

## Orion pH, ORP and ISE Applications

### Brief Guide to ISE Applications and References

Applications for electrodes are as numerous as the need for analytical measurements. Hundreds of different analyses can be made faster and easier through electrode methods. The following illustrates the many uses for ion selective electrodes. Further information on the use and care of ion selective electrodes can be found on the Thermo website on the world wide web (<http://www.thermo.com>). Many regulatory agencies and bodies have officially approved electrode methods. Although state and federal regulations vary, the following chart describes some of the many Orion electrode methods which are approved for use. Look for updates on the Thermo website page (<http://www.thermo.com>).

Species Measured	ISE Applications				
	ASTM (1)	EPA (2)	Standard Methods (3)	AOAC (4)	USGS (5)
Acidity	D1067-92	305.1, 305.2	2310B	945.26, 962.19, 942.15, 984.24, 950.07	I-1020
Alkalinity	D1067-92; D1067-92B	310.1	2320B	973.43	I-1030; I-1030-85
Ammonia	D1426-93	350.3	4500-NH <sub>3</sub> (D) (E)	–	I-1524
Bromide	D1246-88	60 FR 37974 (6) (7)	–	–	–
Carbon Dioxide	D513-92	–	–	–	–
Chloride	D512-89	60 FR 37974 (6) (7)	4500-Cl (D)	971.27, 980.25	–
Chloride Leachable	F1277-90	–	–	–	–
Chloride by Titration	–	–	–	933.06, 962.05, 962.07, 963.05, 986.26, 966.10, 969.10, 966.09	–
Chloride Total in Coal	D4208-88	–	–	–	–
Chlorine Residual	–	59 FR 62456 (7)	4500-Cl (I)	–	–
Chlorine in Organics	E256-91	–	–	–	–
Conductivity	D1125-91; D1125-95A	120.1	2510B	–	–
Cyanate	–	–	4500-CN (L)	–	–
Cyanide	D2036-91	60 FR 37974 (6) (7)	4500-CN (F) (G)	–	–
Fluoride	D3868-79, D1179-93	59 FR 62456, 60 FR 37974 (6) (7)	4500-F (C)	984.37, 975.08, 973.10	I-1327, I-2327
Fluoride in Air	D3269, D3268, D4765	–	–	–	–
Fluorine in Coal	D3761-91	–	–	–	–
Iodide	D3869	–	–	–	–
Kjeldahl Nitrogen	D3590-89A	351.4	4500-N <sub>org</sub> (A) (B)	–	–
Nitrate	–	59 FR 62456, 60 FR 37974, 601	4500-NO <sub>3</sub> (D) (G)	986.31	–
ORP	D1498-93; D1498-00	–	2580	–	–
Oxygen	D888-92	360.1	4500-O (G)	–	–
Potassium	–	–	3500-K (E)	–	–
Salinity	–	–	2520 (B)	–	–
Sodium	D2791-93	–	–	976.25	–
Sulfide	D4658-92	60 FR 37974 (6) (7), 9215 (SW-846 Ch 5)	4500-S- (G)	–	–
Sulfur in Coal	D4239-94	–	–	–	–
pH	D1293-84; D1293-95	150.1; 150.2, 9045C (SW-846 Ch 6)	4500-H+B	981.12, 943.02, 945.10, 940.23, 950.07, 960.19, 962.19, 945.42, 970.21, 973.04, 973.40, 945.27, 973.41, 979.02, 981.12	I-1586
pH Titrations	–	–	–	949.02, 955.01, 960.19	–
Biochemical Oxygen Demand (BOD)	–	405.1	5210B, 5210D (Proposed)	–	–

### Key

- (1) "Annual Book of ASTM Standards, Water and Environmental Technology," American Society for Testing and Materials, 1992
- (2) "Methods for Chemical Analysis of Water and Wastes," Environmental Protection Agency, Environmental Monitoring Systems Laboratory, EPA-600/4-79-020, 1983
- (3) "Standard Methods for Water and Wastewater Analysis," 18th Edition, 1994
- (4) Official Methods of Analysis of the Association of Official Analytical Chemists, Methods Manual, 15th edition, 1990
- (5) Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments, U.S. Dept. of the Interior, Techniques of Water Resource Investigations of the U.S. Geological Survey, Denver, CO, Revised 1989
- (6) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Update III
- (7) These references were in the process of being updated at time of publication; contact our technical service for status

## Orion pH, ORP and ISE Applications

Species/Sample	Electrode	ISE Applications and References	
		Method	Reference
Aluminum (Al <sup>3+</sup> ) Newsprint Pulp	94-09, 96-09	Titration with silver fluoride	B1202
Amino Groups	94-17, 96-17	Titration with silver nitrate	B712
Ammonia (NH <sub>3</sub> ) Air and Stack Gases	95-12	Direct	B678
Beer	95-12	Direct or known addition	B877
Biological Samples	95-12	Direct or known addition	B682, B817
Boiler Feed Water	95-12	Direct	B841
Fertilizers	95-12	Direct	B574
Fish Tanks	95-12	Direct	B607
Plating Baths	95-12	Direct	IM95-12
Sea Water	95-12	Known addition	B571, B607, B829, B1019
Soils	95-12	Direct	A502, ASTM, B502 B510, B563, B571, EPA
Shrimp	95-12	Direct	B1023
Water and Waste Water	95-12	Direct	B1019, A502, B563, EPA, B563, B510, B571, SM, ASTM
Wine and Musts	95-12	Known addition	B715
Ammonium (NH <sub>4</sub> <sup>+</sup> ) Air	93-18, 95-12	Direct, direct as ammonia	IM93-18, B678
Arsenic (As <sup>3+</sup> )	96-78, 97-78	Redox titration with potassium	IM96-78/97-78
Azide (N <sub>3</sub> <sup>-</sup> )	94-16, 96-16	Titration with silver nitrate	B359
Boron (B <sup>3+</sup> ) Graphite	93-05	Titration	ASTM, B1202
Plant Tissues and Soils	93-05	Direct as fluoroborate	B162, B583, B1200
Reactor Coolants	93-05	Direct as fluoroborate	B1200, B583
Silicon	93-05	Direct as fluoroborate	B766
Bromide (Br <sup>-</sup> ) Soils and Plant Tissues	94-35, 96-35	Direct	B799, B891
Wines	94-35, 96-35	Known addition	B821
Bromine (Br <sub>2</sub> ) Organic Compounds	94-16, 96-16	Titration with silver nitrate	B814, B513
Cadmium (Cd <sup>2+</sup> ) Fluoroborate Plating Baths	94-48, 96-48	Direct	B377
Calcium (Ca <sup>2+</sup> ) Beer	93-20, 97-20	Known addition	AB8a
Boiler Feed Water	93-20, 97-20	Direct	IM93-20/97-20
Food Stuffs	93-20, 97-20	Direct	AB9, B148
Skim Milk	93-20, 97-20	Direct	B109
Soils and Fertilizers	93-20, 97-20	Direct	B253, B559, B650
Sugar Solutions	93-20, 97-20	Direct or known addition	B436, B463
Water	93-20, 97-20	Direct	B159, B248, B698
Wines	93-20, 97-20	Known addition	B770
Carbon Dioxide (CO <sub>2</sub> ) Bacterial Cultures	95-02	Direct	B757
Carbonated Beverages	95-02	Direct	IM95-02
Wines	95-02	Direct	IM95-02
Chloride (Cl <sup>-</sup> ) Acid Copper Baths	94-17, 96-17	Known addition	B377
Boiler Cleaning Soln	94-17, 96-17	Known subtraction	B196
Canned Vegetables	94-17, 96-17	Direct	A205
Fish Cakes	94-17, 96-17	Direct	A207
Infant Formula	94-17, 96-17	Direct	A206
Milk	94-17, 96-17	Direct	A212
Non-liquid Dairy Products	94-17, 96-17	Direct	A202
Processed Meats	94-17, 96-17	Direct	A204
Salad Dressing and Mayonnaise	94-17, 96-17	Direct	A213
Tomato Sauce and Paste	94-17, 96-17	Known addition	A203
Plant Tissues	94-17, 96-17	Titration with silver nitrate	B184, B413
Sea Water	94-17, 96-17	Direct	B270, B511
Silicate Rock	94-17, 96-17	Direct	B496
Soils	94-17, 96-17	Direct or titration	B370, B422, B677
Water, Wastewater and Brines	94-17, 96-17	Direct	IM94-17, A507
Chlorine (Cl <sub>2</sub> ) Residual Chlorine	97-70	Direct as iodine	A505, IM97-70, EPA
Chromium (Cr <sup>6+</sup> ) Cu-Cr Alloys	96-78, 97-78	Titration with Fe(NH <sub>4</sub> ) <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub>	ASTM
Steels and Cast Iron	96-78, 97-78	Titration	ASTM

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Species/Sample	Electrode	ISE Applications and References	
		Method	Reference
Chymotrypsin	94-09, 96-09	Indirect	B225
Copper (Cu <sup>2+</sup> ) Acid Plating Baths	94-29, 96-29	Direct	B377
Natural Water	94-29, 96-29	Known addition	B565
Silicon	94-29, 96-29	Known addition	B565, B874
Cyanate (CNO) Water	95-12	Known addition	Standard methods
Cyanide (CN) Biological Materials	94-06, 96-06	Direct	B1024
Cigarette Smoke	94-06, 96-06	Direct	B459
Plant Tissues	94-06, 96-06	Direct	B168
Plating Baths	94-06, 96-06	Direct, known addition	B377, B506, B543, B718
Water, Wastewater and Brines	94-06, 96-06	Direct	ASTM
Epoxy Groups	94-35, 96-35	Titration	B266
Fluoride (F <sup>-</sup> ) Acids	94-09, 96-09	Direct	B78, B609, B860
Air and Stack Gases	94-09, 96-09	Direct	ASTM, B9, B285, B328, B554, B570
Aluminum Fluoride	94-09, 96-09	Direct	B532
Bones	94-09, 96-09	Direct	B29
Samples with Boron	94-09, 96-09	Direct	B768
Carbonated Beverages	94-09, 96-09	Direct	B204
Chromium Plating Baths	94-09, 96-09	Direct	B6
Coal	94-09, 96-09	Direct	B831
Cryolite	94-09, 96-09	Direct	B24, B75, B307, B329, B532
Dental Plaque	94-09, 96-09	Direct	B177
Drinking Water	94-09, 96-09	Direct	ASTM, A503, B61, B113, B16, B313, B501, B536
Feces	94-09, 96-09	Direct	B512
Feeds	94-09, 96-09	Known addition	B60, B223, B697
Fish	94-09, 96-09	Direct	B160, B214, B767, B830
Fluomica	94-09, 96-09	Direct	B830
Fluorospar	94-09, 96-09	Direct	B307, B532
Fluorosilicic Acid	94-09, 96-09	Direct	B232
Glass	94-09, 96-09	Known addition	B760
Minerals	94-09, 96-09	Direct	B24
Phosphate Rocks	94-09, 96-09	Direct	B140, B238, B547
Phosphoric Acid	94-09, 96-09	Direct	B448
Pickling Baths	94-09, 96-09	Direct	B860
Plant Tissues	94-09, 96-09	Direct	B881
Rain Water	94-09, 96-09	Direct	B551
Saliva	94-09, 96-09	Direct	B555, B594
Seawater	94-09, 96-09	Direct	B132, B213, B270, B470, B482, B501
Biological Fluids	94-09, 96-09	Direct	B62, B167, B396, B670, B252, B750
Silicate Rocks	94-09, 96-09	Direct	B300, B518
Soils	94-09, 96-09	Direct	B881, B406, B564
Sugar Canes	94-09, 96-09	Direct	B497
Teeth	94-09, 96-09	Direct	B271, B917
Toothpastes	94-09, 96-09	Direct	B739, B34, B478
Tungsten	94-09, 96-09	Direct	B12
Uranium Oxides	94-09, 96-09	Direct	B48
Uranyl Nitrate	94-09, 96-09	Direct	B111
Urine	94-09, 96-09	Direct	B142, B210, B503
Vitamins	94-09, 96-09	Known addition	B208
Wines	94-09, 96-09	Direct	B548, B672
Zirconium Decladding	94-09, 96-09	Direct	B111
Fluoroborate (BF <sub>4</sub> <sup>-</sup> ) Plating Baths	93-05	Direct	B377, B837
Hydrogen Chloride in Air	94-17, 96-17	Direct	B782

## Orion pH, ORP and ISE Applications

Species/Sample	Electrode	ISE Applications and References	
		Method	Reference
Iodide (I <sup>-</sup> ) Feeds and Plants	94-53, 96-53	Direct	B389
Milk	94-53, 96-53	Known addition	B1041
Selenium	94-53, 96-53	Known addition	B375
Iodine (I <sub>2</sub> ) Pharmaceuticals	94-53, 96-53	Direct	B175, B181
Iron (Fe <sup>2+</sup> , Fe <sup>3+</sup> )	96-78, 97-78	Redox titration with ceric sulfate	IM96-78/97-78
Silicate Rocks	96-78, 97-78	Back titration	B811
Lead (Pb <sup>2+</sup> ) Organic Compounds	94-82, 96-82	Titration	B1013
Lithium (Li <sup>+</sup> ) Water	94-09, 96-09	Titration	B36
Manganese (Mn <sup>2+</sup> ) Ore	96-78, 97-78	Titration with KMnO <sub>4</sub>	ASTM, B1213
Nickel (Ni <sup>2+</sup> ) Water	94-29, 96-29	Titration	B148
Nitrate (NO <sub>3</sub> <sup>-</sup> ) Atmospheric Particles	93-07, 97-07	Direct	B772
Baby Foods	93-07, 97-07	Direct	B849
Fertilizers	93-07, 97-07	Direct	B923
Limestone	93-07, 97-07	Direct	B320
Organic Compounds	93-07, 97-07	Direct	B880
Pickling Baths	93-07, 97-07	Sample addition	B806
Plant Tissues	93-07, 97-07	Direct	B77, B187, B283, B413, B578, B855
Potable Water	93-07, 97-07	Direct	B283
Potatoes	93-07, 97-07	Direct	B424
Soils	93-07, 97-07	Direct	A103, A104, B65, B283, B338, B366, B374, B578, B785
Sulfuric Acid	93-07, 97-07	Direct	B374
Wastewater and Sea Water	95-46	Direct	IM95-46
Nitroacetate (NTA)	96-78, 97-78	Titration	B667
Nitrite (NO <sub>2</sub> <sup>-</sup> ) Fish	95-46	Known addition	B876
Soils	95-46	Direct	B734
Water	93-46, 97-46	Direct	IM93-46/97-46
Nitrogen Oxide (NO <sub>x</sub> ) Air	95-46	Known addition	IM95-46
Stack Gases	93-07, 97-07	Indirect as nitrate	B274, B360, B582
Oxygen (BOD)	97-08	Direct	A516, IM97-08
Potassium (K <sup>+</sup> ) Feldspar	93-19, 97-19	Known addition	B794
Fertilizer	93-19, 97-19	Known addition or direct	A101
Soils	93-19, 97-19	Direct	IM93-19/97-19
Wines	93-19, 97-19	Direct	IM93-19
Protein Water	94-16, 96-16	Indirect	B668
Silver (Ag <sup>+</sup> ) Low Levels	94-16, 96-16	Direct	B171
Cyanide Plating Baths	94-16, 96-16	Known addition	B377, B718
Sodium (Na <sup>+</sup> ) Foods	84-11, 86-11	Known addition	B878
Feldspar	84-11, 86-11	Known addition	B794
Plant Tissues	84-11, 86-11	Direct	B851
Pulping Liquors	84-11, 86-11	Direct or sample addition	B456
Sulfate (SO <sub>4</sub> <sup>2-</sup> ) Water	94-82, 96-82	Titration	B108, B530, B887, B889
Sulfide (S <sup>2-</sup> ) Water	94-16, 96-16	Direct	B639, B692
Wood Chips	94-16, 96-16	Direct	B681
Sulfur (S) Coal	94-82, 96-82	Titration	B659
Pulping Liquors	94-82, 96-82	Titration	B916
Water and Solid Samples	94-48, 96-48	Titration	B1028, B1032
Thioglycolic Acid Hair Dye	94-16, 96-16	Titration	B393, B517, B805
Thiols Petroleum Products	94-16, 96-16	Titration	B596
Urea Biological Fluids	95-12	Direct as ammonia	B728
Fertilizer	95-12	Direct as ammonia	B922
Vitamin B <sub>1</sub> Pharmaceutical	94-82, 96-82	Titration	B971