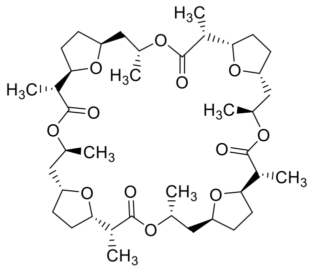
# Product Information



## 09877 Ammonium ionophore I

(Nonactin)
Selectophore®, function tested

## Electrochemical Transduction

### Ion-Selective Electrodes

**Application 1 and Sensor Type[1,2]**
Assay of $NH_4^+$ activity in aq. solutions with solvent polymeric electrodes based on Ammonium ionophore I.

**Recommended Membrane Composition**

1.00 wt% Ammonium ionophore I (09877)
66.80 wt% Bis(2-ethylhexyl) sebacate (DOS) (84818)*)
32.20 wt% Poly(vinyl chloride) high molecular weight (81392)

*) The use of Bis(1-butylpentyl)decane-1,10-diyl diglutarate (30585) or Bis(1-butylpentyl)adipate (02150) leads to a membrane electrode of similar performance.

**Recommended Cell Assembly**

Reference || sample solution || ion-selective membrane | 0.1 M $NH_4Cl$ | AgCl, Ag

**Electrode Characteristics and Function**

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

| | | | |
|---|---|---|---|
| $\log K^{Pot}_{NH_4,H}$ | -3.8 | $\log K^{Pot}_{NH_4,K}$ | -0.8 |
| $\log K^{Pot}_{NH_4,Li}$ | -3.6 | $\log K^{Pot}_{NH_4,Mg}$ | -5.5 |
| $\log K^{Pot}_{NH_4,Na}$ | -2.9 | $\log K^{Pot}_{NH_4,Ca}$ | -4.8 |

Nernstian electrode response with detection limit: $\log a_{NH4} < -6$

**Application 2 and Sensor Type[3]**
Assay of $NH_4^+$ activity in aq. solutions with solvent polymeric electrodes based on Ammonium ionophore I.

**Recommended Membrane Composition**

1.00 wt% Ammonium ionophore I (09877)
66.00 wt% Dibutyl sebacate (84838)
33.00 wt% Poly(vinyl chloride) high molecular weight (81392)

**Recommended Cell Assembly**

Reference | sample solution || ion-selective membrane | 0.01 M $NH_4Cl$ | Ag, AgCl

### Electrode Characteristics and Function

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

| | | | |
|---|---|---|---|
| $\log K^{Pot}_{NH_4,Li}$ | -4.5 | $\log K^{Pot}_{NH_4,Ca}$ | -5.0 |
| $\log K^{Pot}_{NH_4,Na}$ | -2.9 | $\log K^{Pot}_{NH_4,Me_4}$ | -3.7 |
| $\log K^{Pot}_{NH_4,K}$ | -0.9 | $\log K^{Pot}_{NH_4,H}$ | -5.0 |
| $\log K^{Pot}_{NH_4,Mg}$ | -2.9 | | |

Slope of linear regression: 58.3 mV ($10^{-4}$ to $3 \cdot 10^{-3}$ M $NH_4Cl$ in 0.01 M TRIS/HCl, pH 7.2)
Resistance: $0.98 \cdot 10^8$ Ω
Lifetime log $P_{TLC}$ ionophore[4]: 6.0

## Application 3 and Sensor Type[5]

Assay of $NH_4^+$ activity in aqueous solutions with solvent polymeric electrodes based on Ammonium ionophore I. This membrane composition does not require the use of a buffer trap as in other plasticizer systems.

### Recommended Membrane Composition

- 0.20 wt% Ammonium ionophore I (09877)
- 69.00 wt% 2-Nitrophenyl octyl ether (73732)
- 30.80 wt% Poly(vinyl chloride) high molecular weight (81392)

### Recommended Cell Assembly

Reference || sample solution || liquid membrane | 0.01 M $NH_4Cl$ | AgCl, Ag

### Electrode Characteristics and Function

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

| | | | |
|---|---|---|---|
| $\log K^{Pot}_{NH_4,Li}$ | -2.9 | $\log K^{Pot}_{NH_4,Ca}$ | -3.2 |
| $\log K^{Pot}_{NH_4,Na}$ | -2.6 | $\log K^{Pot}_{NH_4,Mg}$ | -3.8 |
| $\log K^{Pot}_{NH_4,K}$ | -1.6 | | |

Slope of linear regression: 59 mV ($10^{-5}$ to $10^{-1}$ M $NH_4Cl$)
Detection limit: $5 \cdot 10^{-6}$ $NH_4^+$
Practical pH measuring range: <9
Membrane resistance: 1.33 Ω (membrane thickness 0.47 mm)

## Application 4 and Sensor Type[6,7]

Assay of $NH_4^+$ activity derived from enzymatic decomposition of urea with solvent polymeric membrane electrodes based on Ammonium ionophore I

### Recommended Membrane Composition

- 0.60 wt% Ammonium ionophore I (09877)
- 0.50 wt% Tetraheptylammonium tetraphenylborate (87293)
- 63.60 wt% Dibutyl sebacate (84838)
- 35.30 wt% Poly(vinyl chloride) high molecular weight (81392)

### Recommended Cell Assembly

Reference || sample solution || ion-selective membrane | 0.001 M $NH_4Cl$ | AgCl, Ag

### Electrode Characteristics and Function:

Slope of linear regression: 53 mV ($4 \cdot 10^{-6}$ to $6 \cdot 10^{-3}$ M $NH_4^+$ in 0.02 M TRIS/HCl, $10^{-3}$ M $Na_2EDTA$; pH 8)
Electrical Resistance: ~$3 \cdot 10^4$ Ω

### Application 5 and Sensor Type[8]

Assay of $NH_4^+$ activity in an urea sensor which uses enzyme immobilization on a nylon net together with a specially designed ammonium ion-selective field-effect transistor, coated with a solvent polymer membrane based on Ammonium ionophore I.

**Recommended Membrane Composition**

| | |
|---|---|
| 0.99 wt% | Ammonium ionophore I (09877) |
| 0.60 wt% | Potassium tetrakis(4-chlorophenyl)borate (60591) |
| 68.49 wt% | Tetraundecyl benzhydrol-3,3',4,4'-tetracarboxylate (ETH 2112) (12103) |
| 29.82 wt% | Poly(vinyl chloride) high molecular weight (81392) |

**Recommended pH buffer**

0.001 M TRIS/HCl buffer; pH 7.3

**Electrode Characteristics**

| | |
|---|---|
| Slope of linear regression: | 57 mV ($10^{-4}$ to $3 \cdot 10^{-3}$ M urea) |
| Response time: | 38 s |
| Lifetime: | >20 d |

### Application 6 and Sensor Type[9]

Assay of $NH_4^+$ activity derived from enzymatic decomposition of urea with solvent polymeric membrane electrodes based on Ammonium ionophore I.

**Recommended Membrane Composition**

| | |
|---|---|
| 4.00 wt% | Ammonium ionophore I (09877) |
| 2.00 wt% | Palmitic acid (76120) |
| 64.00 wt% | Bis(2-ethyl)hexyl sebacate (DOS) (84818) |
| 30.00 wt% | Poly(vinyl chloride) high molecular weight (81392) |

**Recommended pH buffer**

Trizma base pH 7.00

**Electrode Characteristics**

| | |
|---|---|
| Slope of linear regression: | $54.3 \pm 0.4$ mV ($1.0 \cdot 10^{-5}$ to $1.0 \cdot 10^{-2}$ M) urea;<br>$54.8 \pm 0.1$ mV ($1.0 \cdot 10^{-6}$ to $1.0 \cdot 10^{-1}$ M) $NH_4^+$ |
| Response time: | <1 min |
| Lifetime: | >2 months |

## Microelectrodes

### Application 1 and Sensor Type[10,11,12]

Assay of $NH_4^+$ activity with microelectrodes based on Ammonium ionophore I.

Ammonium ionophore I - Cocktail A (99978)

**Cocktail Composition:**

| | |
|---|---|
| 6.90 wt% | Ammonium ionophore I (09877) |
| 0.70 wt% | Potassium tetrakis(4-chlorophenyl)borate (60591) |
| 92.40 wt% | 2-Nitrophenyl octyl ether (73732) |

**Recommended Cell Assembly**

Reference || sample solution || cocktail | 0.01 M $NH_4NO_3$ | AgCl,Ag

### Electrode Characteristics and Function

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

| | | | |
|---|---|---|---|
| $\log K^{Pot}_{NH_4,H}$ | -2.2 | $\log K^{Pot}_{NH_4,K}$ | -0.6 |
| $\log K^{Pot}_{NH_4,Li}$ | -3.6 | $\log K^{Pot}_{NH_4,Ca}$ | -4.4 |
| $\log K^{Pot}_{NH_4,Na}$ | -2.0 | $\log K^{Pot}_{NH_4,Mg}$ | -4.2 |

| | |
|---|---|
| Slope of linear regression: | 54.5 mV ($10^{-4}$ to $10^{-1}$ M $NH_4Cl$) |
| Detection limit (NH4Cl, no ion background): | log $a_{NH4}$ ~5.8 |
| Electrical resistance, tip diam. ~1 µm, filling height 200-300 µm: | ~$6\cdot10^{10}$ Ω |
| Membrane resistance: | 1.33 Ω (membrane thickness 0.47 mm) |

## Ion-Selective Field Effect Transistors (ISFET)

### Application and Sensor Type[13]

Assay of $NH_4^+$ activity with silicon rubber matrix ion-selective field effect transistors based on Ammonium ionophore I.

### Recommended Membrane composition

- 2.00 wt% Ammonium ionophore I (09877)
- 0.54 wt% Potassium tetrakis(4-chlorophenyl)borate (60591)
- 88.60 wt% Siloprene K 1000 (85417)
- 8.86 wt% Siloprene crosslinking agent K 11 (85418)

### Electroanalytical Characteristics

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the fixed interference solution method (0.0011 M solutions of the chlorides).

| | |
|---|---|
| $\log K^{Pot}_{NH_4,K}$ | -1.2 |
| $\log K^{Pot}_{NH_4,Na}$ | -2.1 |

| | |
|---|---|
| Slope of linear regression: | 56 mV ($10^{-5}$ to $10^{-2}$ M $NH_4NO_3$) |
| Drift: | <0.5 mV/h (after 24 h preconditioning) |

## Optical Transduction

### Application 1 and Sensor Type[14]

Assay of $NH_4^+$ activity in aqueous pH-buffered solutions with polymeric optode membranes based on Ammonium ionophore I and Chromoionophore III (ETH 5350).

### Recommended Membrane Composition

- 2.00 wt% Ammonium ionophore I (09877)
- 1.30 wt% Potassium tetrakis(4-chlorophenyl)borate (60591)
- 1.00 wt% Chromoionophore III (27088)
- 67.50 wt% Bis(2-ethylhexyl)sebacate (84818)
- 15.00 wt% Poly(vinyl chloride) high molecular weight (81392)
- 15.00 wt% Polyurethane (81367)

### Recommended pH Buffer

0.16 M sodium acetate, adjusted with acetic acid to pH 5.3 for recording the calibration curve

### Optode Characteristics and Function

Selectivity coefficients $\log K^{Opt}_{NH_4,M}$ as obtained by the separate solution method in pH-buffered solutions.

| | |
|---|---|
| $\log K^{Opt}_{NH_4,Na}$ | -3.6 |
| $\log K^{Opt}_{Ca,K}$ | -3.8 |
| $\log K^{Opt}_{Ca,Mg}$ | -4.1 |

## Application 2 and Sensor Type[15]

Assay of $NH_4^+$ activity in aqueous pH-buffered solutions with polymeric optode membranes based on Ammonium ionophore I and Chromoionophore I (ETH 5294).

### Recommended Membrane Composition

| | |
|---|---|
| 1.58 wt% | Chromoionophore I (27086) |
| 2.36 wt% | Ammonium ionophore I (09877) |
| 1.54 wt% | Potassium tetrakis(4-chlorophenyl)borate (60591) |
| 63.02 wt% | Bis(2-ethylhexyl)sebacate (84818) |
| 31.50 wt% | Poly(vinyl chloride) high molecular weight (81392) |

### Optode Characteristics and Function

Selectivity coefficients $\log K^{Opt}_{NH_4,M}$.[16]

| | |
|---|---|
| $\log K^{Opt}_{NH_4,K}$ | -1.2 |
| $\log K^{Opt}_{NH_4,Na}$ | -2.7 |
| $\log K^{Opt}_{NH_4,Li}$ | -3.4 |

| | |
|---|---|
| Dynamic measuring range: | $10^{-2}$ to $10^{-5}$ M $NH_4^+$ at pH 7.35 |
| Response time: | 95% response time 5 s (membrane thickness 4 µm) |

## Application 3 and Sensor Type[17]

Assay of $NH4^{+a}$ctivity in urea-sensitive reverse micelle based biooptode membranes. The ammonium-selective optode membrane contains Ammonium ionophore I and Chromoionophore III (ETH 5350).

### Recommended Membrane Composition

| | |
|---|---|
| 0.37 wt% | Chromoionophore III (27088) |
| 0.46 wt% | Ammonium ionophore I (09877) |
| 0.62 wt% | Sodium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate (72017) |
| 5.76 wt% | Sodium bis(2-ethylhexyl)sulfosuccinate (86139) |
| 0.49 wt% | Cyclohexanone (29135) |
| 0.79 wt% | Urease (94278) |
| 0.01 wt% | Water (95283) |
| 58.70 wt% | Nitrophenyl octyl ether (NPOE) (73732) |
| 32.80 wt% | Poly(vinyl chloride) high molecular weight (81392) |

### Recommended pH buffer

0.018 M LiOH adjusted with phosphoric acid to pH 7.55

### Optode Characteristics:

| | |
|---|---|
| Dynamic measuring range: | $10^{-5}$ to $10^{-1}$ M urea at pH 7.55 |
| Response time: | 95% response time 1-3.5 min |

## Application 4 and Sensor Type[18]

Determination of urea based on the measurement of $NH_4^+$ produced through enzymatic decomposition of urea, using fluorescence detection. The solvent polymeric optode membrane contains Ammonium ionophore I and Chromoionophore I.

### Recommended Membrane Composition

- 9.50 wt% Ammonium ionophore I (09877)
- 5.59 wt% Chromoionophore I (27086)
- 4.47 wt% Potassium tetrakis(4-chlorophenyl)borate (60591)
- 53.63 wt% Bis(2-ethylhexyl)sebacate (84818)
- 26.81 wt% Poly(vinyl chloride) high molecular weight (81392)

### Recommended pH Buffer

10 or 200 mM TRIS/HCl buffer; pH 7.24.

### Optode Characteristics

| | |
|---|---|
| Dynamic range: | 30 μM to 10 mM $NH_4^+$ |
| Detection limit: | 0.03 to 0.6 mM at near neutral pH |
| Response time: | 4 min (enzyme membrane thickness 150 μm) |

## Application 5 and Sensor Type[19]

Determination of urease activity based on the measurement of $NH_4^+$ produced through enzymatic decomposition of urea. This biosensor of urea incorporates an ammonium-selective bulk optode membrane containing Ammonium ionophore I and Chromoionophore III.

### Recommended Membrane Composition

- 0.47 wt% Ammonium ionophore I (09877)
- 0.43 wt% Chromoionophore III (27088)
- 0.53 wt% Sodium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate (72017)
- 66.25 wt% 2-Nitrophenyl octyl ether (73732)
- 32.26 wt% Poly(vinyl chloride) high molecular weight (81392)

### Recommended pH Buffer

0.029 M NaOH/0.05 M $NaH_2PO_4$, pH 7.0.

### Optode Characteristics

| | |
|---|---|
| Dynamic range: | $10^{-4}$ to $10^{-1}$ M $NH_4Cl$ at pH 7.0 |
| Detection limit: | 0.03 to 0.6 mM at near neutral pH |
| Response time: | 95% response time 0.5-2 min |

## Application 6 and Sensor Type[20]

Assay of ammonia gas in aqueous solutions with solvent polymeric optode membranes based on Chromoionophore III (ETH 5350) and Ammonium ionophore I.

### Recommended Membrane Composition

- 2.36 wt% Ammonium ionophore I (09877)
- 1.54 wt% Chromoionophore III (27088)
- 1.54 wt% Potassium tetrakis(4-chlorophenylphenyl)borate (60591)
- 63.04 wt% Bis(2-ethylhexyl)sebacate (84818)
- 31.52 wt% Poly(vinyl chloride) high molecular weight (81392)

### Optode Characteristics

Selectivity coefficients $\log K^{Opt}_{NH_3,G}$ as obtained by the separate solution method.

| | | | |
|---|---|---|---|
| $\log K^{Opt}_{NH_3,MeNH_2}$ | -2.7 | $\log K^{Opt}_{NH_3,Me_2NH}$ | -4.0 |
| $\log K^{Opt}_{NH_3,EtNH_2}$ | -3.7 | $\log K^{Opt}_{NH_3,Me_3N}$ | -4.7 |
| $\log K^{Opt}_{NH_3,PrNH_2}$ | -3.5 | | |

| | |
|---|---|
| Reproducibility: | $10^{-4}$ $NH_3$ ~4.5%; $10^{-3}$ M $NH_3$ ~2.6% |
| Response time: | 95% response time ≤1 min (concentration range: ~$10^{-4}$ M) |

## Miscellaneous Sensor Systems

### Application 1 and Sensor Type[21]

Assay of $NH_4^+$ activity with silicon microsensor chips based on Ammonium ionophore I silicon matrix membranes.

#### Recommended Membrane Composition

| | |
|---|---|
| 2.10 wt% | Ammonium ionophore I (09877) |
| 0.80 wt% | Potassium tetrakis(4-chlorophenyl)borate (60591) |
| 28.00 wt% | Bis(2-ethylhexyl)sebacate (84818) |
| 69.10 wt% | Fluorosilicone 730 Dow Corning |

#### Electroanalytical Characteristics

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the fixed interference method (0.01 M $Na^+$; 0.001 M $K^+$).

| | |
|---|---|
| $\log K^{Pot}_{NH_4,K}$ | -0.8 |
| $\log K^{Opt}_{NH_4,Na}$ | -3.1 |

| | |
|---|---|
| Slope of linear regression: | 54 mV ($4\cdot10^{-5}$ to $10^{-2}$ M $NH_4NO_3$) |
| Lifetime: | >7 d |

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