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## R3.256F - Technical Information

### NEW FOR 2020

### BWB+ISI 12mm Fluoride Ion Measuring Combination Electrode



*Diamond  
in the Ruff*



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### Recommended Applications

#### For general laboratory and field use

- Drinking water supplies
- Dental products
- Aluminium and Phosphates ore processing
- Industrial waste
- Fluoride tablets
- Apple fruit
- Natural mineral water
- Chrome plating baths

### Your benefits

- **Response follows Nernst Equation**
- **Non-fouling PTFE Liquid Junction**
- **Double Reference Junction System Standard with Unique "Never Dry" Reference Electrolytes**
- **New Top68 Quick Disconnect Cable Connector**
- **Reasonably Priced Premier 12mm Combination Electrode**

### Introduction

The BWB+ISI R3.256F Fluoride Ion Measuring combination electrode is a robust, high performance 12mm electrode constructed from an inert polymer material which incorporates an ion sensitive membrane. The membrane is a crystal of Lanthanum Fluoride which produces a potential proportional to the amount of fluoride ion in the solution. The Fluoride ion is complexed with hydrogen below pH5 and the electrode is subject to hydroxide interference above pH8, therefore accurate measurements can only be made between pH5 and pH8.

### Specification

Membrane Type:	LaF Crystal
Measurement Range M:	1M - $5 \times 10^{-7}$ M
Lower Limit - ppm:	0.01
pH Limits:	5 to 8 pH
Temperature Range:	-5 to 80°C
Approximate Slope:	-50 to -59mV per decade
pH Range:	5 to 8
Interferences:	Al <sup>3+</sup> , Fe <sup>3+</sup> , Si <sup>4+</sup> , Ca <sup>2+</sup> Fe <sup>2+</sup> and other polyvalent ions that form complexes with F <sup>-</sup>
Reproducibility	± 2%

### Theory of Measurement

The BWB+ISI Fluoride sensing element is sealed into a Rohs compliant glass tube. After a settling time of several minutes, equilibrium is set up between the F<sup>-</sup> ions in the surface and in the solution resulting in a charge imbalance which is dependent on the activity and concentration of the fluoride ions under test.

The response is given by the Nernst equation:

$$E = E_o + \text{slope} \times \log_{10} (\text{ion concentration})$$

The slope is theoretically about 59mV/decade at 25°C where  $n = -1$  for F<sup>-</sup> ions.

$E_o$  is a constant which incorporates the reference potentials.

Practically, for concentrations from about 1ppm the typical potential will be given by:

$$E(\text{mV}) = 0.03 - 0.059 \log_{10} (\text{ppm}/100)$$

Typically, zero fluoride gives a potential >200mV and the slope will be 59±10mV.

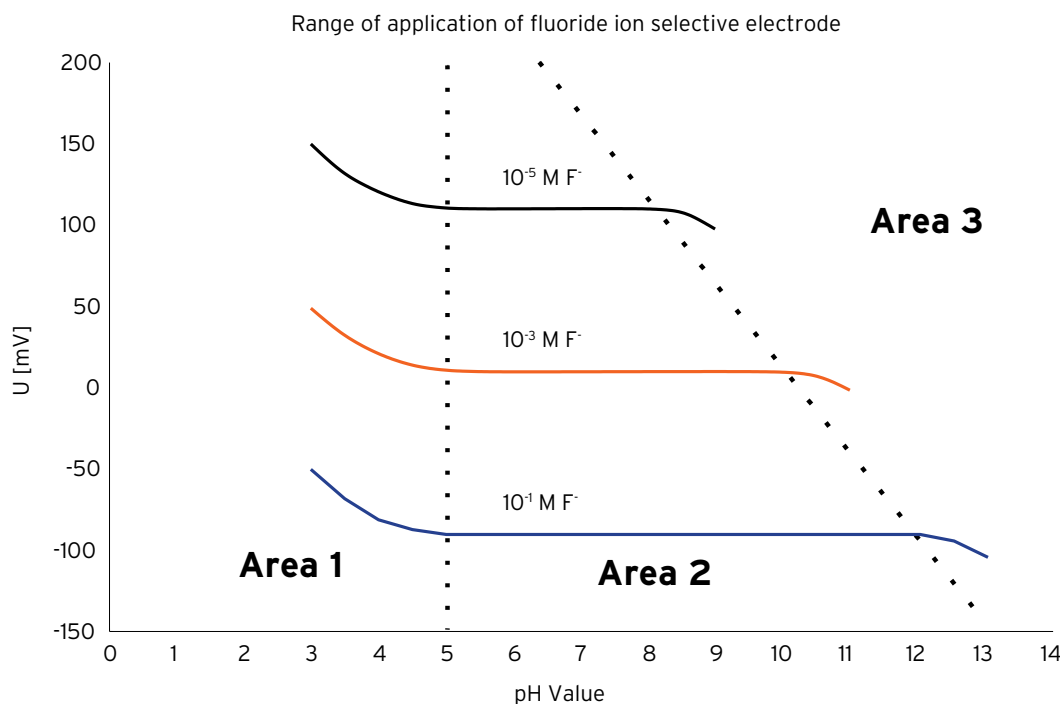
Typically 1ppm gives approximately 125mV and 10ppm approximately 60mV

## Experience

Sometimes there can be problems in getting expected potentials and performance from  $\text{LaF}_3$  electrodes. This is not likely to be a problem in the sensing crystal but probably in the surface polish and preparation, or if the surface has become contaminated. It is thought that the lanthanum fluoride electrode can have a surface film resembling a hydrolyzed surface. Soaking the element in 50% glacial acetic / 50% water will generally condition the surface for use. Wiping the  $\text{LaF}_3$  tip with a little fluoride toothpaste has been known to work too.

The fluoride electrode with  $\text{LaF}_3$  membrane is one of the most selective ion sensors. The potential is built by a reaction according  $\text{LaF}_3 \leftrightarrow \text{La}^{+3} + 3 \text{F}^-$ .

The fluoride electrode is only usable within narrow limits.



The fluoride electrode can be used in pH-range 5 to 8.  
 $0.1$  to  $10^{-6}$  M/L are the limits of the fluoride concentration.

area 1	$\text{pH} < 5$	$\rightarrow \text{H}^+ + \text{F}^- \leftrightarrow \text{HF} + \text{F}^- \leftrightarrow \text{HF}_2^- + \text{F}^- \leftrightarrow \text{HF}_3^{2-}$
area 2	Suitable for fluoride ion measurement	
area 3	$\text{pH} > 8$	$\rightarrow \text{LaF}_3 + 3 \text{OH}^- \leftrightarrow \text{La}(\text{OH})_3 + 3 \text{F}^-$

ion selectivity coefficient  $\text{F}^-$  to  $\text{OH}^- = 0.1$

You can calculate the deviation,  
 but - a number of "insoluble" fluorides falsifies the results  
 - the activity coefficients in calibration solutions and in test solution  
 should be comparable with only slight differences

In work with ion-selective electrodes you need ionic strength adjusters.

For example you can use TISAB from MERCK (= Total Ionic Strength Adjustment Buffer) and then you can measure the potential of the fluoride electrode.



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### Preparation for Use

Remove the R3.256F- from the packaging and inspect the electrode and membrane for any physical damage.

Clamp the electrode in suitable fixture and place the membrane in a solution of 100ppm fluoride standard solution for a period of two hours, or until the electrode potential remains constant. Overnight soaking prior to use is recommended.

### Calibration Procedure

#### Equipment Required:

1. pH/Ion/mV Meter
2. R3.256F- combination electrode
3. Measuring cable

#### Reagents Required:

1. Ionic Strength Adjustment Buffer (ISAB)
2. Standard Fluoride Solution (10,000ppm)

The following commonly used formulations may be used for the preparation of standards as above:

#### 1. Ionic Strength Adjustment Buffer (ISAB)

Dissolve 57ml glacial acetic acid, 58g Sodium Chloride, 0.2g CDTA in 900ml distilled water. Adjust the pH to 5.5 using 4M Sodium Hydroxide. Bring to a final volume of 1 liter.

#### 2. Standard Fluoride Solution (10,000ppm)

Dissolve 22.105g of A.R. grade sodium fluoride in distilled water. Make up a 1 liter solution using distilled water. Prepare standards of 1000, 100, 10, 1 and 0.1ppm by serial dilution of the 10,000ppm Standard Fluoride Solution. Dilute each standard with an equal volume (1:1) of ISAB.

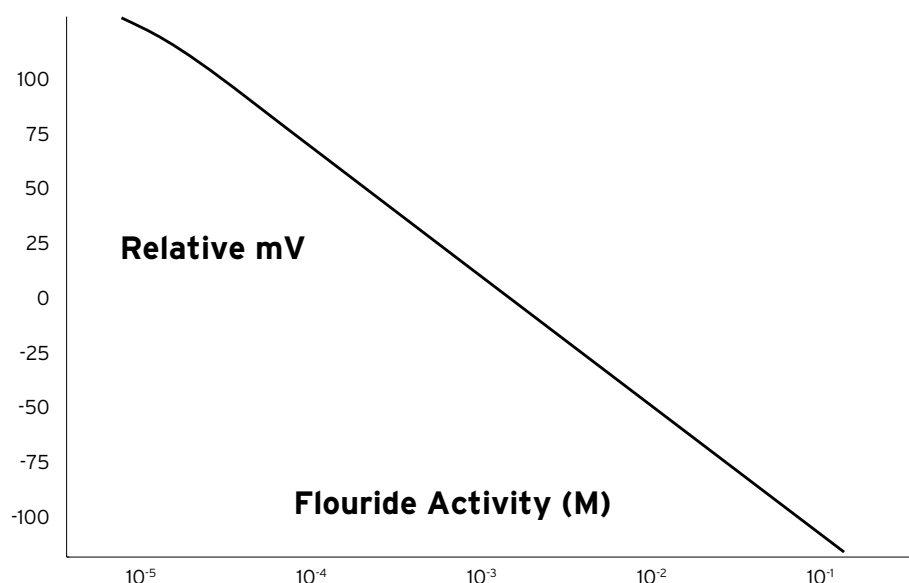
#### Method:

1. Connect the R3.256F to the meter.
2. Switch the meter to the mV mode.
3. Dispense 100ml of each prepared standard (100, 10, 1 and 0.1ppm dilutions) into individual 250ml beakers. Ensure standards are stirred continuously during measurement. The stirrer speed should be set to cause a small vortex to appear in the solution.
4. Immerse the electrode in to each of the prepared standards, in turn, in increasing concentration steps. Record the mV readings when stable. **NOTE: Rinse the electrode(s) with distilled water and blot dry between each sample.**
5. Create a calibration curve on semi-log graph paper by plotting the mV values on the linear axis and the concentration on the log axis.
6. Transfer equal amounts of the unknown sample and ISAB into a 250ml beaker. Immerse the electrode(s) in the sample and record the mV response to determine the sample concentration from the graph.

### Calculations:

As both standards and sample have been diluted by the same amount of ISAB, the result obtained from the graph is the concentration of the original sample.

**NOTE: Ion Meters allow multiple calibration point entry and provide direct readout of sample concentration. Refer to manufacturer's instructions for specific method.**



### Interference:

Correct use of the ISAB will eliminate interference by  $\text{OH}^-$ . Interferences  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Si}^{4+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Fe}^{2+}$  and other polyvalent ions form complexes with fluoride. Response time +(99%) in concentrated samples- several seconds; close to detection limits- several minutes.

Temp (°C)	Slope (mV/pX)
0	-54.2
10	-56.2
20	-58.2
25	-59.2
30	-60.1
40	-62.1
50	-64.1

All samples and standards should be at the same temperature for precise measurement, preferably ambient temperature. Temperature should be less than 80°C. A difference of 1°C in temperature will result in a 2% measurement error.



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### Conditioning

For the determination of concentrations under 1 mg/l the electrode should be conditioned in deionized water for approx 30 minutes.

### Handling

The lanthanide fluoride crystal is sensitive to mechanical impact. Cracks and scratches render the electrode useless. Avoid fat deposits on the crystal, do not touch with bare fingers.

### Care and Maintenance

If the sensor is giving an unacceptable response, is dirty or contaminated, the membrane should be cleaned with distilled or deionized water. After dry storage, before making measurements below 1ppm, or if measurement difficulties are observed, lightly polish the face of the electrode using light pressure and a rotary motion for 30-60 seconds. Rinse with deionized water. A smooth glasslike surface is ideal. Polishing powder and a cloth are supplied with each electrode. TIP - Fluoride toothpaste and a soft toothbrush works great!

### Storage

The R3.256F electrode is recommended to be stored wet. For long term storage, place the R3.256F in the original packaging. The electrode may be stored in 10ppm Fluoride Standard with 4 mol/L potassium chloride solution for short periods of time. For storage longer than two weeks, use the original storage system electrode was received in.

### Ordering Information

R3.256F- Fluoride Combination Ion Measuring Device with polishing kit