM 4500P B.5 E	48 Hours	1/2 Pt Plastic	Cool 4°C	0.006	0.009	mg/l	79.3-118	4.5	92.5-107
TKN	QC	Field Composite	Ki-Low	EPA 351.2	28 Days	1/2 Pt Plastic	H2SO4, pH<2	0.12	0.3	mg/l	68.4-126	17.2	73.7-117
Ammonia, as N	NJ Analyt	Field Composite	NH3-Low	SM 4500NH3 B+D	28 Days	1/2 Pt Plastic	H2SO4, pH<2	0.01	0.10	mg/l	+/-27	+/-20	+/-10
Organic Nitrogen, by Calculation	QC	Field Composite	(TKN-NH3)	Calculation	NA	NA	NA	0.12	0.12	mg/l	NA	NA	N/A
Oil & Grease	NJ Analyt	Grab	1664-HEM	EPA 1664-HEM	28 Days	1 QT Glass	HCL, pH<2	1.02	1.4	mg/l	78-114	18	83-101
Field PH	QC/Accutest	Grab - instu	FLD-PH	SM 4500 H + B	Immediate	N/A	N/A	0.50	0.50	Std Units	NA	+/-0.5	+/-0.5 unit
Field Dissolved Oxygen	QC/Accutest	Grab - instu	FLD-DO	SM 4500 O C/G	Immediate	N/A	N/A	0.25	0.25	mg/l	NA	+/-0.5	+/-0.5 mg/L
Field Temperature	QC/Accutest	Grab - instu	FLD-Temp	SM 2550 B	Immediate	N/A	N/A	0.0	0.0	Degree C	0.2 °C	+/-0.5	+/-0.5°C
Field Specific Conductance	QC/Accutest	Grab - instu	FLD-Cond	SM 2510 B	Immediate	N/A	N/A	10	10	uMhos/cm	NA	20%	80-120
Chlorine Produced Oxidants (Residual Chlorine)	QC	Grab	Residual Chlorine	SM 4500 CLG	Immediate	N/A	N/A	0.02	0.02	mg/l	NA	0.1 mg/l	80-120
Nitrate as N	QC	Field Composite	NO3-Low	EPA 300.0	48 Hours	1/2 Pt Plastic	H2SO4, pH<2	0.0257	0.1	mg/l	89.4-113	6.45	88.3-109
Nitrite as N	QC	Field Composite	NO2-Low	EPA 300.0	48 Hours	1/2 Pt Plastic	Cool 4°C	0.0049	0.025	mg/l	76.2-104	2.68	88.7-108
Alkalinity, Total as CaCO3	QC	Field Composite	Alk	SM 2320B	14 days	1/2 Pt Plastic	Cool 4°C	2	2	mg/l	NA	10	90-110
Turbidity	QC	Field Composite	Turb	EPA 180.1	48 Hours	1/2 Pt Plastic	Cool 4°C	0.1	0.1	NTU	NA	10	90-110
Sulfate	QC	Field Composite	SO4	EPA 300.0	28 Days	1/2 Pt Plastic	Cool 4°C	1.7	5	mg/l	89.6-113	3.41	91.9-107
Chlorophyll A	NJ Analyt	Field Composite	CHL-A	EPA 446.0	48 hr	2 x550 mL Amber Glass	Cool 4°C	0.5	0.5	mg/m3	70-130	25	70-130

7/18/11 Rev.

Plumsted Twp, Ocean Co

Antidegradation Study Work Plan

CROSSWICKS CREEK WATER QUALITY SAMPLING

Parameter	Laboratory	Sample Type	Test Code	Method	Holding Time	Container	Preservation	Lab MDL	Project Quantification Level	Units	Accuracy MS/D % Rec	Precision % RPD	LCS Accuracy % Rec
<b>Base Neutral Extractable Organics</b>													
Bis (2-Ethylhexyl) Phthalate	QC	Field Composite	625-BN	EPA 625	7 Days	3 x 1 Liter Glass	Cool 4°C	0.7	1	ug/L	8-158%	17%	8-158%

Parameter	Laboratory	Sample Type	Test Code	Method	Holding Time	Container	Preservation	Lab MDL	Project Quantification Level	Units	MS Accuracy Limits % Recovery	Precision Standard Deviation (s) ug/L	LCS Accuracy Concentration Limits ug/L
<b>Volatile Organics</b>													
1,1,1-Trichloroethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.19	1	ug/L	52-162	2.5	13.7-30.1
1,1,2,2-Tetrachloroethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.16	1	ug/L	46-157	2.5	13.5-27.2
1,1,2-Trichloroethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.12	1	ug/L	52-150	3.0	14.3-27.1
1,1-Dichloroethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.1	1	ug/L	59-155	2.9	14.2-28.5
1,1-Dichloroethylene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.19	1	ug/L	det-234	2.9	3.7-42.3
1,2-Dichloroethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.14	1	ug/L	49-155	2.7	14.3-27.4
1,2-Dichloropropane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.21	1	ug/L	det-210	2.5	3.8-36.2
1,2-trans-Dichloroethylene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.19	1	ug/L	54-156	2.6	13.6-28.5
1,3-Dichloropropene-cis	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.1	1	ug/L	det-227	2.5	det-227
1,3-Dichloropropene-trans	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.12	1	ug/L	17-183	2.8	17-183
2-Chloroethyl Vinyl Ether	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.15	1	ug/L	det-305	12.8	det-50.4
Acrolein	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	1.81	2	ug/L	48-161	13.2	2.2-81.7
Benzene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.11	1	ug/L	37-151	2.5	15.2-26.0
Bromodichloromethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.13	1	ug/L	35-155	2.9	10.1-28.0
Bromoform	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.12	1	ug/L	45-169	2.6	11.4-31.1
Carbon Tetrachloride	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.19	1	ug/L	70-140	2.5	17.2-23.5
Chlorobenzene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.13	1	ug/L	37-160	2.4	16.4-27.4
Chlorodibromomethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.17	1	ug/L	53-149	3.0	13.8-26.6
Chloroethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.19	1	ug/L	14-230	3.1	8.4-40.4
Chloroform	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.12	1	ug/L	51-138	2.6	13.7-24.2
Ethylbenzene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.11	1	ug/L	37-162	2.6	17.4-26.7
Methyl Bromide, Bromomethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.38	1	ug/L	det-242	4.2	det-41.2
Methyl Chloride, Chloromethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.14	1	ug/L	14-230	3.2	det-45.9
Methylene Chloride	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.15	1	ug/L	det-221	2.3	det-41.0
Tetrachloroethylene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.19	1	ug/L	64-148	2.7	17.0-26.6
Toluene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.15	1	ug/L	47-150	2.6	16.6-26.7
Trichloroethylene	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.12	1	ug/L	71-157	2.7	18.6-27.6
Trichlorofluoromethane	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.2	1	ug/L	17-181	3.3	8.9-31.5
Vinyl Chloride	QC	Grab	VOC-624/ac/can	EPA 624	14 days	3 x 40 mL VOA Vials	HCL, PH2	0.22	1	ug/L	det-251	2.8	det-43.5

Note: NA = Not Applicable

[1] For the purposes of reporting Chromium Trivalent (+3) data for this project, the following protocol will be followed:

- A. When the Total Chromium value is reported as a value less than the Project Quantification Level (i.e.<2 ug/L), Chromium Trivalent will also be reported as a value of less than the Total Chromium Project Detection Level (i.e. <2 ug/L)
- B. When (1) the Total Chromium value is reported as a quantifiable value greater or equal to the Project Quantification Level (i.e. >2 ug/L) but less than the Project Quantification Level for Chromium Trivalent (+6) (i.e. <10.0 ug/L) and (2) the results for Chromium (+6) are reported as a value less than the reported value for Total Chromium.
- C. When (1) the Total Chromium value is reported as a quantifiable value greater or equal to the Project Quantification Level for Chromium (+6) (i.e. >10.0 ug/L) and (2) the results for Chromium (+6) are reported as a value less than Project Quantification Level (i.e. "<10.0 ug/L"), Chromium (+3) will be reported using the following calculation:  
Chromium (+3) = Total Chromium - 10.5 x the Project Quantification Level for Chromium (+6)
- D. When (1) the Total Chromium value is reported as a quantifiable value greater or equal to the Project Quantification Level (i.e. >10.0 ug/L), Chromium (+3) will be reported using the following calculation: Chromium (+3) = Total Chromium - Chromium (+6)  
reported as a quantifiable value greater or equal to the Project Quantification Level (i.e. >10.0 ug/L)
- E. When the Chromium (+6) results are greater than the Total Chromium results, the results for Chromium (+3) will be reported as a footnote indicating the value for Chromium (+3) cannot be determined.

## APPENDIX G

Sediment Oxygen Measurements  
As provided by HDR/HydroQual

# **SEDIMENT OXYGEN DEMAND MEASUREMENTS**

## **1 INTRODUCTION**

A critical component of water quality models is the sediment oxygen demand (SOD). HydroQual, and its predecessor organization Hydrosience, have been measuring SOD and sediment flux and incorporating it into water quality models for over twenty-five years. Applications include models where measured SOD is directly incorporated, such as for the Qachita River in Arkansas and Louisiana (July 1992) and state-of-the-art sediment flux models such as developed for the Chesapeake Bay for the U.S. Army Corps of Engineers (February 1991). SOD analysis is under the general direction of Dr. Dominic DiToro. Dr. DiToro is a recognized expert on sediment flux processes and modeling. Publications include "Sediment Oxygen Demand Model: Methane and Ammonia Oxidation," (Journal of Environmental Engineering, ASCE, September/October, 1991) and "A Diagenic Oxygen Equivalents Model of Sediment Oxygen Demand," (Sediment Oxygen Demand, Processes, Modeling & Measurement, University of Georgia Institute of Natural Resources, 1986).

## **2 SAMPLING PROCEDURES**

SOD measurements are performed in the laboratory using sediment cores. HydroQual has found the core technique to generally be more effective than in-situ methods. Performing SOD measurements in the laboratory allows better analytical control, allows low water column dissolved oxygen concentrations to be adjusted to avoid SOD inhibition, and allows replicates to be performed on the same core by reaerating and repeating the experiment.

Sediment cores are collected using four inch inner diameter plexiglass core tubes having a beveled lower edge to aid in core tube penetration. Core tubes are manufactured by Aquatic Research Innovations, Seattle, Washington. Use of these relatively large diameter core tubes minimizes possible wall effects which could disturb the sediment sample and also maximizes test sensitivity and availability of overlying sample water for a given depth of overlying water. Cores are collected upstream of the sampler to minimize disturbance of the sediment sample. Core tubes are pressed into the sediment such that, as nearly as possible, 6 inches of overlying water is retained in the core tube above the core sample. A rubber end cap is then placed on top of the core tube to create a vacuum which prevents the core sample from slipping downward and the core sample is

then slowly removed from the sediment. At this point a plastic disc is placed on the bottom of the core tube and a second rubber end cap is then placed on the bottom end of the core tube. The core is then returned to the surface where the bottom end caps are sealed with stainless steel clamps to insure that leakage does not occur. Cores may also be collected from a boat by using an extension rod. When using an extension rod, an anti-backflow valve is attached to the top end of the core tube. This automatically seals the tube to create a vacuum as the tube is withdrawn from the sediment.

The four inch core tubes work best in soft sediments with high organic concentrations. For sandy or hardpacked sediments onto which the four inch core tubes can not be driven or for which the wall friction of the four inch core tubes is insufficient to prevent the core from slipping out of the tube, two inch inner diameter plexiglass core tubes manufactured by Wildco, Inc., may be substituted. The two inch core tubes fit inside a stainless steel sleeve which protects the plexiglass core tube and allows the core tube to be driven with much greater force. In some cases, when the bottom is too rocky to obtain a core and an alternate location must be selected.

To correct for oxygen demand due to water column BOD, water column samples are collected along with each core.

After collection, cores are maintained in an upright position, at approximately in situ river temperature, and are transported to the laboratory for analysis. The cores will be set up and run at HydroQual's Laboratory, Mahwah, New Jersey.

### **3 ANALYTICAL PROCEDURES FOR OXYGEN DEMAND**

In the laboratory, dissolved oxygen monitoring is performed using a standard YSI Model 50 dissolved oxygen meter calibrated in accordance with New Jersey DEP SOPs.

#### **SOD Laboratory Procedures**

The following procedure is followed to determine the SOD of the sediment core. The procedure measures the flux of O<sub>2</sub> to the sediment. Units are in g/m<sup>2</sup>/day.

1. The top rubber end cap is removed and a circular plexiglass lid having o-rings is slid inside the core tube to provide an air tight and leak proof seal. About 6 inches of water column is left above the sediment. Care is taken

to insure that all air bubbles are removed. The o-ring lids have a 0.8 inch hole sized to facilitate a dissolved oxygen probe and several smaller holes to facilitate a circulation system (for mixing). These holes are sealed with stoppers when not in use.

2. The water column is gently aerated using an air stone until the dissolved oxygen approaches saturation and core temperature stabilizes at lab temperature.
3. Overlying water column "blanks" are set up along side the sediment cores to correct the SOD for demand due to water column BOD. These can be set up in an empty tube or done in a BOD bottle.
4. The dissolved oxygen meter (YSI Model 50 w/ stirrer) is calibrated.
5. Cores are gently mixed between dissolved oxygen readings using a circulation system or a mixing paddle.
6. The lid stopper is removed, dissolved oxygen probe inserted, and initial dissolved oxygen reading is taken. Prior to all dissolved oxygen readings, the overlying water is gently mixed to insure dissolved oxygen uniformity. The time, temperature (from meter), and dissolved oxygen are recorded. The dissolved oxygen probe is then removed and the lid stopper is reinserted.
7. Readings are generally made every hour. Active sediments will necessitate more frequent measurements and less active sediments less frequent measurements.
8. Generally, the experiment is run until a dissolved oxygen depletion of at least 2 to 4 mg/L has been achieved. If the dissolved oxygen for a core depletes rapidly, the water column may be reaerated and the experiment repeated as a replicate.

The sediment oxygen demand rate is derived from the SOD procedure raw data (Step 8) by plotting the dissolved oxygen versus time for both the sediment core and water column "blank", performing linear regressions to obtain slopes, and deriving the SOD from the following equation:



$$\text{SOD} = (K_{\text{sod}} - K_{\text{bod}}) \times H$$

where:  $K_{\text{sod}}$  = Sediment dissolved oxygen slope (mg/L per day)  
 $K_{\text{bod}}$  = "Blank" dissolved oxygen slope (mg/L per day)  
 $H$  = water column height (m) in core tube

SOD may then be corrected to 20°C using the following equation:

$$\text{SOD}_{20} = \text{SOD}_T / (\theta^{(T-20)})$$

with  $\theta = 1.08$

$T$  = temperature at which SOD test is performed, °C

## APPENDIX H

YSI 556 MPS Multi-Meter

# YSI Environmental



**YSI 556 MPS**  
Multi Probe System

**Operations  
Manual**

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## 2. General Information

---

### 2.1 Description

The rugged and reliable YSI 556 MPS (Multi-Probe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multi-parameter system. Featuring a waterproof, impact-resistant case, the YSI 556 MPS simultaneously measures dissolved oxygen, conductivity, temperature, and optional pH and ORP. A simple cellular phone style keypad and large display make the instrument easy to use. The YSI 556 MPS is compatible with YSI EcoWatch<sup>TM</sup> for Windows<sup>TM</sup> software.

The YSI 556 MPS assists the user in conforming to Good Laboratory Practice (GLP) standards which help ensure that quality control/quality assurance methods are followed. Battery life is displayed with a fuel gauge, and the user can choose standard alkaline batteries or an optional rechargeable battery pack.

The 1.5 MB memory can store more than 49,000 data sets. Other options include a flow cell and barometer. The internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure.

#### Features

- Waterproof -meets IP67 specifications
- Field-replaceable DO electrode module; pH and pH/ORP sensors
- Compatible with EcoWatch<sup>TM</sup> for Windows<sup>TM</sup> data analysis software
- Assists with Good Laboratory Practice Standards (GLP)
- Choice of DO membrane material for different applications
- Easy-to-use, screw-on cap DO membranes
- User-upgradeable software from YSI website
- Three-year warranty on the instrument; one-year on the probe modules
- Available with 4,10, and 20 m cable lengths
- Stores over 49,000 data sets, time and date stamped

- Auto temperature compensating display contrast
- Optional barometer
- Optional rechargeable battery pack or standard alkaline batteries

## 2.2 Unpacking the Instrument

1. Remove the instrument from the shipping box. Note that the probe module and sensors are shipped in a separate box and will be unpacked later in Section 3.2 *Unpacking the Probe Module*

**NOTE:** Do not discard any parts of supplies.

2. Use the packing list to ensure all items are present.
3. Visually inspect all components for damage.

**NOTE:** If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to Appendix E Customer Service or [www.ysi.com](http://www.ysi.com).



2.3 Features of the YSI 556 Multi-Probe System

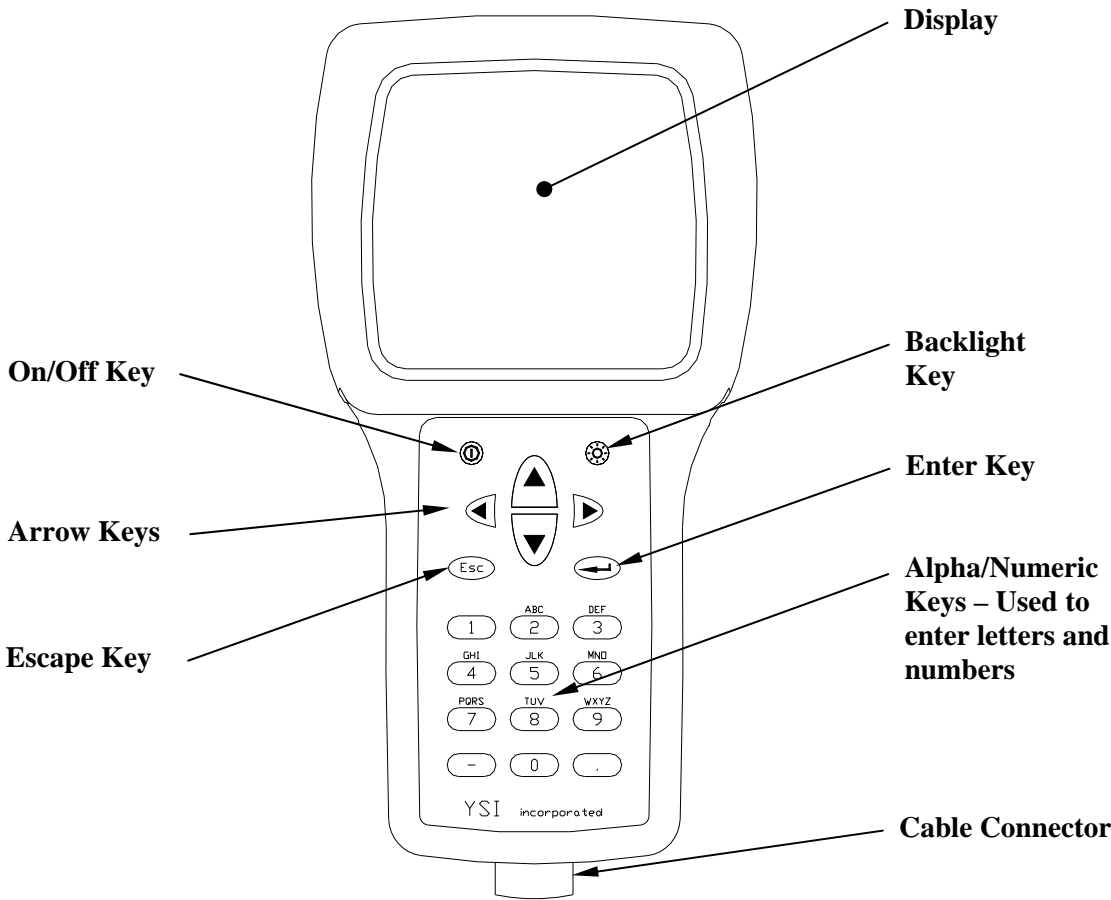
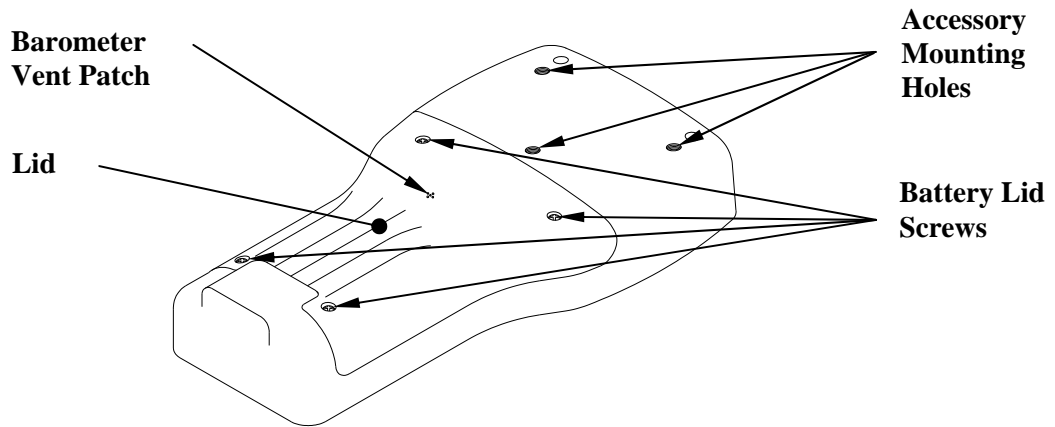


Figure 2.1 Front View of YSI 556 MPS



**Figure 2.2 Back View of YSI 556 MPS**

## **2.4 Batteries**

### **2.4.1 Battery Life**

#### **Standard Alkaline Batteries**

With the standard battery configuration of 4 alkaline C cells, the YSI 556 MPS will operate continuously for approximately 180 hours. Assuming a standard usage pattern when sampling of 3 hours of “on time” in a typical day, the alkaline cells will last approximately 60 days.

#### **Optional Rechargeable Battery Pack**

When fully charged, the optional rechargeable battery pack will provide approximately 50 hours of battery life.

### 2.4.2 Inserting 4 C Batteries

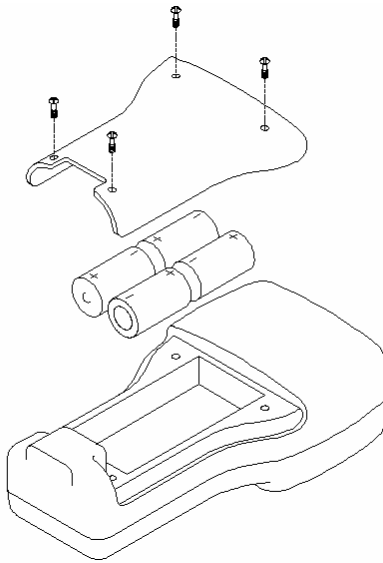


Figure 2.1 Inserting C Cells



**CAUTION:** Install batteries properly to avoid damage to the instrument.

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.
2. Remove the battery lid.
3. Insert four C batteries between the clips following the polarity (+ and -) labels on the bottom of the battery compartment.
4. Check gasket for proper placement on the battery lid.
5. Replace the battery lid and tighten the 4 screws securely and evenly.

**NOTE:** Do not over-tighten the screws.

### 2.4.3 Inserting Optional Rechargeable Battery Pack

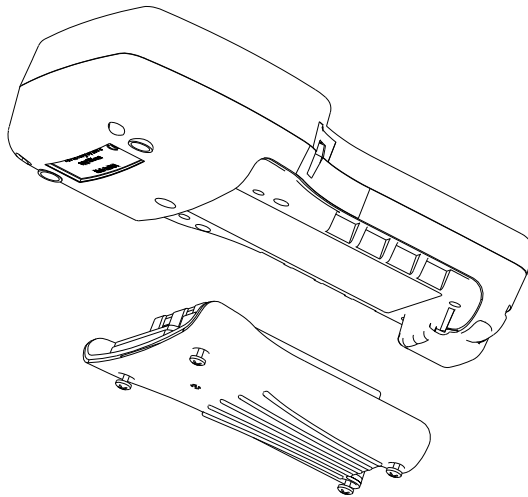


Figure 2.2 Inserting Battery Pack



**CAUTION:** Read all cautions and warning that come with the battery pack before using the battery pack.

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.
2. Remove the C battery lid and store for future use. Remove C batteries, if installed.
3. Install the rechargeable battery pack and lid and tighten the 4 screws securely and evenly.

**NOTE:** Do not over tighten the screws.

## 2.4.4 Charging the Optional Rechargeable Battery Pack

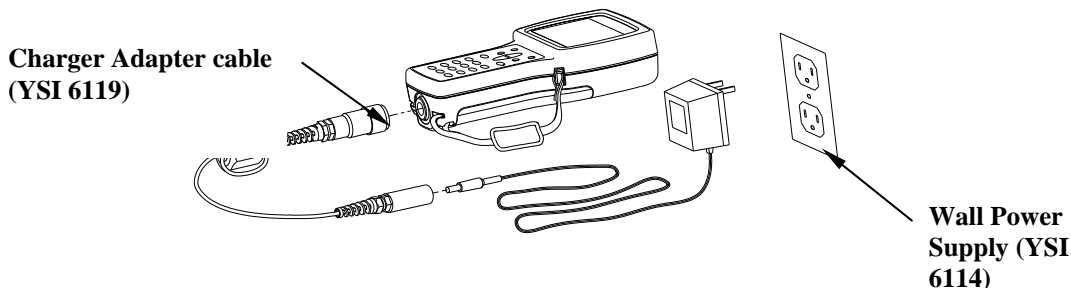


Figure 2.3 Charging the Battery Pack

**CAUTION:** Do not use or store the battery pack at extreme temperatures such as in strong direct sunlight, in cars during hot weather or close to heaters.

1. Install the rechargeable battery pack into the instrument as described in Section 2.4.3 *Inserting Optional Rechargeable Battery Pack*.
2. Attach the charger adapter cable (YSI 6119) to the instrument.

**NOTE:** Wall power supplies for use in countries outside the US and Canada can be found in *Appendix B Instrument Accessories*.

3. Insert the barrel connector of the wall power supply into the barrel of the adapter cable.

**CAUTION:** Do not charge the battery pack continuously for more than 48 hours.

**CAUTION:** Do not drop or expose to water.

**CAUTION:** Do not charge the battery pack at temperatures below 0°C or above 40°C.

4. Plug the wall power supply into an AC power outlet for approximately 2 hours to obtain an 80% to 90% charge for 6 hours to get a full charge.


**NOTE:** The battery pack can be recharged whether the instrument is on or off.

### 2.4.5 Storing the Battery Pack


Remove the battery pack from the instrument when the instrument will not be used for extended periods of time to prevent over discharge of the battery pack.

Store the battery pack in a heavy plastic bag to prevent accidental shorting of the terminals. Store between  $-20$  and  $30^{\circ}\text{C}$ .

### 2.4.6 Optional Cigarette Lighter Charger

 **CAUTION:** Read all warnings and cautions that come with the charger before using the charger.

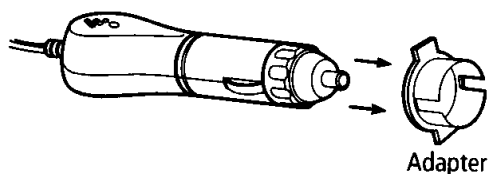
 **CAUTION:** Only use cigarette lighter charger when rechargeable battery pack is inserted into instrument.

 **CAUTION:** Do not mishandle cigarette lighter charger. Do not expose to moisture.

1. Plug the barrel connector of the cigarette lighter charger into the mating end of the YSI 6119 Charger Adapter Cable.
2. Attach the MS-19 end of the YSI 6119 Charger Adapter Cable to the instrument.
3. Make one of the following modifications to the other end of the charger:

Slide the adapter ring off the plug to use the device with an American or Japanese vehicle.

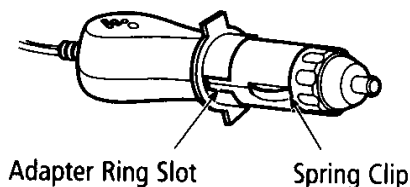
### American and Japanese Vehicles



**Figure 2.1 Charger Plug Adapter Use**

Leave the adapter ring on the plug and position it so that the slots on the adapter ring line up with the plug's spring clips to use the device on a European vehicle.

### European Vehicles



**Figure 2.2 European Charger Plug Adapter Use**

**NOTE:** If the charger stops working properly, refer to Section 13 *Troubleshooting*.

## 2.5 Power On

Press and release the on/off button in the upper left corner of the instrument keypad to turn the instrument on or off. See Figure 2.1 Front View of YSI 556 MPS.

## 2.6 Setting Display Contrast

The display contrast automatically compensates for temperature changes. However, under extreme temperature conditions you may wish to optimize the display by manual adjustment as follows:

1. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “up” arrow to increase (darken) the contrast.
2. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “down” arrow to decrease (lighten) the contrast.

## 2.7 Backlight

Press and *release* the backlight key in the upper right corner of the keypad to turn the backlight on or off. See Figure 2.1 Front View of YSI 556 MPS.

**NOTE:** The backlight turns off automatically after two minutes of non-use.

## 2.8 General Screen Features

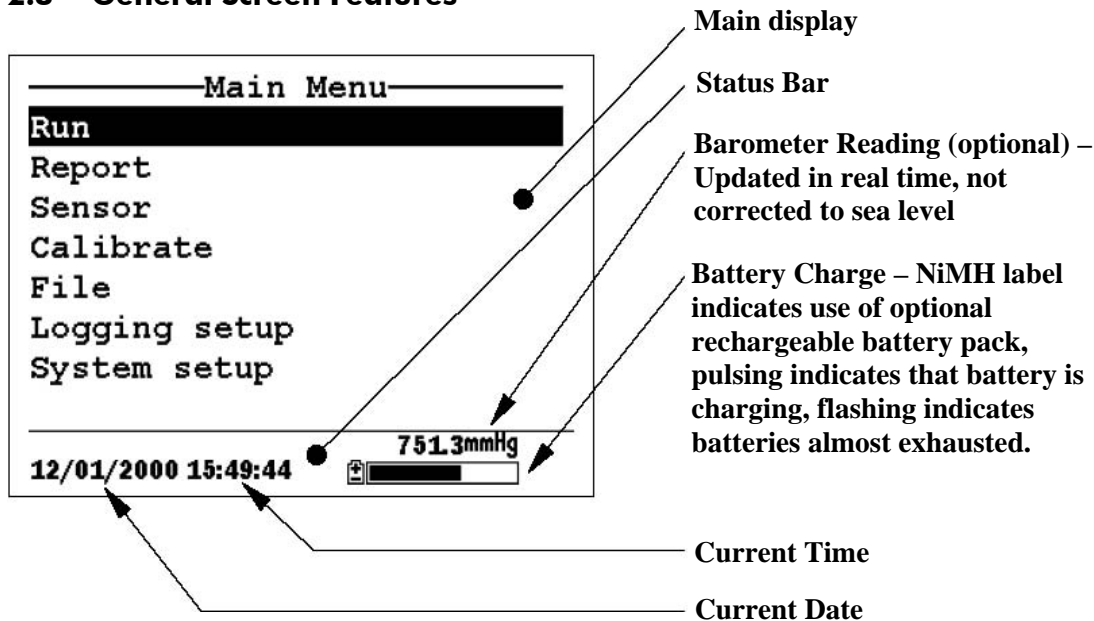


Figure 2.4 Main Screen Menu



2.9 Keypad Use

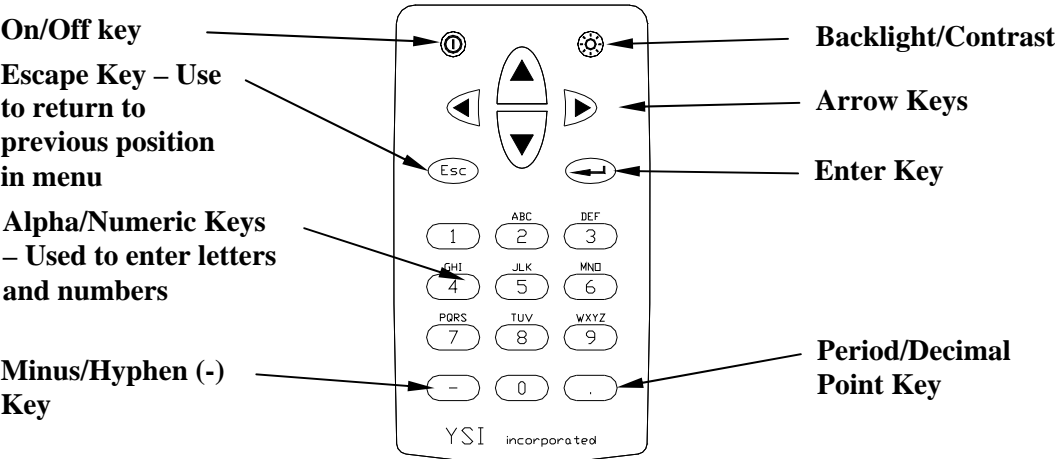


Figure 2.5 Keypad Features

KEY	LETTER/NUMBER
1	1
2	ABC2abc3
3	DEF3def3
4	GHI4ghi4
5	JKL5jkl5
6	MNO6mno6
7	PQRS7pqrs7
8	TUV8tuv8
9	WXYZ9wxyz9
0	0

Figure 2.6 Keypad Features

1. See Figure 2.10 Keypad Letters & Numbers and press the appropriate key repeatedly until letter or number desired appears in display.

**NOTE:** Press the key repeatedly in rapid succession to get to the desired letter or number. If you pause for more than a second, the cursor automatically scrolls to the right to prepare for the next input.

EXAMPLE 1: Press the **6** key *once* and *release* to display an uppercase “M”.

EXAMPLE 2: Press the **6** key *four times* and *release* to display the number “6”.

EXAMPLE 3: Press the **6** key *five times* and *stop* to display a lowercase “m”.

2. Press the left arrow key to go back and reenter a number or setter that needs to be changed.

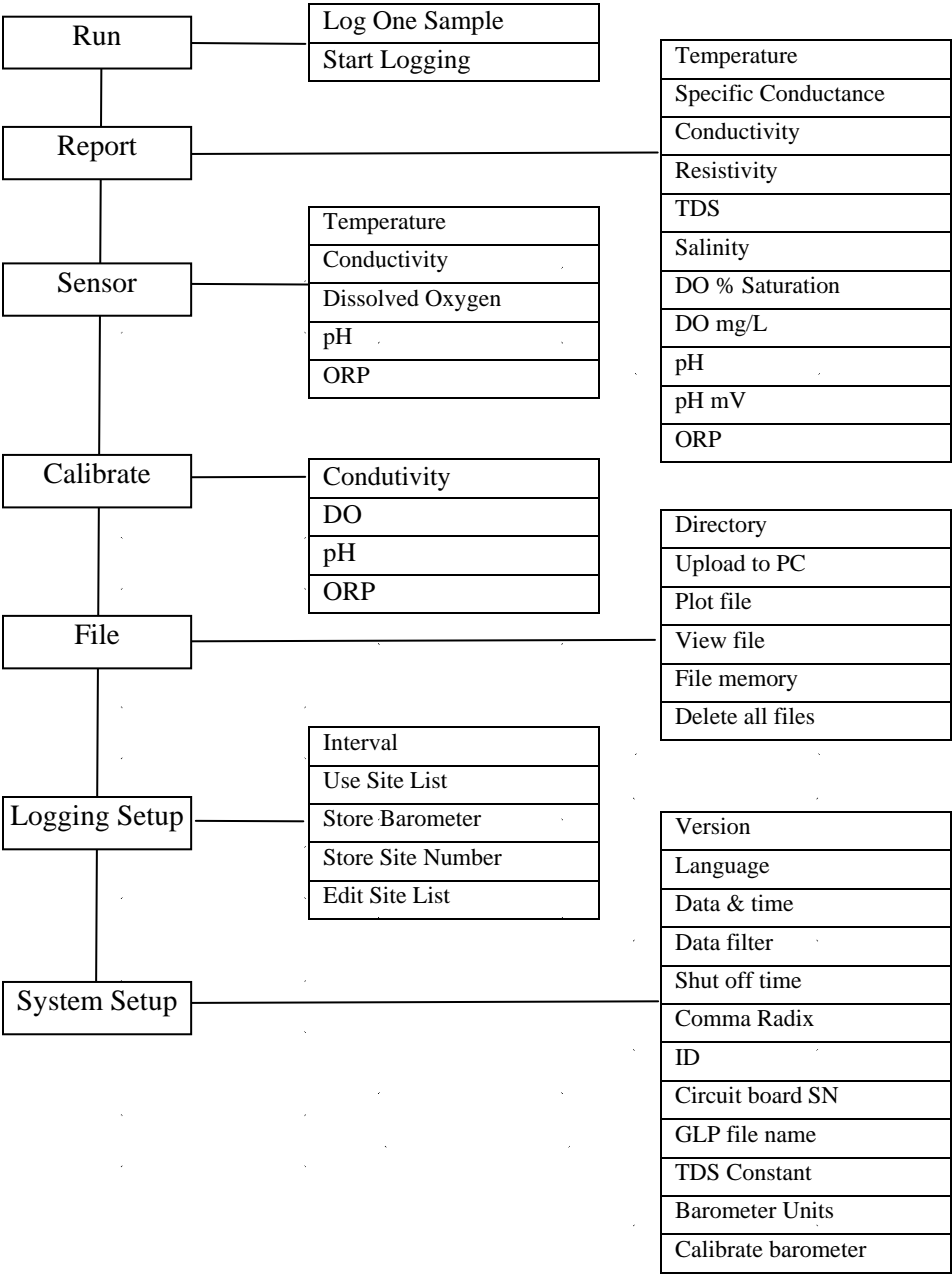
Press the **Enter** key when your entry is complete.

**NOTE:** The instrument software permits only numeric entries in many instances, such as when setting the clock or entering calibration parameters.

## 2.10 Instrument Reset

The YSI 556 MPS is characterized by sophisticated software that should provide trouble-free operation. However, as with all high-capability software packages, it is always possible that the user will encounter circumstances in which the instrument does not respond to keypad entry. If this occurs, the instrument function can easily be restored by removing and then reapplying battery power. Simply remove either your C-cells or rechargeable battery pack from the battery compartment, wait 30 seconds and then replace the batteries. See Section 2.4 *Batteries* for battery removal/reinstallation instructions.

2.11 Menu Flowchart



## 3. Probe Module

---

### 3.1 Introduction

The YSI 5563 Probe module is used for measuring dissolved oxygen, temperature, conductivity, and optional pH and ORP. The probe module is rugged, with the sensors enclosed in a heavy duty probe sensor guard with attached sinking weight. A 4, 10 or 20 meter cable is directly connected to the probe module body making it waterproof. An MS-19 connector at the end of the cable makes the YSI 5563 fully compatible with the YSI 556 Multi-Probe System.

### 3.2 Unpacking the Probe Module

1. Remove the YSI 5563 Probe Module from the shipping boxes.

**NOTE:** Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.
3. Visually inspect all components for damage.

**NOTE:** If any parts are missing or damaged, contact a YSI representative immediately. Refer to: *Appendix E Customer Service* or visit [www.ysi.com](http://www.ysi.com).

### 3.3 Features of the YSI 5563 Probe Module

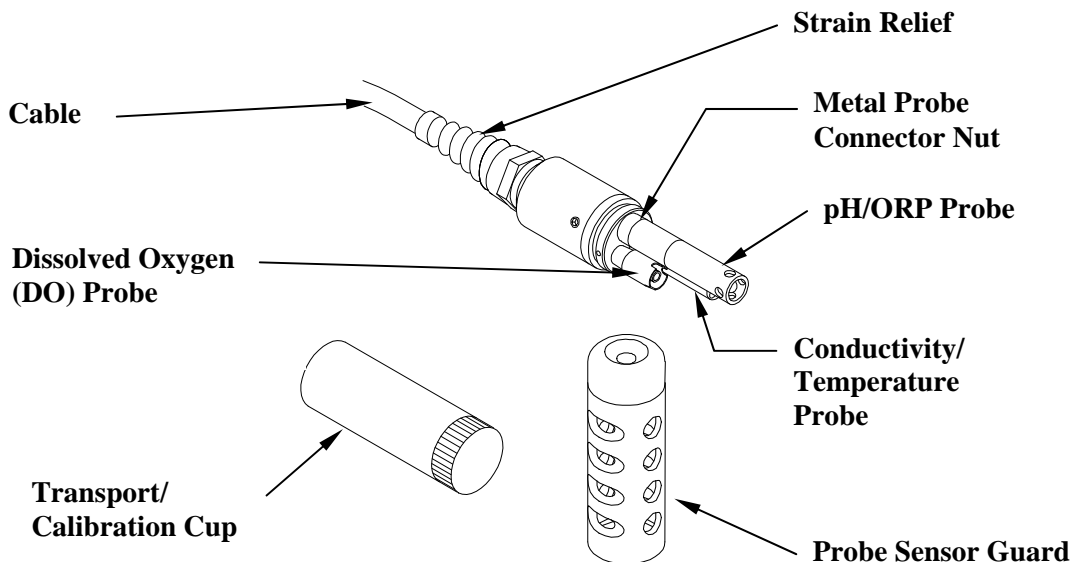


Figure 3.1 Probe Module

### 3.4 Preparing the Probe Module

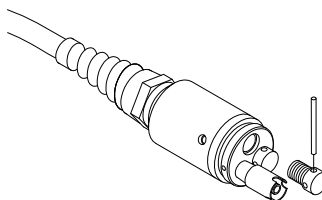
To prepare the probe module for calibration and operation, you need to install the sensors into the connectors on the probe module bulkhead. In addition to sensor installation, you need to install a new DO membrane cap.

#### 3.4.1 Sensor Installation

Whenever you install, remove or replace a sensor, it is extremely important that the entire probe module and all sensors be thoroughly dried prior to the removal of a sensor or a sensor port plug. This will prevent water from entering the port. Once you remove a sensor or plug, examine the connector inside the probe module sensor port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the probe module to your YSI Distributor or directly to YSI Customer Service. Refer to *Appendix E Customer Service*.

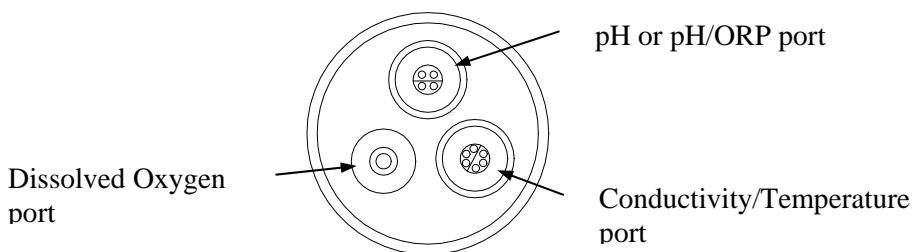
## Conductivity/Temperature and pH, pH/ORP Sensor Installation

1. Unscrew and remove the probe sensor guard.
2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.



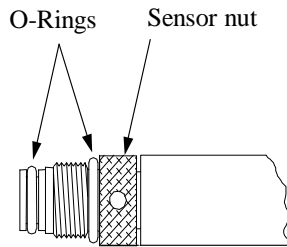
**Figure 3.2 Port Plug Removal**

3. Locate the port with the connector that corresponds to the sensor that is to be installed.



**Figure 3.3 Sensor Port Identification**

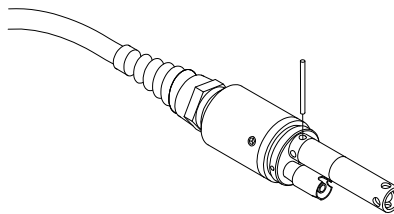
4. Apply a thin coat of o-ring lubricant (supplied in the YSI 5511 maintenance kit) to the o-rings on the connector side of the sensor (see Figure 3.4 O-ring Lubrication).



**Figure 3.4 O-ring Lubrication**

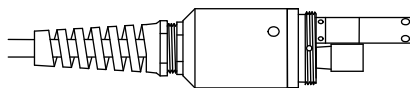
**⚠ CAUTION:** Make sure that there are NO contaminants between the o-ring and the sensor. Contaminants that are present under the o-ring may cause the o-ring to leak.

5. Be sure the probe module sensor port is free of moisture and then insert the sensor into the correct port. Gently rotate the sensor until the two connectors align.
6. With the connectors aligned, screw down the sensor nut using the sensor installation tool.



**Figure 3.5 Sensor Installation**

**⚠ CAUTION:** Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.



**Figure 3.6 Bulkhead Seating**

7. Repeat steps 3-6 for any other sensors.

## 8. Replace the probe sensor guard.

### Dissolved Oxygen Sensor Installation

The YSI 5563 comes with the DO sensor already installed. Refer to Section *11.1.2 DO Sensor Replacement* for instructions on installing the YSI 559 Replaceable DO Module Kit.

#### 3.4.2 Membrane Cap Selection

The YSI 5563 is shipped with a YSI 5909 kit that contains membrane caps made with 2 mil polyethylene (PE), a material which should be ideal for most field applications of the 556. However, YSI also offers membrane caps made with two other materials (1 mil polyethylene and 1 mil Teflon) which some users may also prefer. All membranes available for the 556/5563 system provide comparable accuracy if used properly. The difference between the two thicknesses of PE is found in the trade-off of flow dependence and response time as described below. Teflon is offered because some users may prefer to continue using the traditional membrane material used by YSI. To avoid confusion, the membrane caps are color coded as described below and can be ordered in kits as noted:

1 mil Teflon – Black Caps (Kit = YSI 5906)

1 mil Polyethylene (PE) – Yellow Caps (Kit = YSI 5908)

2 mil Polyethylene (PE) – Blue Caps (Kit = YSI 5909)

The 1 mil Teflon caps will offer traditional, reliable performance for most dissolved oxygen applications. The 1 mil PE caps will provide a significantly faster dissolved oxygen response (as long as your 556 Data Filter is set correctly as described below in Sections 10.2 and 10.3.1) while also giving readings which are significantly less flow dependent than the 1 mil Teflon caps. Finally, 2 mil PE caps will show a large reduction in flow dependence over 1 mil Teflon while not significantly increasing the response time. Generally, one of the PE caps is likely to provide better performance for your application.

**IMPORTANT:** No matter which type of membrane cap you select, you will have to confirm your selection in the 556 software from the Sensor menu as described in Section *4 Sensors*.



### 3.4.3 Membrane Cap Installation

**NOTE:** The YSI 5563 DO sensor (already installed in the probe module) was shipped dry. A shipping membrane was installed to protect the electrode. **A new membrane cap must be installed before the first use.**

1. Unscrew and remove the probe sensor guard.
2. Unscrew, remove, and discard the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the electrolyte according to the directions on the electrolyte solution bottle.
5. Hold the new membrane cap and fill it at least ½ full with the electrolyte solution.
6. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.



**Caution:** Do not touch the membrane surface.

7. Screw the probe sensor guard on moderately tight.

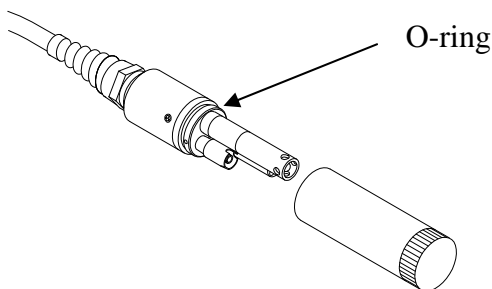
### 3.5 Transport/Calibration Cup

The YSI 5563 Probe module has been supplied with a convenient transport/calibration cup. This cup is an ideal container for calibration of the different sensors, minimizing the amount of solution needed. Refer to Section 6 *Calibrate*.

### 3.5.1 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if already installed.
2. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.
3. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

**NOTE:** Do not over tighten as this could cause damage to the threaded portions.



**Figure 3.7 Transport/Calibration Cup Installation**

### 3.6 Instrument/Cable Connection

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 Front View of YSI 556 MPS.
2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

## 4. Sensors

The Sensors screen allows the user to enable or disable each of the sensors and select which membrane material will be used for the dissolved oxygen sensor. Disabled sensors will not be displayed on the screen in real time or logged to files.

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.

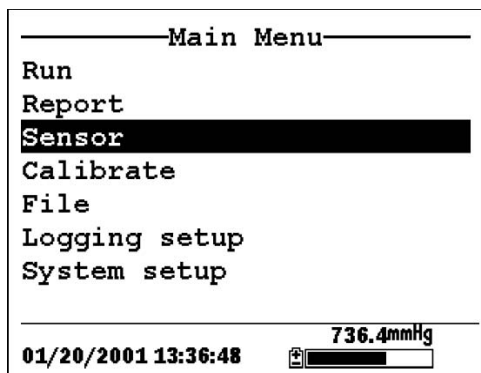
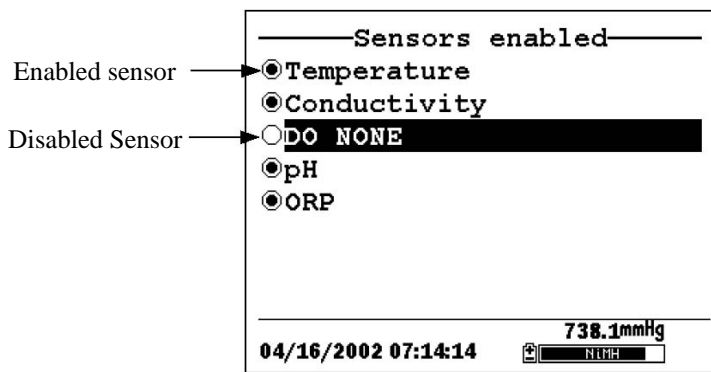


Figure 4.1 Main Menu Screen

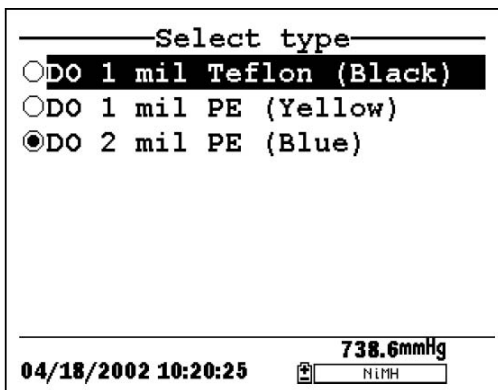
3. Use the arrow keys to highlight the **Sensor** selection.
4. Press the **Enter** key to display the sensors enabled screen.



**Figure 4.2 Sensors Enabled Screen Before DO Membrane Selection**

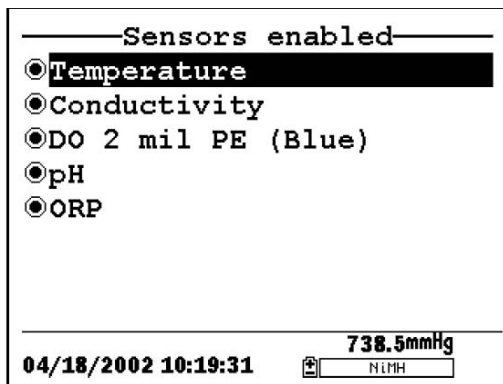
A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.

Highlight the “DO None” entry as shown above and press **Enter** to display the membrane choice screen. Consult Section 3.4.2 *Membrane Cap Selection* for information on the advantages of each type of membrane material. Blue membrane caps using 2 mil polyethylene (PE) were shipped with your YSI 5563 and are likely to be the best choice for most 556 field applications.



**Figure 4.3 Membrane Selection Screen**

Highlight the desired membrane choice – in this case, 2 mil PE - and press Enter to activate your selection with a dot to the left of the screen. Then press **Escape** to return to the Sensor menu that now shows your DO membrane selection.



**Figure 4.4 Sensors Enabled Screen After DO Membrane Selection**

**NOTE:** The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

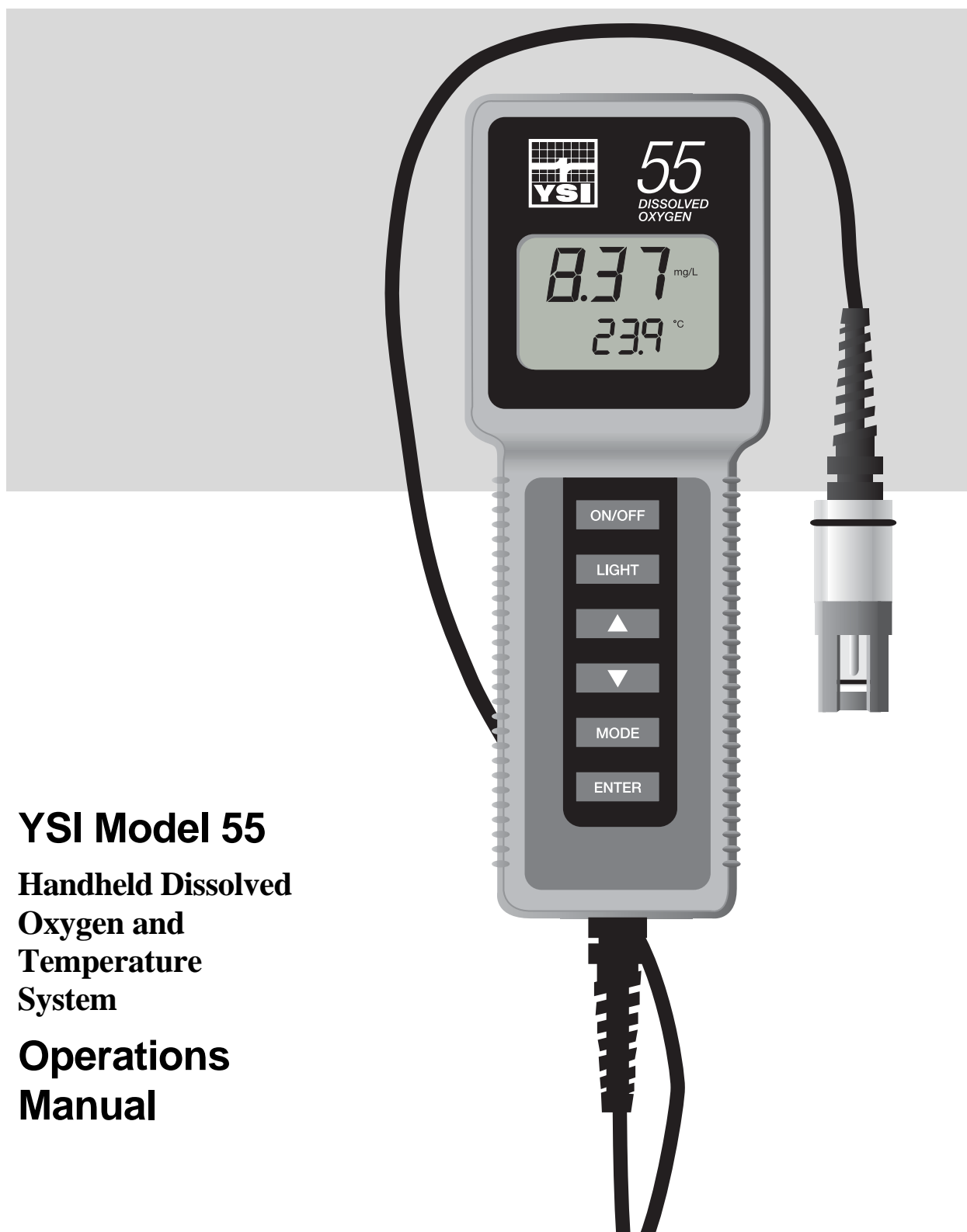
5. Use the arrow keys to highlight the sensor you want to change, then press the Enter key to enable or disable it.
6. Repeat step 5 for each sensor you want to change.
7. Press the Escape key to return to the main menu screen.

## APPENDIX I

YSI 55 – Dissolved Oxygen & Temperature Meter



*YSI incorporated*



**YSI Model 55**  
**Handheld Dissolved**  
**Oxygen and**  
**Temperature**  
**System**  
**Operations**  
**Manual**

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# 1. General Description

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The YSI Model 55 Handheld Dissolved Oxygen System is a rugged, micro-processor based, digital meter with an attached YSI dissolved oxygen probe.

The YSI Model 55 is designed for field use and is available with cable lengths of 12, 25 or 50 feet. The body of the probe has been manufactured with stainless steel to add rugged durability and sinking weight. The large Liquid Crystal Display (LCD) is easy to read and is equipped with a back-light for use in dark or poorly lighted areas.

The Model 55's micro-processor allows the system to be easily calibrated with the press of a few keys. Additionally, the micro-processor performs a self-diagnostic routine each time the instrument is turned on. The self-diagnostic routine provides you with useful information about the function of the instrument circuitry and the quality of the readings you obtain. For a list of these diagnostic features, see chapter 7 *Troubleshooting*.

The system simultaneously displays temperature in °C and dissolved oxygen in either mg/L (milligrams per liter) or % air saturation. The system requires only a single calibration regardless of which dissolved oxygen display you use. You can switch back and forth from % air saturation to mg/L with a single push of the **MODE** key.

A calibration chamber is built into the instrument. A small sponge in the chamber can be moistened to provide a water saturated air environment which is ideal for air calibration. This chamber is also designed for transporting and storing the probe. When the probe is stored in the chamber, the moist environment will prolong effective membrane performance and probe life.

The instrument is powered by six AA-size alkaline batteries. A new set of alkaline batteries will provide approximately 100 hours of continuous operation. When batteries need to be replaced, the LCD will display a "**LO BAT**" message.

The YSI Model 55 instrument case is splash resistant. You can operate your Model 55 in a steady rain without damage to the instrument.

## 2. Specifications

---

### Probe Operating Environment

Medium: fresh, sea, or polluted water

Temperature: -5 to +45°C

Depth: 0 to 12, 0 to 25 or 0 to 50 feet (depending on cable length)

**Meter Ambient Operating/Storage Temperature:** -10 to +50°C

**Material:** ABS, Stainless Steel, Acrylic, and other materials.

### Dimensions:

Height:	9.5 inches	(24.13 cm)
Thickness:	2.2 inches	(5.6 cm)
Width:	3.5 inches max.	( 8.89 cm)
Weight:	1.7 pounds	( 0.77 kg)

**Power:** 9 VDC - 6 AA-size Alkaline Batteries (included)

Approximately 100 hours operation from each new set of batteries

**Water Tightness:** Meets or exceeds IP65 standards

***Extensive testing of the YSI Model 55 suggests the following typical performance:***

### Temperature

Sensor Type.....	Thermistor
Range.....	-5 to +45°C
Accuracy .....	± 0.2°C
Resolution .....	0.1°C

### Dissolved Oxygen % Saturation

Sensor Type.....	Membrane covered polarographic
Range.....	0 to 200 % air saturation
Accuracy .....	± 2 % air saturation
Resolution .....	0.1 % air saturation

### Dissolved Oxygen mg/L

Sensor Type.....	Calculated from % air saturation, temperature and salinity.
Range.....	0 to 20 mg/L
Accuracy .....	± 0.3 mg/L
Resolution .....	0.01 mg/L

## 3. Preparing The Meter

---

### 3.1. Unpacking

When you unpack your new YSI Model 55 Handheld Dissolved Oxygen System for the first time, check the packing list to make sure you have received everything you should have. If there is anything missing or damaged, call the dealer from whom you purchased the Model 55. If you do not know which of our authorized dealers sold the system to you, call YSI Customer Service at 800-765-4974 or 937-767-7241, and we'll be happy to help you.

### 3.2. Warranty Card

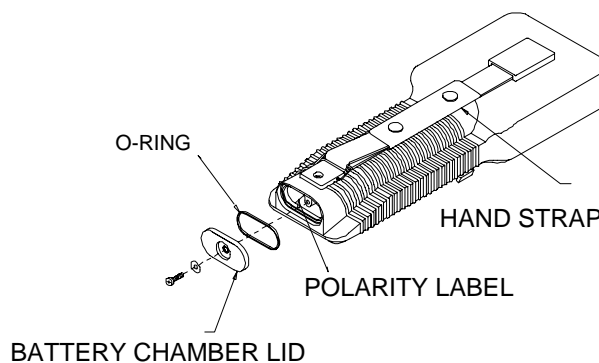
Before you do anything else, please complete the Warranty Card and return it to YSI. This will record your purchase of this quality instrument in our computer system. Once your purchase is recorded, you will receive prompt, efficient service in the event any part of your YSI Model 55 should ever need repair.

### 3.3. Batteries

There are a few things you must do to prepare your YSI Model 55 for use. First, locate the six AA-size alkaline batteries which were included. Use a screwdriver or a small coin to remove the thumbscrew on the bottom of the instrument. This thumbscrew holds the battery-chamber cover in place. The battery-chamber cover is marked with the words "OPEN" and "CLOSE."

NOTE: On some models, the battery cover thumbscrew may be unscrewed by hand (a screwdriver may not be required).

There is a small label inside each of the two battery-chamber sleeves. These labels illustrate the correct way to install the batteries into each sleeve of the battery-chamber.



**NOTE:** It is very important that the batteries be installed **ONLY** as illustrated. The instrument will not function if the batteries are installed incorrectly.

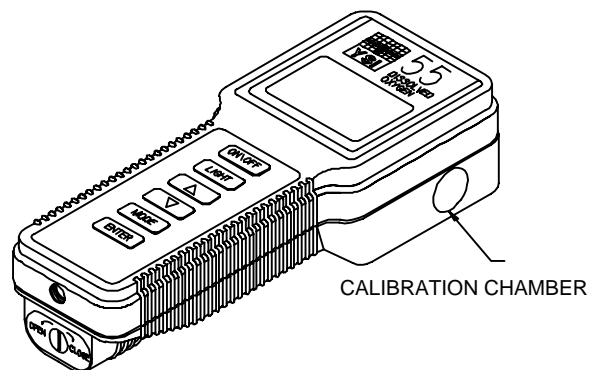
Turn the instrument on by pressing and releasing the **ON/OFF** button on the front of the instrument. The instrument will activate all segments of the display for a few seconds, which will be followed by a self test procedure which will last for several more seconds. During this power on self test sequence, the instrument's microprocessor is verifying that the instrument is working. If the instrument were to detect a problem, a **continuous** error message would be displayed. If the instrument does not operate, consult chapter 7 *Troubleshooting*.

**NOTE:** The information on the display will be meaningless since the probe has not yet been prepared.

You may also want to take the instrument into a dark room and, with the instrument ON, hold down the **LIGHT** key. The instrument back-light should illuminate the LCD so that the display can be easily read.

### **3.4. Calibration/Storage Chamber**

The Model 55 has a convenient calibration/storage chamber built into the instrument's side. This chamber provides an ideal storage area for the probe during transport and extended non-use. If you look into the chamber, you should notice a small round sponge in the bottom. Carefully put 3 to 6 drops of clean water into the sponge. Turn the instrument over and allow any excess water to drain out of the chamber. The wet sponge creates a 100% water saturated air environment for the probe which is ideal for dissolved oxygen calibration.



### **3.5. Hand Strap**

The hand strap is designed to allow comfortable operation of the Model 55 with minimum effort. If the hand strap is adjusted correctly, it is unlikely that the instrument will be easily dropped or bumped from your hand.

To adjust the hand strap on the back of the meter, unsnap the leather cover and pull the two Velcro strips apart. Place your hand between the meter and the strap and adjust the strap length so that your hand is snugly held in place. Press the two Velcro strips back together and snap the leather cover back into place.

### **3.6. The Meter Case**

The meter case is sealed at the factory and is not intended to be opened, except by authorized service technicians. **Do not attempt to separate the two halves of the meter case as this may damage the instrument, break the water-proof seal, and may void the manufacturer's warranty.**

## 4. Preparing The Probe

---

### 4.1. Description

The YSI Model 55 dissolved oxygen probe is a non-detachable, polarographic sensor designed specifically for the YSI Model 55 Handheld Dissolved Oxygen System. Probe cables are available in lengths of 12, 25 or 50 feet.

### 4.2. Choosing The Right Membrane

The YSI Model 5775 Standard Membrane Kit is supplied with the YSI Model 55. This kit contains thirty 1 mil (.001") membranes and a bottle of KCl solution. YSI recommends the 5775 membranes for most applications.

For special conditions, a 0.5 mil (.0005") membrane is available. Order YSI Model 5776 High Sensitivity Membrane Kit. This half-thickness membrane improves measurement time at low temperatures and helps suppress background current at very low dissolved oxygen levels. When data is routinely collected at sample temperatures below 15°C and at dissolved oxygen levels below 20% air saturation, the low signal current resulting from the use of the standard membranes tends to magnify the probe's inherent constant background signal. Using the high sensitivity membranes in this situation will decrease the percentage of error due to the probe's background current.

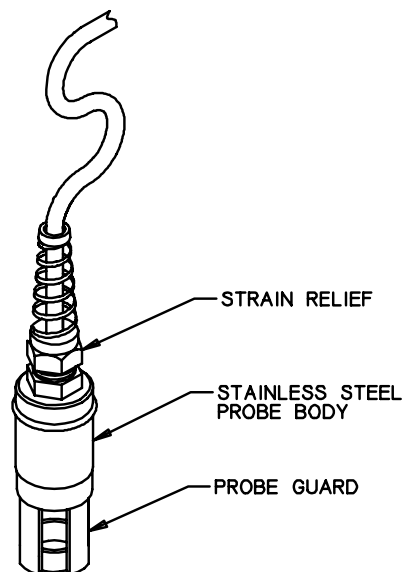
For long-term monitoring situations **ONLY**, a half-sensitivity, double-thickness, 2 mil (.002") membrane is available. For these applications, order the YSI Model 5685 Membrane Kit, which includes membranes and electrolyte.

### 4.3. Probe Preparation

The YSI Model 55 probe is shipped dry. **Before using the Model 55, the protective membrane on the probe tip must be removed, the probe must be filled with KCl solution and a new membrane must be installed.** Follow the instructions below to install the KCl solution and membrane.

To prepare for installation of a new membrane on your YSI Model 55 dissolved oxygen probe:

1. Unscrew the probe sensor guard.
2. Remove the old O-ring and membrane.
3. Thoroughly rinse the sensor tip and KCl reservoir with distilled water.
4. Prepare the electrolyte according to the directions on the KCl solution bottle.

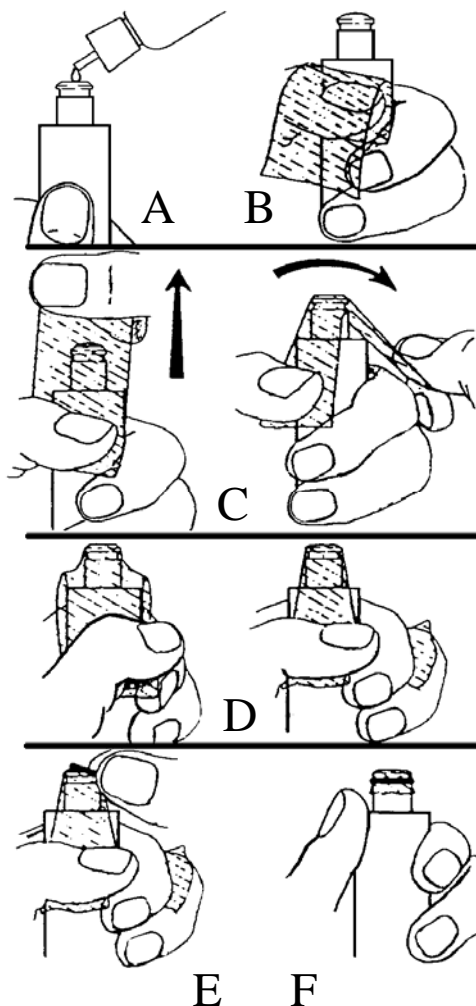


#### 4.4. Membrane Installation

- A. Secure a membrane between your thumb and the probe body. Add electrolyte to the probe until a large meniscus completely covers the gold cathode.

**NOTE:** Handle the membrane material with care, touching it at the ends only.

- B. With the thumb and forefinger of your other hand, grasp the free end of the membrane.
- C. With a continuous motion, stretch the membrane up, over, and down the other side of the sensor. Stretching forms the membrane to the contour of the sensor tip.
- D. Secure the end of the membrane under your forefinger while continuing to hold the probe.
- E. Roll the O-ring over the end of the probe, being careful not to touch the membrane surface. There should be no wrinkles in the membrane or trapped air bubbles under the membrane. Some wrinkles may be removed by lightly tugging on the edges of the membrane beyond the O-ring.
- F. Trim off excess membrane with scissors or a sharp knife. Check that the stainless steel temperature sensor is not covered by excess membrane.
- G. Shake off excess KCl. Rinse the stainless steel thoroughly with distilled water to prevent corrosion. Reinstall the sensor guard. The sensor should be kept in a humid environment (such as the calibration chamber) between measurements and when not in use.



#### **4.5. Probe Operation and Precautions**

1. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the KCl solution. The average replacement interval is two to four weeks.
2. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen evolving organisms (e.g. algae), erroneous readings may occur.
3. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the probe. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.
4. Avoid any environment which contains substances that may attack the probe materials. Some of these substances are concentrated acids, caustics, and strong solvents. The probe materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the polyurethane cable covering.
5. For correct probe operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, you may either return the instrument to the factory or clean it using the YSI Model 5680 Probe Reconditioning Kit. Never use chemicals or abrasives not supplied with this kit.
6. It is also possible for the silver anode to become contaminated, which will prevent successful calibration. To clean the anode, remove the O-ring and membrane and soak the probe overnight in 3% ammonium hydroxide. Next, rinse the sensor tip and KCl reservoir with deionized water, add new KCl solution, and install a new membrane and O-ring. Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, return the YSI Model 55 system to an authorized service center for service.
7. If the sensor O-ring is worn or loose, replace it with the appropriate O-ring provided in the YSI Model 5945 O-ring Pack.
8. To keep the electrolyte from drying out, store the probe in the calibration/storage chamber with the wet sponge.

## 5. Calibration

---

Dissolved oxygen calibration must be done in an environment with a known oxygen content. Since the amount of oxygen in the atmosphere is known, it makes an excellent environment for calibration (at 100% relative humidity). The calibration/storage chamber contains a moist sponge to create a 100% water saturated air environment.

### 5.1. Before You Calibrate

**Before you calibrate the YSI Model 55, complete the procedures discussed in the *Preparing the Meter* and *Preparing the Probe* chapters of this manual.**

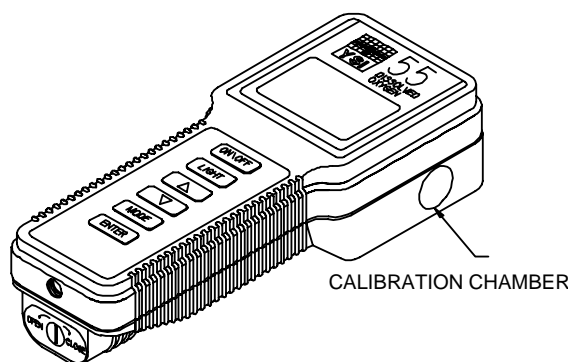
To accurately calibrate the YSI Model 55, you will need to know the following information:

- The approximate altitude of the region in which you are located.
- The approximate salinity of the water you will be analyzing. Fresh water has a salinity of approximately zero. Sea water has a salinity of approximately 35 parts per thousand (ppt). If you are not certain what the salinity of the sample water is, use a YSI Model 30 Salinity-Conductivity-Temperature meter to determine it.

### 5.2. The Calibration Process

1. Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.
2. Turn the instrument on by pressing the **ON/OFF** button on the front of the instrument. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required after turning the instrument on).
3. To enter the calibration menu, use two fingers to press and release both the **UP ARROW** and **DOWN ARROW** keys at the same time.
4. The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude.

**EXAMPLE:** Entering the number 12 here indicates 1200 feet.





5. When the proper altitude appears on the LCD, press the **ENTER** key. The Model 55 should now display **CAL** in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current DO reading (before calibration) should be on the main display.
6. Make sure that the DO reading (large display) is stable, then press the **ENTER** button. The LCD will prompt you to enter the approximate salinity of the water you are about to analyze. You can enter any number from 0 to 40 parts per thousand (PPT) of salinity. Use the arrow keys to increase or decrease the salinity setting. When the correct salinity appears on the LCD (zero for fresh water), press the **ENTER** key. The instrument will return to normal operation.

Once the calibration process is complete, the only keys which will remain operational are the **MODE** key, the **LIGHT** key and the **ON/OFF** key. You can move back and forth from reading dissolved oxygen in the mg/L mode or the % air saturation mode by pressing the **MODE** key. If you are working in a dark area and have difficulty reading the LCD, press and hold the **LIGHT** key to activate the back-light of the YSI Model 55. The **ON/OFF** key turns the instrument on or off.

**For best results:**

- Each time the Model 55 is turned off, re-calibrate before taking measurements.
- Calibrate at a temperature within  $\pm 10^{\circ}\text{C}$  of the sample temperature.

## 6. Principles Of Operation

---

The sensor consists of an acrylic body with a circular gold cathode embedded in the end. Inside the gold ring there is a small chamber containing a porous silver anode. In operation, this chamber is filled with a solution of KCl electrolyte containing a small amount of surfactant to improve wetting action.

A thin permeable membrane, stretched over the sensor, isolates the electrodes from the environment, while allowing gases to enter. When a polarizing voltage is applied to the sensor electrodes, oxygen which has passed through the membrane reacts at the cathode causing a current to flow.

The membrane passes oxygen at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that the oxygen pressure inside the membrane is zero. Hence, the force causing the oxygen to diffuse through the membrane is proportional to the partial pressure of oxygen outside the membrane. As the oxygen partial pressure varies, so does the oxygen diffusion through the membrane. This causes the probe current to change proportionally.

It is important to recognize that oxygen dissolved in the sample is consumed during the test. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the probe tip, or by rapidly moving the probe through the sample. The rate of stirring should be at least 1 foot per second.

### 6.1. Discussion Of Measurement Errors

There are three basic types of dissolved oxygen errors. Type 1 errors are related to limitations of instrument design and tolerances of instrument components. These are primarily the meter linearity and the resistor tolerances. Type 2 errors are due to basic probe accuracy tolerances, mainly background signal, probe linearity, and variations in membrane temperature coefficient. Type 3 errors are related to the operator's ability to determine the conditions at the time of calibration. If calibration is performed against more accurately known conditions, type 3 errors are appropriately reduced.

#### Type 1 Errors

- A. Meter linearity error:  $\pm 1\%$  of full scale reading, or  $\pm 0.15$  mg/L
- B. Component and circuitry error:  $\pm 0.05$  mg/L

#### Type 2 Errors

- A. DO errors caused by temperature compensation for measurements at  $\pm 10^\circ\text{C}$  from calibration temperature:  $\pm 1\%$  (0.08 mg/L at  $25^\circ\text{C}$ )

DO errors caused by temperature measurement errors: A maximum  $\pm 0.2^\circ\text{C}$  temperature error is equal to  $\pm 0.5\%$  (0.04mg/L at  $25^\circ\text{C}$ ).

## Type 3 Errors

### A. Altitude:

Operator Error: A 1000 foot error in altitude (when calibrating) is equal to an error of approximately 3.6% at the 10 mg/L level.

Instrument Error: The maximum DO error caused by calibrating to altitude in increments of 100 feet:  $\pm 0.18\%$  ( $< 0.015$  mg/L at  $25^{\circ}\text{C}$ )

### B. Humidity:

Errors occur if calibration is performed at less than 100% humidity. The worst possible case would be calibration at 0% humidity. The error varies with the calibration temperature as follows:

Temperature	Calibration Error at 0% humidity
0°C	0.09 mg/L
10°C	0.14 mg/L
20°C	0.21 mg/L
30°C	0.33 mg/L
40°C	0.50 mg/L

## Approximating The Error

It is unlikely that the actual error in any measurement will be the maximum possible error. A better error approximation is obtained using a root mean squared (r.m.s.) calculation:

$$\text{r.m.s. error} = \pm [1a^2 + 1b^2 + 2a^2 + 2b^2 + 3a^2 + 3b^2]^{1/2} \text{ mg/L}$$

**NOTE: This sample calculation is for a near extreme set of conditions.**

## 7. Troubleshooting

**NOTE: An error displayed briefly during the first few seconds after turning the instrument on does NOT indicate a problem.**

SYMPTOM	POSSIBLE CAUSE	ACTION
1. Instrument will not turn on	A. Low battery voltage B. Batteries installed incorrectly C. Meter requires service	A. Replace batteries (Page 3) B. Check battery polarity. (Page 3) C. Return system for service (Page 14)
2. Instrument will not calibrate	A. Membrane is fouled or damaged B. Probe anode is fouled or dark C. Probe cathode is tarnished D. System requires service	A. Replace membrane and KCl (Page 6) B. Clean anode (Page 7) C. Clean cathode (Page 7) D. Return system for service (Page 14)
3. Instrument "locks up"	A. Instrument has received a shock B. Batteries are low or damaged C. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid. (Page 3) B. Replace batteries (Page 3) C. Return system for service (Page 14)
4. Instrument readings are inaccurate	A. Cal altitude is incorrect B. Salinity setting is incorrect C. Probe not in 100% water saturated air during Cal procedure D. Membrane fouled or damaged E. Probe anode is fouled or dark F. Probe cathode is tarnished G. System requires service	A. Recalibrate w/correct value (Page 8) B. Recalibrate w/correct value (Page 8) C. Moisten sponge and place in Cal chamber w/ probe and Recal (Page 4, 8) D. Replace membrane (Page 6) E. Clean anode (Page 7) F. Clean cathode (Page 7) G. Return system for service (Page 14)
5. LCD displays "LO BAT" or Main display flashes "OFF"	A. Batteries are low or damaged	A. Replace batteries (Page 3)
6. Main display reads "undr"	A. Probe current too low to calibrate B. System requires service	A. Replace membrane and KCl (Page 6) B. Clean anode (Page 7) C. Clean cathode (Page 7) D. Return system for service (Page 14)
7. Main display reads "OVER"	A. Sample O <sub>2</sub> concentration is more than 20 mg/L B. Probe current too high to calibrate C. System requires service	A. Recalibrate using correct altitude and salinity compensation (Page 8). B. Replace membrane and KCl (Page 6) C. Clean cathode (Page 7) D. Clean anode (Page 7) E. Return system for service (Page 14)
8. Main display reads "Er 0"	A. Calibration current out of range B. Instrument's self-test detects improper probe voltage during calibration	A. Replace membrane and KCl (Page 6) B. Clean anode (Page 7) C. Clean cathode (Page 7) D. Return system for service (Page 14)

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>ACTION</b>
9. Main display reads "Er 1" or Main display reads "Err" (Secondary display reads "ra")	A. Instrument's self-test detects a variance in RAM B. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid. (Page 3) B. Return system for service (Page 14)
10. Main display reads "Er 2" or Main display reads "Err" (Secondary display reads "ro")	A. Instrument's self-test detects a variance in ROM checksum B. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid. (Page 3) B. Return system for service (Page 14)
11. Main display reads "Er 3" or Main display reads "FAIL" (secondary display reads "eep")	A. Instrument's self-test detects a system malfunction or component failure B. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid. (Page 3) B. Return system for service (Page 14)
12. Main display reads "Er 4"	A. Sample O <sub>2</sub> concentration is more than 20 mg/L B. System requires service	A. Recalibrate using correct altitude and salinity compensation (Page 8). B. Replace membrane and KCl (Page 6) C. Clean anode (Page 7) D. Clean cathode (Page 7) E. Return system for service (Page 14)
13. Main display reads "Er 5"	A. Displayed O <sub>2</sub> concentration is below -0.5 mg/L. B. System requires service	A. Recalibrate using correct altitude and salinity compensation (Page 8). B. Return system for service (Page 14)
14. Main display reads "Er 6"	A. Sample O <sub>2</sub> concentration is over range (% mode) B. System requires service	A. Recalibrate using correct altitude and salinity compensation (Page 8). B. Replace membrane and KCl (Page 6) C. Clean anode (Page 7) D. Clean cathode (Page 7) E. Return system for service (Page 14)
15. Main display reads "Er 7"	A. Displayed O <sub>2</sub> concentration is below -3.0% B. System requires service	A. Recalibrate using correct altitude and salinity compensation (Page 8). B. Return system for service (Page 14)
16. Secondary display reads "Er 8" or Main Display reads "OVER" (Secondary display reads "ovr")	A. Sample temperature is more than +45.9°C B. System requires service	A. Reduce the sample temperature B. Return system for service (Page 14)
17. Secondary display reads "Er 9" or Main Display reads "OVER" (Secondary display reads "udr")	A. Sample temperature is less than -5°C B. System requires service	A. Increase sample temperature. B. Return system for service (Page 14)
18. Main display reads "Er A"	A. Short in probe/cable assembly B. System requires service	A. Replace probe/cable assembly B. Return system for service (Page 14)

## 8. Warranty And Repair

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YSI Model 55 Dissolved Oxygen and Temperature Meters are warranted for two years from date of purchase by the end user against defects in materials and workmanship. YSI Model 55 probes and cables are warranted for one year from date of purchase by the end user against defects in material and workmanship. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

### **Limitation of Warranty**

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

### **YSI Authorized Service Centers**

**Please visit [www.ysi.com](http://www.ysi.com) or contact YSI Technical Support for the nearest authorized service center.**

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## **8.1. Cleaning Instructions**

**NOTE: Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected.** Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with waste water. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

1. In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4 cup bleach to 1 gallon tap water are suitable for most disinfecting. Instruments used with waste water may be disinfected with .5% Lysol if this is more convenient to the user.
2. The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
3. If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
4. Any product being returned to the YSI Repair Center, should be packed securely to prevent damage.
5. Cleaning must be completed and certified on any product before returning it to YSI.

## 8.2. *Packing Instructions*

1. Clean and decontaminate items to insure the safety of the handler.
2. Complete and include the Cleaning Certificate.
3. Place the product in a plastic bag to keep out dirt and packing material.
4. Use a large carton, preferably the original, and surround the product completely with packing material.
5. Insure for the replacement value of the product.

<b>Cleaning Certificate</b>	
Organization _____	
Department _____	
Address _____	
City _____	State _____ Zip _____
Country _____	Phone _____
Model No. of Device _____	Lot Number _____
Contaminant (if known) _____	
Cleaning Agent(s) used _____	
Radioactive Decontamination Certified?	
(Answer only if there has been radioactive exposure)	
_____ Yes _____ No	
Cleaning Certified By _____	
Name	Date



## 9. Required Notice

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The Federal Communications Commission defines this product as a computing device and requires the following notice:

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. There is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- re-orient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 0004-000-00345-4.

## 10. Accessories And Replacement Parts

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The following parts and accessories are available from YSI or any Franchise Dealer authorized by YSI.

YSI Order Number	Description
5775	Standard Membrane and KCl kit (1 mil)
5776	High Sensitivity Membrane and KCl kit (.5 mil)
5685	Half Sensitivity Membrane Kit (2 mil)
5680	Probe Reconditioning Kit (sanding tool and disks for cathode cleaning)
5945	O-ring Kit
5520	Carrying Case
055205	Replacement Probe and Cable Assembly (12 feet)
055206	Replacement Probe and Cable Assembly (25 feet)
055229	Replacement Probe and Cable Assembly (50 feet)
055201	Replacement Front Case Cover
055242	Replacement Rear Case Cover
055244	Replacement Battery Cover Kit
055204	Replacement Case Gasket and Screw
055219	Storage Chamber Sponge
115603	Main Board Assembly

## 11. Appendix A - Solubility Table

**Solubility of Oxygen in mg/L in Water Exposed to Water-Saturated Air at 760 mm Hg Pressure.**

**Salinity = Measure of quantity of dissolved salts in water.**

**Chlorinity = Measure of chloride content, by mass, of water.**

$$S(^{\circ}/_{\infty}) = 1.80655 \times \text{Chlorinity } (^{\circ}/_{\infty})$$

Temp °C	Chlorinity: 0 Salinity: 0	5.0 ppt 9.0 ppt	10.0 ppt 18.1 ppt	15.0 ppt 27.1 ppt	20.0 ppt 36.1 ppt	25.0 ppt 45.2 ppt
0.0	14.62	13.73	12.89	12.10	11.36	10.66
1.0	14.22	13.36	12.55	11.78	11.07	10.39
2.0	13.83	13.00	12.22	11.48	10.79	10.14
3.0	13.46	12.66	11.91	11.20	10.53	9.90
4.0	13.11	12.34	11.61	10.92	10.27	9.66
5.0	12.77	12.02	11.32	10.66	10.03	9.44
6.0	12.45	11.73	11.05	10.40	9.80	9.23
7.0	12.14	11.44	10.78	10.16	9.58	9.02
8.0	11.84	11.17	10.53	9.93	9.36	8.83
9.0	11.56	10.91	10.29	9.71	9.16	8.64
10.0	11.29	10.66	10.06	9.49	8.96	8.45
11.0	11.03	10.42	9.84	9.29	8.77	8.28
12.0	10.78	10.18	9.62	9.09	8.59	8.11
13.0	10.54	9.96	9.42	8.90	8.41	7.95
14.0	10.31	9.75	9.22	8.72	8.24	7.79
15.0	10.08	9.54	9.03	8.54	8.08	7.64
16.0	9.87	9.34	8.84	8.37	7.92	7.50
17.0	9.67	9.15	8.67	8.21	7.77	7.36
18.0	9.47	8.97	8.50	8.05	7.62	7.22
19.0	9.28	8.79	8.33	7.90	7.48	7.09

Temp °C	Chlorinity: 0 Salinity: 0	5.0 ppt 9.0 ppt	10.0 ppt 18.1 ppt	15.0 ppt 27.1 ppt	20.0 ppt 36.1 ppt	25.0 ppt 45.2 ppt
20.0	9.09	8.62	8.17	7.75	7.35	6.96
21.0	8.92	8.46	8.02	7.61	7.21	6.84
22.0	8.74	8.30	7.87	7.47	7.09	6.72
23.0	8.58	8.14	7.73	7.34	6.96	6.61
24.0	8.42	7.99	7.59	7.21	6.84	6.50
25.0	8.26	7.85	7.46	7.08	6.72	6.39
26.0	8.11	7.71	7.33	6.96	6.62	6.28
27.0	7.97	7.58	7.20	6.85	6.51	6.18
28.0	7.83	7.44	7.08	6.73	6.40	6.09
29.0	7.69	7.32	6.96	6.62	6.30	5.99
30.0	7.56	7.19	6.85	6.51	6.20	5.90
31.0	7.43	7.07	6.73	6.41	6.10	5.81
32.0	7.31	6.96	6.62	6.31	6.01	5.72
33.0	7.18	6.84	6.52	6.21	5.91	5.63
34.0	7.07	6.73	6.42	6.11	5.82	5.55
35.0	6.95	6.62	6.31	6.02	5.73	5.46
36.0	6.84	6.52	6.22	5.93	5.65	5.38
37.0	6.73	6.42	6.12	5.84	5.56	5.31
38.0	6.62	6.32	6.03	5.75	5.48	5.23
39.0	6.52	6.22	5.98	5.66	5.40	5.15
40.0	6.41	6.12	5.84	5.58	5.32	5.08
41.0	6.31	6.03	5.75	5.49	5.24	5.01
42.0	6.21	5.93	5.67	5.41	5.17	4.93
43.0	6.12	5.84	5.58	5.33	5.09	4.86
44.0	6.02	5.75	5.50	5.25	5.02	4.79
45.0	5.93	5.67	5.41	5.17	4.94	4.72

\* This table is provided for your information only. It is **NOT** required when calibrating the Model 55 in accordance with the instructions outlined in the chapter entitled *Calibration*.

## 12. Appendix B - Conversion Chart

---

To Convert From	To	Equation
Feet	Meters	Multiply by 0.3048
Meters	Feet	Multiply by 3.2808399
Degrees Celsius	Degrees Fahrenheit	$(^{\circ}\text{C} \times 9/5) + 32$
Degrees Fahrenheit	Degrees Celsius	$(^{\circ}\text{F} - 32) \times 5/9$
Milligrams per liter (mg/L)	Parts per million (ppm)	Multiply by 1

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055207  
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January 07

## APPENDIX J

YSI EC300 – Conductivity & Temperature Meter



YSI Environmental

# Operations Manual YSI EC300

**Portable  
Conductivity, Salinity  
and Temperature  
Instrument**

- English
- Français
- Español
- Deutsch
- Italiano



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Data for a  
Healthy  
Planet. ®



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## **GENERAL INTRODUCTION**

The model EC300 is one of three instruments in the EcoSense product line from YSI. The EC300 is a precision tool that measures conductivity, salinity and temperature. A built-in microprocessor calculates and compensates for all parameters related to conductivity and temperature determinations.

This unit has a splash-resistant IP65 case. The mechanical touch keys are highly reliable with tactile and audio feedback. This instrument uses one 9V battery. Re-calibration is not required when power is restored.

The front of the instrument has a large LCD that displays temperature and either temperature compensated or non-temperature compensated conductivity, salinity or TDS simultaneously along with user prompts and mode indicators. The unit prompts users through calibration and measurement procedures.

The model EC300 is available with a single four-electrode cell. Other features include automatic conductivity ranging, automatic temperature compensation, long battery life, and 50/60 Hz AC noise rejection. This meter is universal and user-friendly for field, industrial and laboratory applications.

## **INITIAL INSPECTION**

Carefully unpack the unit and accessories, and inspect for shipping damages. Compare received parts with materials listed on the packing list. Notify YSI immediately of any damage or missing parts. Save all packing materials until satisfactory operation is confirmed.

## **SPLASH RESISTANCE**

Though the EC300 instrument is housed in a splash proof case, DO NOT use it underwater; the connector is not waterproof. The splash-resistant case prevents permanent damage to the unit if accidentally dropped into non-corrosive solutions. In case of submersion, follow these steps immediately:

1. Dry the connector if necessary, and replace the conductivity probe. Rinse unit carefully with distilled water. After rinsing and drying, inspect and clean connectors to remove all contaminants that may affect probe connections.
2. Wait for the unit and probe to dry completely before resuming operation.
3. If the unit does not function correctly after steps 1 and 2, call YSI for possible repair or replacement (see Warranty).

## **BATTERY INSTALLATION**

An initial display of "BAT" on the LCD indicates approximately one hour of battery life for unit operation within specifications. Replace battery when "BAT" appears on the LCD. (See Figure 1.)

To replace battery, remove the two battery cover screws, battery cover and o-ring. Replace the 9V battery. Replace battery cover and o-ring (align the o-ring properly to insure a good seal) and fasten the two battery cover screws for the splash-resistant feature.

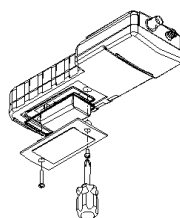


Figure 1.  
Battery Installation

## **KEY FUNCTIONS OF THE MODEL EC300**

1. **⏻**: Turns the unit ON or OFF. Calibration values are not erased when the unit is turned off. When the unit is not in use, turn it off to save battery life. For long-term storage, remove the battery.
2. **MODE**: Selects display mode. In Normal operation, press **MODE** to sequentially display uncompensated conductivity, temperature compensated conductivity, salinity and total dissolved solids (TDS). In calibration mode, this key exits the current calibration and displays the next calibration parameter.
3. **CAL**: In normal operation, changes the mode from Normal to Calibration.
4. **↵** (Enter) : In Calibration Set-up, press this key to save the current parameter to memory.
5. **Δ** and **▽** **Keys**: Increases or decreases the display value as desired.

## **THE LCD DISPLAY**

1. **CONDUCTIVITY**: Displays when measuring conductivity.
2. **BAT**: Low battery indicator.
3. Main display for compensated and uncompensated conductivity, salinity and TDS values.
4. **CAL**: Calibration mode indicator.
5. **TDS**: Displays when measuring total dissolved solids.
6. **SALINITY**: Displays when measuring salinity.
7. **CELL**: Indicates conductivity cell constant value.
8. **°C**: Flashes during temperature compensated conductivity measurement. During calibration, indicates temperature reference unit.
9. **%**: Displays during calibration; indicates temperature coefficient unit.
10. **ppt**: Parts per thousand; indicates salinity measurement.
11. **uS, mS**: micro Siemens, milli Siemens; Indicates conductivity measurement.
12. **g/L**: grams/Liter; indicates TDS measurement.
12. **°C**: Temperature display.

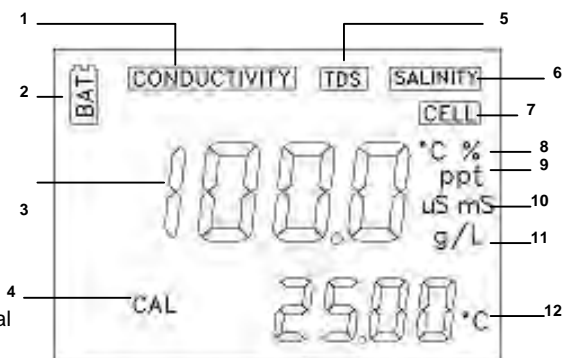


Figure 1. LCD Display

## **MEASUREMENT MODES**

1. **Temperature** - Current solution temperature continually displays.
2. **Temperature Compensated Conductivity** - Measurement of conductivity, compensated to 25°C or another specified value between 15 and 25°C. Expressed as uS/cm or mS/cm with a flashing "°C".
3. **Uncompensated Conductivity** – Direct measurement of conductivity, not compensated to a specific temperature. Expressed as uS/cm or mS/cm.
4. **Salinity** – Measurement of salinity; expressed in parts per thousand (ppt).
5. **TDS** – Measurement of total dissolved solids (TDS); expressed in grams per liter (g/L)

Carefully observe the units displayed at the far side of the LCD to determine the desired mode.

## **CALIBRATION**

Calibration setup contains five sections: TDS, Cell, Temperature Coefficient, Temperature reference, and Conductivity Calibration. To access these sections:

1. Connect the conductivity probe and cable assembly to the unit and turn the unit on. The screen will display **CELL** and the cell constant of the conductivity probe.
2. Allow temperature readings to stabilize, then press **CAL** to enter the calibration mode; **CAL** appears on the LCD. Press **MODE** to sequentially display the following sections:

**Note:** Press Enter (↵) to accept any values changes in each section and automatically advance to the next section. If there are no changes, the unit accepts the current value and proceeds to the next section.

### **TDS**

TDS is determined by multiplying conductivity (mS) by a TDS factor. The default factor value is 0.65. To change the TDS factor, use the **Δ** and **▽** keys to adjust the value between 0.30 and 1.00. Press Enter (↵) to save the new value, or press **MODE** to cancel the change and display the **CELL** screen.

### **CELL**

The second screen will display **CELL** and the current cell value. The default cell value is 5.00 and is displayed in the lower right of the screen. The unit allows a variance of  $\pm 0.50$  before displaying an error message. The cell value cannot be adjusted at this screen; calibrating conductivity is the only way to adjust the cell constant. Press Enter (↵) to reset the cell constant to 5.00 and display the **Temperature Coefficient** screen.

**Note:** Be certain to press Enter (↵) to reset the cell constant to 5.00. If **MODE** is pressed, the unit retains the previous cell constant and calibrates from a value that is already offset.

### **Temperature Coefficient**

The unit uses the temperature coefficient to calculate temperature compensated conductivity. The default value is 1.91%. To change the temperature coefficient, use the **Δ** and **▽** keys to adjust the value between 0 and 4.00%. Press Enter (↵) to save the new value, or press **MODE** to cancel the change and display the **Temperature Reference** screen.

### **Temperature Reference**

The unit uses the temperature reference value to calculate temperature compensated conductivity. The default value is 25°C. To change the temperature coefficient, use the **Δ** and **▽** keys to adjust the value between 15 and 25°C. Press Enter (↵) to save the new value, or press **MODE** to cancel the change and display the **Conductivity Calibration** screen.

### **Conductivity Calibration**

1. Immerse the probe in a standard of known conductivity, preferably a standard in the middle range of the solutions to be measured. Completely submerge the probe without touching the sides of the calibration container. Shake the probe lightly to remove any air bubbles trapped in the conductivity cell.
2. Allow temperature to stabilize. The message 'rAng' (range) may display briefly to indicate unit auto-ranging; this is normal. After temperature stabilization, use the **Δ** and **▽** keys to adjust the conductivity value to that of the conductivity standard at 25°C. Press Enter (↵) to calibrate. The unit beeps twice to indicate a successful calibration, then automatically switches to normal operation mode.

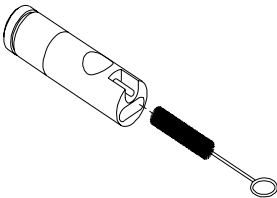
**CONDUCTIVITY MEASUREMENTS**

- 1. Turn the unit on. Place the probe in the solution to be measured. Completely submerge the probe. Shake the probe lightly to remove any trapped air bubbles in the conductivity cell.
- 2. Press **MODE** to enter the desired measurement mode. The message 'rAng' (range) may appear briefly on the display indicate auto-ranging; this is normal. Allow temperature to stabilize before taking measurements.

**PROBE MAINTENANCE**

The most important requirement for accurate and reproducible conductivity measurements is a clean cell. A dirty cell changes the conductivity of a solution through contamination. Clean the cell thoroughly before storing it. To clean the conductivity cell:

- 1. Dip the cell in cleaning solution and agitate for two to three minutes. Any foaming acid tile cleaner, such as Dow Chemical Bathroom Cleaner, should clean adequately. For a stronger cleaner, use a solution of 1:1 isopropyl alcohol and 1 N HCl. Remove the cell from the cleaning solution.
- 2. Use the nylon brush (supplied) to dislodge any contaminants from inside the electrode chamber.
- 3. Repeat steps one and two until the cell is completely clean. Rinse the cell thoroughly in deionized, or clean tap water.



**TROUBLESHOOTING**

MAIN DISPLAY		PROBLEM	POSSIBLE SOLUTION
OvEr		<ul style="list-style-type: none"><li>• Conductivity is &gt;200.0 mS</li><li>• Salinity is &gt; 70.00 ppt</li></ul>	<ul style="list-style-type: none"><li>• Completely submerge the probe.</li><li>• Allow sufficient time for the electrode and Temp probe stabilization.</li></ul>
OvEr/Undr during calibration		Cell Constant Calibration is out of range	<ul style="list-style-type: none"><li>• Recalibrate with correct value for the conductivity standard.</li><li>• Replace conductivity standard.</li><li>• Clean cell.</li><li>• Return for service.</li></ul>
MAIN DISPLAY	SECONDARY DISPLAY		
OvEr/Undr	OvEr	Temperature >90.0 °C	<ul style="list-style-type: none"><li>• Decrease/Increase the sample temperature.</li><li>• Return for service.</li></ul>
	Undr	Temperature < -10.0 °C	

## SPECIFICATIONS

Display	Range	Accuracy	Resolution
Conductivity, Auto-ranging	0.0 to 499.9 $\mu$ S/cm 500 to 4999 $\mu$ S/cm 5.00 to 49.99 mS/cm 50.0 to 200.0 mS/cm	$\pm 1\%$ of reading plus 2 $\mu$ S/cm $\pm 1\%$ of reading plus 5 $\mu$ S/cm $\pm 1\%$ of reading plus 0.05 $\mu$ S/cm $\pm 2.5\%$ of reading plus 0.5 mS/cm	0.01 $\mu$ S/cm 1 mS/cm 0.01 mS/cm 0.1 mS/cm
Salinity	0.0 to 70.0 ppt	0.2% Full Scale	0.1 ppt
Temperature $^{\circ}$ C	-10.0 to 90 $^{\circ}$ C	$\pm 0.2^{\circ}$ C or $\pm 0.4\%$ Full Scale, whichever is greater	0.1 $^{\circ}$ C

Reference Temperature	15.0 to 25.0 $^{\circ}$ C
Temperature Coefficient	0.0% to 4.0%
Cell Constant	5.00 $\pm$ 0.50
TDS Constant Range	0.30 to 1.00
Power	One 9V battery
Calibration Back-up	Yes
Audio Feedback	Yes, on all touch keys
Water Resistance	Splash-resistant, IP 65
Operating Temp. Range	0 to 50 $^{\circ}$ C
Operating Relative Humidity Range	up to 95%
Temperature Probe	Thermistor, 10k $\Omega$ / 25 $^{\circ}$ C
Dimensions (L x W x D)	186 mm x 70 mm x 37 mm (7.3 in x 2.8 in x 1.5 in)
Weight (batteries included)	430 grams (1 lb)

## RECOMMENDED SPARE PARTS LIST

PART #	DESCRIPTION
300-4	4-meter probe and cable assembly.
300-10	10-meter probe and cable assembly.
380	Carrying case, hard sided.
480	Instrument carrying case with shoulder strap, soft sided.

## APPENDIX K

YSI 100 – pH & Temperature Meter

# Operations Manual

## EcoSense® pH100

**Portable  
pH, mV and  
Temperature  
Instrument**



- English
- Français
- Español
- Deutsch
- Italiano



## **WARRANTY**

The EcoSense® pH100 Instrument is warranted for one year from date of purchase by the end user against defects in materials and workmanship. pH100 probes and cables are warranted for six months from date of purchase by the end user against defects in material and workmanship. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

### **Limitation of Warranty**

This Warranty does not apply to any YSI product damage or failure caused by: (i) failure to install, operate or use the product in accordance with YSI's written instructions; (ii) abuse or misuse of the product; (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure; (iv) any improper repairs to the product; (v) use by you of defective or improper components or parts in servicing or repairing the product; or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

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## **GENERAL INTRODUCTION**

The model pH100 is one of three instruments in the EcoSense product line from YSI. The pH100 is a precision tool that measures pH, mV and temperature. A built-in microprocessor stores, calculates and compensates for all parameters related to pH determinations including pH electrode temperature characteristics, electrode slope deviations and buffer solutions.

This unit has a splash-proof IP65 case. The mechanical touch keys are highly reliable with tactile and audio feedback. This meter uses one 9V battery. Re-calibration is not required when power is restored.

The front of the meter has a large LCD that displays pH or mV and temperature simultaneously along with user prompts and mode indicators. The unit prompts the user through calibration and measurement procedures.

An AUTOLOCK feature for both pH and mV measurements enables the unit to automatically sense the end point and "lock" the display to indicate the end point value of a measurement. The pH100 can also be used in non-AUTOLOCK mode. AUTOLOCK and user prompts help eliminate most errors in determining pH and mV values, resulting in precise, repeatable, error-free measurements.

The model pH100 is available with pH, mV, ORP and ATC (Automatic Temperature Compensation) probes. Other features include electrode offset recognition, electrode slope recognition, electrode efficiency display, built-in buffer coefficients, automatic or manual temperature compensation, long battery life, and 50/60 Hz AC noise rejection. This meter is universal, user-friendly, for field, industrial and laboratory applications.

## **INITIAL INSPECTION**

Carefully unpack the unit and accessories, and inspect for shipping damages. Compare received parts with materials listed on the packing list. Notify YSI immediately of any damage or missing parts. Save all packing materials until satisfactory operation is confirmed.

## **SPLASH RESISTANCE**

Though the pH100 meter is housed in a watertight case, DO NOT use it underwater. The splash-resistant case prevents permanent damage to the unit if accidentally dropped into non-corrosive solutions. Follow these steps immediately if the unit is immersed in any solution:

1. Rinse unit carefully with distilled water. After rinsing and drying, inspect and clean connectors to remove all contaminants that may affect probe connections.
2. Wait for the unit and probe to dry completely before resuming operation.
3. If the unit does not function correctly after steps 1 and 2, call YSI for possible repair or replacement (see Warranty).

## **BATTERY INSTALLATION**

An initial display of "BAT" on the LCD indicates approximately one hour of battery life for unit operation within specifications. Replace battery when "BAT" appears on the LCD. (See Figure 1.)

To replace battery, remove the two battery cover screws and battery cover and o-ring. Replace the 9V battery. Replace battery cover and o-ring (align the o-ring properly to insure a good seal) and fasten the two battery cover screws for the splash-resistant feature.

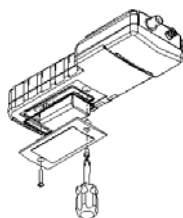


Figure 1.  
Battery Installation

## KEY FUNCTIONS OF THE MODEL pH100

1. **⏻**: Turns the unit ON or OFF. The pH calibration values are not erased when the unit is turned off. The unit powers up in the same status as when it was turned off. When the unit is not in use, turn it off to save battery life. For long term storage, remove the batteries.
2. **MODE**: Selects display mode. Press **MODE** to sequentially display pH-AUTOLOCK , mV-AUTOLOCK , pH, and mV. Calibration values are not affected by changing display mode.
3. **STAND** and **SLOPE Keys**: Used for dual-point pH calibration of the unit. Press and hold **STAND** while turning on the power to change buffer sets.
4. **Δ** and **▽ Keys**: Press to enter temperature values in manual (MAN) mode. These keys are inoperative when operating in ATC mode.
5. **MEA/EFF.:** Press to release the unit from AUTOLOCK status when operating in pH-AUTOLOCK or mV-AUTOLOCK mode. Press and hold for 5 seconds to display the electrode efficiency.
6. **ESC**: Press to clear the unit when an error signal appears; it clears all calibration values stored in internal memory. To prevent accidental clearing during normal use, the key does not respond unless pressed and held for 2 seconds. The key responds only when an error message displays.

When **ESC** is pressed, all LCD elements light. After about 2 seconds, the unit enters pH-AUTOLOCK mode. "AUTOLOCK" displays and "STAND" begins to flash indicating the need for calibration. Press **ESC** only when errors occur that require unit re-calibration.

## THE LCD DISPLAY

1. **WAIT**: Displays while unit waits for a stable reading or end point sensing.
2. **BAT**: Low battery indicator.
3. **ATC/MAN**: "ATC" displays if an ATC probe is connected. Otherwise, "MAN" displays.
4. **STAND/SLOPE**: "STAND" or "SLOPE" remains steady if the parameter has been calibrated. If either one has not been calibrated, it flashes.
5. **AUTO**: Autolock mode indicator.
6. **HOLD**: Indicates a reading is frozen during Autolock mode.
7. **EFF%**: Displays when the user views electrode efficiency. It is recommended to replace the electrode when efficiency is less than 75%.
8. **pH/mV** : Unit and mode indicators.
9. Main display for pH, mV and probe efficiency values.
10. **°C**: Temperature display.

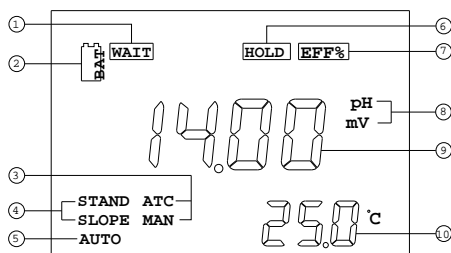


Figure 2. LCD Display

## OPERATIONAL PROCEDURES

### **Buffer Set Selection**

The pH100 has two buffer sets: 7.00, 4.01, 10.01 pH and 6.86, 4.00, 9.18 pH. The factory default is buffer set 7.00, 4.01, and 10.01. To change the buffer set, turn off the unit and place the sensor in buffer 7.0. Next, turn the unit on while pressing and holding the **STAND** key. Continue pressing the STAND key until the unit beeps. If the unit is uncalibrated and in pH mode, it displays "7.00" if the first set is active, and "6.86" if the second set is active.

## pH Calibration

The pH100 uses a 2-point calibration. The first point must be a 6.86/7.00 buffer, and the second either a 4.00/4.01 or 9.18/10.01. These buffers can be purchased from a YSI representative.

1. Turn the unit on. Connect the pH electrode to the BNC connector and the ATC/Temp probe to the ATC/Temp connector of the unit; "ATC" displays. Press **MODE** until "pH" displays. Autolock may be on or off as desired.
2. Place the pH and ATC/temp probes into the first buffer solution (either 7.00 or 6.86). Allow temperature readings to stabilize, then press and hold "STAND" for 3 seconds to calibrate. If **AUTOLOCK** is off, the first point has been calibrated. If **AUTOLOCK** is on, "WAIT" flashes until the unit detects a stable reading. Once the unit calibrates the first point, "SLOPE" flashes.

**NOTE:** If no temperature probe is connected, adjust the temperature reading to that of the first buffer using the  $\Delta$  or  $\nabla$  keys (0.0 to 60°C) **BEFORE** pressing "STAND".

3. Rinse the pH and ATC/temp probes in distilled water, then place into the second buffer solution (either 4.01/4.00 or 10.01/9.18). Allow temperature readings to stabilize, then press "SLOPE" to calibrate. If **AUTOLOCK** is off, the second point has been calibrated. If **AUTOLOCK** is on, "WAIT" flashes until the unit detects a stable reading. Once the unit calibrates the second point, the unit beeps twice and both "STAND" and "SLOPE" display steadily.

**NOTE:** If no temperature probe is connected, adjust the temperature reading to that of the first buffer using the  $\Delta$  or  $\nabla$  keys (0.0 to 60°C) **BEFORE** pressing "SLOPE".

4. The unit calculates and compensates for the pH electrode slope deviation corresponding to the values of the two calibration buffers. The unit is now dual-point calibrated and ready for measurements. After calibration, press and hold **MEA. /EFF.** for about 5 seconds to display the new electrode efficiency.

## Using the model pH160 Electrode Simulator

The model pH160 Electrode Simulator can be used to confirm proper instrument calibration. To use the simulator:

1. Install the 9V battery provided.
2. Attach the pH160 to the pH100. Turn both units on. The pH160 has a small switch to the right of the pH buttons.
3. In pH measurement mode, press one of the pH buffer simulator buttons on the pH160. The corresponding pH value should appear on both screens.

**Note:** Calibration with the pH simulator calibrates only the instrument - NOT the instrument and probe. For best accuracy, calibrate the pH instrument and probe together using buffer solutions.

## pH Measurements

To take pH measurements, "STAND" and "SLOPE" must display steadily, indicating the unit is dual-point calibrated and ready for measurements. If "STAND" and "SLOPE" are blinking, perform a pH calibration before taking measurements.

1. Press **MODE** to enter pH mode with AUTOLOCK on or off as desired. For inherently unstable samples, the unit will not AUTOLOCK. Turn AUTOLOCK off in this case.
2. Rinse the pH electrode and/or ATC/temp probe with distilled water and immerse in the sample to be measured. Remove any air bubbles trapped around the probe by shaking or stirring the probe. Allow the pH and/or temperature to stabilize. If no ATC/temp probe is connected, "MAN" displays, indicating manual temperature compensation. Set unit to display the sample temperature by pressing the  $\Delta$  and  $\nabla$  keys (-10.0 to 120°C). If an ATC/temp probe is connected "ATC" displays along with the sample temperature.

3. If AUTOLOCK is off, the pH value of the sample displays on the screen. If both pH and temperature readings are stable, take a reading. If AUTOLOCK is on, press **MEA/EFF**. "WAIT" flashes until the unit determines a stable pH reading.

## Temperature Measurements

The model pH100 can measure temperature independently with the ATC/Temp probe without using the pH electrode. Place the ATC/Temp probe in the media to be measured. The measured temperature displays.

## mV Measurements

1. Connect the optional combination mV electrode to the unit. Press **MODE** to enter mV mode with AUTOLOCK on or off as desired. For inherently unstable samples, the unit will not AUTOLOCK. Use mV mode with AUTOLOCK off in this case.
2. Rinse electrode with distilled water and immerse it in sample to be measured. If AUTOLOCK is off, the mV value of the sample will be displayed on the screen. If AUTOLOCK is on, press **MEA/EFF**. "WAIT" flashes until the unit determines a stable mV reading.

## TROUBLESHOOTING

MAIN DISPLAY	POSSIBLE CAUSE	CORRECTIVE ACTION
Er 1	<ul style="list-style-type: none"> <li>pH electrode offset is greater/less than <math>\pm 1.5</math> pH.</li> <li><b>STAND</b> was pressed before the electrode and ATC/Temp probe settle to within <math>\pm 1.5</math> pH of the buffer value.</li> <li>pH electrode is faulty</li> </ul>	<ul style="list-style-type: none"> <li>Replace the buffer and/or the pH electrode. Press <b>ESC</b>.</li> <li>Allow sufficient time for the electrode and ATC/Temp probe to stabilize.</li> <li>Return for service.</li> </ul>
Er 2	<ul style="list-style-type: none"> <li>pH electrode slope is off by more than 30% of ideal slope.</li> <li><b>SLOPE</b> was pressed before the electrode and ATC/Temp probe settled to within 30% of the buffer value.</li> <li>Buffer 4.00, 4.01, 9.18 or 10.01 is not correct.</li> </ul>	<ul style="list-style-type: none"> <li>Check that the correct buffer is used and that the electrode slope is not off by more than 30% from the theoretical slope.</li> <li>Allow sufficient time for the electrode and ATC/Temp probe to stabilize.</li> <li>Replace the buffer and/or the pH electrode. Press <b>ESC</b>.</li> <li>Return for service.</li> </ul>
Er 3	<ul style="list-style-type: none"> <li>Temperature is out of the 0.0 to 60.0 °C range.</li> </ul>	<ul style="list-style-type: none"> <li>Bring the buffer temperature within range.</li> <li>Return for service.</li> </ul>
OvEr/Undr	<ul style="list-style-type: none"> <li>Measured pH is out of the 16.00/-2.00 pH range.</li> <li>Measured mV is out of the 1250/-2000 mV range.</li> <li>Measured temperature is out of the 10/120 °C range.</li> </ul>	<ul style="list-style-type: none"> <li>Bring the out of range unit into the correct measuring range.</li> <li>If units are within proper range, return product for service.</li> </ul>

## SPECIFICATIONS

Display	Range	Accuracy	Resolution
pH	-2.00 to 16.00 pH	$\pm 0.1\%$ , $\pm 2$ lsd	0.01 pH
mV	-1999 to 1250 mV	$\pm 0.1\%$ , $\pm 1$ lsd	1 mV
Temperature °C	-10.0 to 120 °C	$\pm 0.5$ °C	0.1 °C

<b>pH Temp Compensation</b>	AUTO/MANual -10.0 to 120.0 °C
<b>pH Buffer Recognition</b>	(4.01, 7.00 & 10.01) or (4.00, 6.86 & 9.18)
<b>pH Buffer Calibration Temp. Range</b>	0 to 60 °C
<b>pH Electrode Offset Recognition</b>	±90mV at pH 7.00 or 6.86
<b>pH Electrode Slope Recognition</b>	±30% at pH 4.00, 4.01, 9.18 or 10.01
<b>Power</b>	One 9V battery
<b>Calibration Back-up</b>	Yes
<b>Audio Feedback</b>	Yes, on all touch keys
<b>Autolock Feature</b>	Yes
<b>Operating Temp. Range</b>	0 to 50 °C
<b>Operating Relative Humidity Range</b>	up to 95%
<b>ATC Probe</b>	Thermistor, 10kΩ / 25 °C
<b>Dimensions (L x W x D)</b>	186 mm x 70 mm x 37 mm (7.3 in x 2.8 in x 1.5 in)
<b>Weight (batteries included)</b>	430 grams (1 lb)

## **RECOMMENDED SPARE PARTS LIST**

<b>PART #</b>	<b>DESCRIPTION</b>
100-1	1-meter waterproof Y-cable with combo pH/reference junction & ATC electrodes.
100-4	4-meter waterproof Y-cable with combo pH/reference junction & ATC electrode.
110-1	pH electrode with 1-meter cable.
115-1	mV electrode with 1-meter cable.
130-1	ATC (temperature) electrode with 1-meter cable.
160	pH Simulator electrode.
180	pH carrying case, hard sided.
440	Cable weight kit
480	Instrument carrying case, soft sided.

Item #605367 • Drawing #A605367

Revision E • March 2008

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