Improved resolution of inorganic anions and oxyhalides in the presence of ethylenediamine

The Thermo Scientific™ Dionex™ IonPac™ AS30 column is a high-capacity, hydroxide-selective anion-exchange column designed for trace level determination of inorganic anions and oxyhalides in drinking water preserved with up to 50 ppm ethylenediamine (EDA). The unique selectivity of the Dionex IonPac AS30 column delivers high-resolution separations of fluoride, chlorite, bromate, chloride, carbonate, sulfate, nitrite, phosphate, bromide, chlorate, and nitrate in drinking water, groundwater, wastewater, and other diverse sample matrices. For added convenience and increased reproducibility, the column can be used in high-pressure ion chromatography (HPIC) systems equipped with Thermo Scientific™ Dionex™ eluent generation cartridges that can automatically produce potassium hydroxide eluents from deionized water.

- HPIC column for trace anions and oxyhalides in drinking water matrices preserved with EDA using a potassium hydroxide gradient with suppressed conductivity detection
- High capacity of 477 µeq/column (4 x 250 mm) allows analysis of most ozone-disinfected drinking water without the need for sample pretreatment or preconcentration
- Compatible with organic solvents to enhance analyte solubility, modify column selectivity, or allow effective column clean-up
- Use with Dionex inorganic anion and oxyhalide standards for fast, simple, and accurate standard preparation

Benefits

- Separation of inorganic anions and oxyhalides in approximately 35 minutes
- Resolves the EDA carbamate artifact and fluoride
- Improved resolution of carbonate and sulfate

Keywords

Anion-exchange chromatography, oxyhalides, inorganic anions, drinking water, ethylenediamine

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High-efficiency particle structure

The Dionex IonPac AS30 column was developed using a unique polymer bonding technology. The stationary phase consists of a novel, hyper-branched anion-exchange condensation polymer electrostatically attached to the surface of a sulfonated wide-pore polymeric substrate. Alternating cycles of epoxy monomer and amines produce a coating which is grown directly off the substrate as illustrated in **Figure 1**. Resin capacity is controlled through the number of alternating coating cycles. The Dionex IonPac AS30 column uses a high-capacity resin (477 µeq per 4 x 250 mm column) with optimized selectivity for inorganic anions and oxyhalides in environmental water matrices containing EDA. It is composed of a polymeric 5.5 µm substrate consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene.

Use with an eluent generator for easy isocratic or gradient separations

The Dionex IonPac AS30 column is recommended for use with eluent generation and RFIC-EG systems. The eluent generator (EG) electrolytically produces high-purity potassium hydroxide eluent from water, eliminating the need for manual eluent preparation. **Figure 2** shows the use of a simple isocratic hydroxide eluent to separate inorganic anions and oxyhalides. An optimized hydroxide gradient can be used as shown in **Figure 3** to achieve run times less than 35 min while maintaining excellent peak resolution.

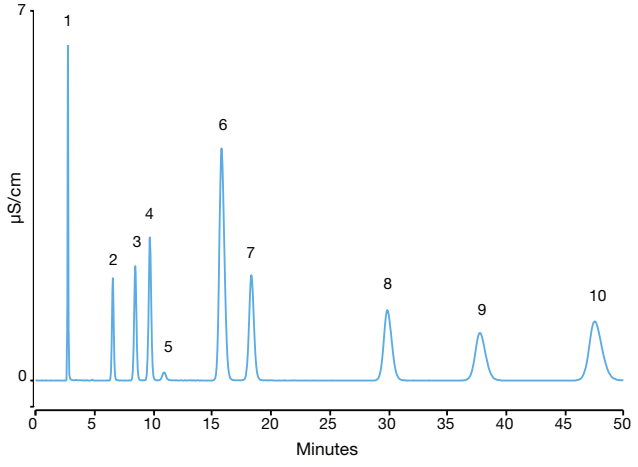
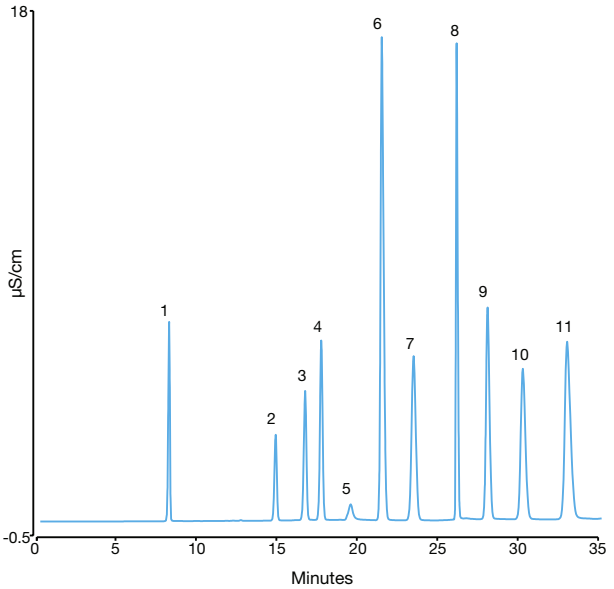


Figure 1. Structure of a Dionex IonPac AS30 column resin particle

Column:	Dionex IonPac AG30/AS30, 2mm
Eluent:	18 mM KOH
Eluent source:	Dionex EGC 500 KOH cartridge
Flow rate:	0.38 mL/min
Inj. volume:	2.5 µL
Temperature:	30 °C
Detection:	Suppressed conductivity, Dionex ADRS 600 2mm AutoSuppression, recycle mode

Peaks:		mg/L
1.	Fluoride	3.0
2.	Chlorite	10.0
3.	Bromate	20.0
4.	Chloride	6.0
5.	Carbonate	NQ
6.	Sulfate	30.0
7.	Nitrite	15.0
8.	Bromide	25.0
9.	Chlorate	25.0
10.	Nitrate	25.0

Figure 2. Isocratic separation of inorganic anions and oxyhalides on a Dionex IonPac AS30 column (2 x 250 mm)



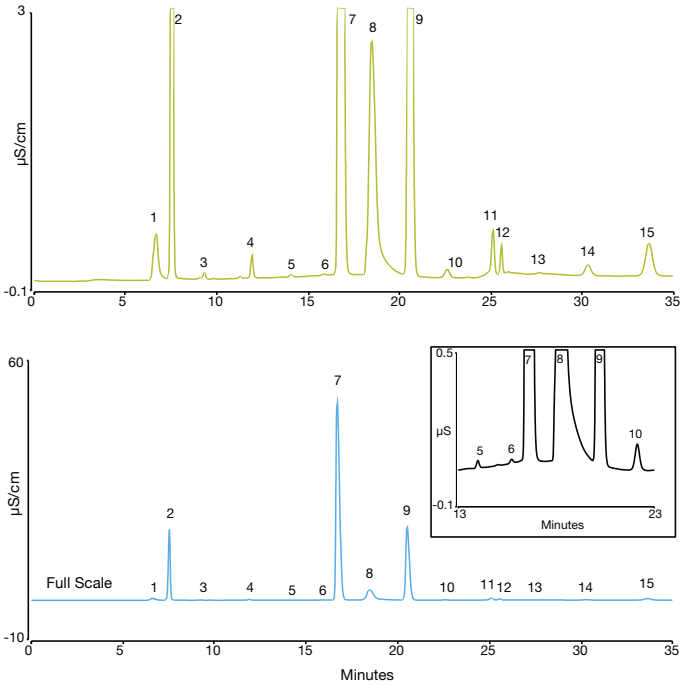
Column:	Dionex IonPac AG30/AS30, 2mm
Eluent:	Equilibration: 7 min At 0 min: 1 mM KOH At 8 min: 8 mM KOH At 16 min: 25 mM KOH At 22 min: 30 mM KOH At 24 min: 60 mM KOH At 35 min: 60 mM KOH (end of run)
Eluent source:	Dionex EGC 500 KOH cartridge
Flow rate:	0.38 mL/min
Inj. volume:	2.5 µL
Temperature:	30 °C
Detection:	Suppressed conductivity, Dionex ADRS 600 2mm AutoSuppression, recycle mode

Peaks:		mg/L
1.	Fluoride	3.0
2.	Chlorite	10.0
3.	Bromate	20.0
4.	Chloride	6.0
5.	Carbonate	NQ
6.	Sulfate	25.0
7.	Nitrite	15.0
8.	Phosphate	40.0
9.	Bromide	25.0
10.	Chlorate	25.0
11.	Nitrate	25.0

Figure 3. Gradient separation of inorganic anions and oxyhalides on a Dionex IonPac AS30 column (2 x 250 mm)

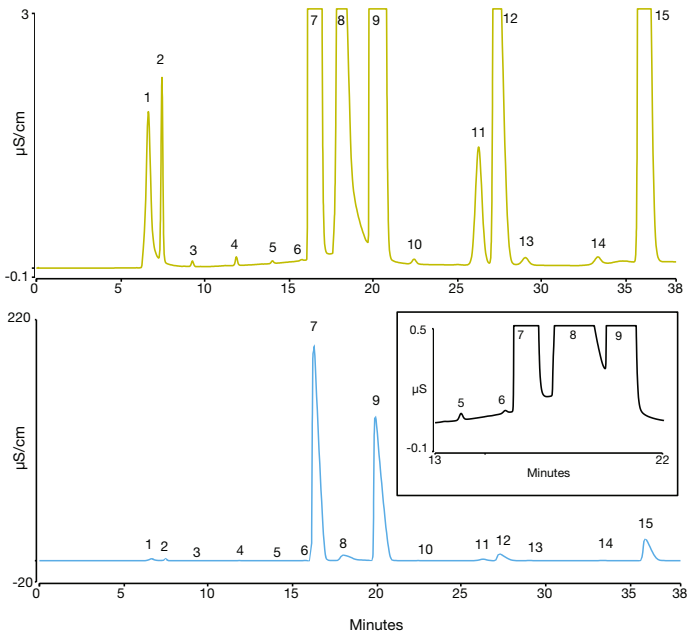
Monitor bromate in drinking water

Bromate, a byproduct of the ozonation disinfection process for drinking water, has been cited by the World Health Organization as a potential carcinogen, even at low µg/L concentrations. Treatment plants that use ozone for disinfection are required to monitor bromate at a maximum contaminant level (MCL) of 10 µg/L in addition to monitoring common inorganic anions. The high-capacity Dionex IonPac AS30 column can be used to determine bromate at low µg/L concentrations in drinking water matrices that have been preserved with 50 ppm EDA. Ethylenediamine is sometimes added to drinking water samples as a preservative and can react with carbonate to produce artifacts that interfere with early eluting analytes like fluoride and bromate. The high-capacity Dionex IonPac AS30 column minimizes the interference by increasing the separation between fluoride and the EDA carbamate artifact, allowing better integration without sample pretreatment or preconcentration. **Figure 4** shows a large loop injection of municipal drinking water spiked with 50 ppm EDA and 5 ppb bromate on the Dionex IonPac AS30 column. As shown in **Figure 5**, the Dionex IonPac AS30 column is suitable for determining bromate at 5 ppb in a matrix containing up to 50 ppm each of chloride, carbonate, and sulfate. For higher ionic strength matrices where chloride levels exceed 50 ppm, the Thermo Scientific™ Dionex™ IonPac AS19 column is recommended for trace bromate analysis below 5 ppb. Alternatively, the Thermo Scientific™ Dionex™ IonPac AS27 column is recommended for higher ionic strength matrices preserved with EDA.



		Peaks:	mg/L
Column:	Dionex IonPac AG30/AS30, 4mm	1. EDA carbamate	50
Eluent:	Equilibration: 7 min	2. Fluoride	0.55
	At 0 min: 1 mM KOH	3. Acetate	NQ
	At 8 min: 8 mM KOH	4. Formate	NQ
	At 16 min: 25 mM KOH	5. Chlorite	0.046
	At 22 min: 30 mM KOH	6. Bromate	0.005
	At 24 min: 50 mM KOH	7. Chloride	5.72
	At 35 min: 50 mM KOH (end of run)	8. Carbonate	6.31
Eluent source:	Dionex EGC 500 KOH cartridge	9. Sulfate	2.62
Flow rate:	1.5 mL/min	10. Nitrite	0.004
Inj. volume:	200 µL	11. Oxalate	NQ
Temperature:	30 °C	12. Phosphate	0.109
Detection:	Suppressed conductivity,	13. Bromide	0.004
	Dionex ADRS 600 4mm	14. Chlorate	0.061
	AutoSuppression, recycle mode	15. Nitrate	0.115

Figure 4. Determination of inorganic anions and oxyhalides in municipal drinking water spiked with 50 ppm EDA and 5 ppb bromate on a Dionex IonPac AS30 column (4 x 250 mm)

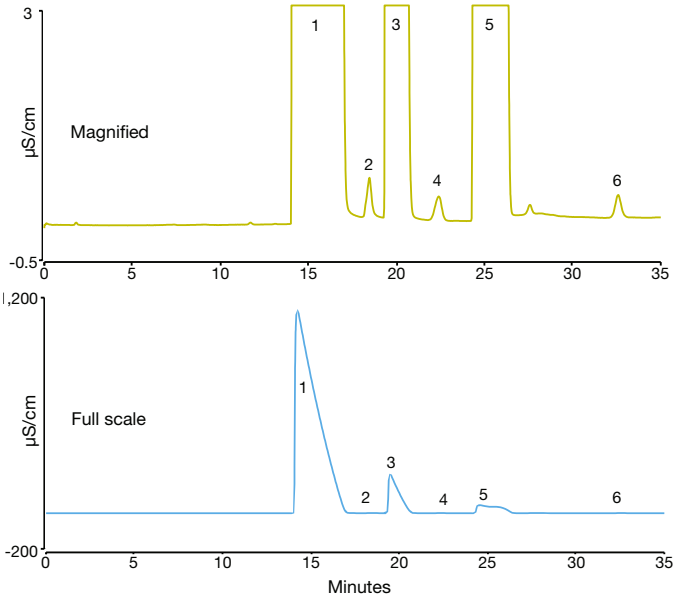


		Peaks:	mg/L
Column:	Dionex IonPac AG30/AS30, 4mm	1. EDA Carbamate	50
Eluent:	Equilibration: 7 min	2. Acetate	NQ
	At 0 min: 1 mM KOH	3. Formate	NQ
	At 8 min: 8 mM KOH	4. Fluoride	0.08
	At 16 min: 25 mM KOH	5. Chlorite	0.01
	At 26 min: 30 mM KOH	6. Bromate	0.005
	At 28 min: 30 mM KOH	7. Chloride	50
	At 29 min: 60 mM KOH	8. Carbonate	50
	At 38 min: 60 mM KOH (end of run)	9. Sulfate	50
Eluent source:	Dionex EGC 500 KOH cartridge	10. Nitrite	NQ
Flow rate:	1.5 mL/min	11. Dichloroacetate	1.0
Inj. volume:	200 µL	12. Phosphate	5.0
Temperature:	30 °C	13. Bromide	0.05
Detection:	Suppressed conductivity,	14. Chlorate	0.05
	Dionex ADRS 600 4mm	15. Nitrate	10
	AutoSuppression, recycle mode		

Figure 5. Determination of inorganic anions and oxyhalides in simulated drinking water spiked with 50 ppm each of EDA, chloride, carbonate, and sulfate, and 1 ppm dichloroacetate on a Dionex IonPac AS30 column (4 x 250 mm)

Determine trace nitrite and nitrate in high ionic strength matrices

The unique selectivity and high capacity of the Dionex IonPac AS30 column make it an ideal column for determining trace levels of nitrite and nitrate in high ionic strength matrices. **Figure 6** shows the determination of 100 ppb nitrite and nitrate in a matrix containing 800 ppm chloride, 100 ppm sulfate, and 100 ppm phosphate using a large loop injection and a potassium hydroxide gradient.



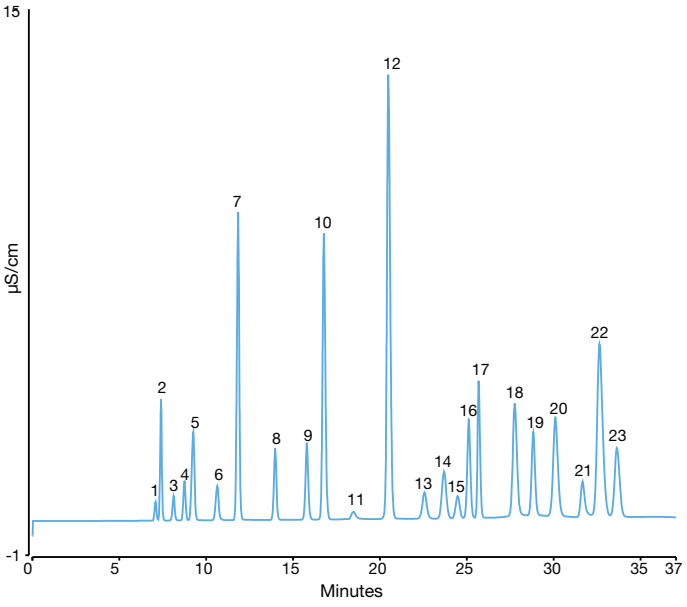
Column:	Dionex IonPac AG30/AS30, 4mm
Eluent:	Equilibration: 7 min At 0 min: 1 mM KOH At 8 min: 8 mM KOH At 16 min: 25 mM KOH At 23 min: 30 mM KOH At 26 min: 60 mM KOH At 35 min: 60 mM KOH (end of run)
Eluent source:	Dionex EGC 500 KOH cartridge
Flow rate:	1.5 mL/min
Inj. volume:	200 µL
Temperature:	30 °C
Detection:	Suppressed conductivity, Dionex ADRS 600 4mm AutoSuppression, recycle mode

Peaks:	**mg/L**
1. Chloride	800
2. Carbonate	NQ
3. Sulfate	100
4. Nitrite	0.1
5. Phosphate	100
6. Nitrate	0.1

Figure 6. Determination of trace nitrite and nitrate in a simulated high ionic strength matrix using a Dionex IonPac AS30 column (4 x 250 mm)

Extended application capabilities

The Dionex IonPac AS30 column can be used to develop specialized applications, providing excellent separation of environmental anions including inorganic anions, oxyhalides, oxyanions, and organic acids. Using gradient elution, these analytes are easily separated in less than 37 min as shown in **Figure 7**.



Column:	Dionex IonPac AG30/AS30, 4mm
Eluent:	Equilibration: 7 min At 0 min: 1 mM KOH At 8 min: 8 mM KOH At 16 min: 25 mM KOH At 22 min: 30 mM KOH At 25 min: 50 mM KOH At 29 min: 65 mM KOH At 37 min: 65 mM KOH (end of run)
Eluent source:	Dionex EGC 500 KOH cartridge
Flow rate:	1.5 mL/min
Inj. volume:	10 µL
Temperature:	30 °C
Detection:	Suppressed conductivity, Dionex ADRS 600 4mm AutoSuppression, recycle mode

Peaks:	**mg/L**
1. Quinate	5.0
2. Fluoride	3.0
3. Shikimate	10.0
4. Lactate	5.0
5. Acetate	10.0
6. Butyrate	10.0
7. Formate	10.0
8. Chlorite	10.0
9. Bromate	20.0
10. Chloride	6.0
11. Carbonate	NQ
12. Sulfate	25.0
13. Nitrite	15.0
14. Malic	10.0
15. Succinic	10.0
16. Oxalate	25.0
17. Phosphate	20.0
18. Bromide	25.0
19. Phthalate	20.0
20. Chlorate	25.0
21. Thiosulfate	20.0
22. Nitrate	25.0
23. Fumarate	20.0

Figure 7. Separation of 23 environmental anions on a Dionex IonPac AS30 column (4 x 250 mm)

System requirements

The Dionex IonPac AS30 column is recommended for use with Thermo Scientific™ Dionex™ ICS-6000, Thermo Scientific™ Dionex™ Integrion, or Thermo Scientific™ Dionex™ ICS-5000^{+} HPIC™ systems equipped with an eluent generation cartridges. These HPIC systems can operate continuously at up to 5000 psi to support the backpressure generated by the Dionex IonPac AS30 column under standard operating conditions. The EG produces potassium hydroxide eluent from deionized water. For all systems, the use of Thermo Scientific™ Dionex™ IC PEEK Viper™ fittings **(Figure 8**) is recommended to achieve consistent low dead volume connections and ensure optimum chromatographic performance.

Suppressor recommendations

For optimum ease of use and performance, Dionex IonPac AS30 analytical columns should be used with a Thermo Scientific™ Dionex™ DRS 600 Dynamically Regenerated Suppressor.

Figure 8. For best chromatographic performance, Dionex IC PEEK Viper fittings are recommended for use with Dionex IonPac AS30 columns

Specifications	
Dimensions:	Dionex IonPac AS30 Analytical Columns: 2 x 250 mm and 4 x 250 mm Dionex IonPac AG30 Guard Columns: 2 x 50 mm and 4 x 50 mm
Maximum operating pressure:	5000 psi
Mobile phase compatibility:	pH 0–14, 100% HPLC solvents (e.g., acetonitrile, methanol, and 2-propanol)

Substrate characteristics	
Analytical columns:	Supermacroporous resin Particle diameter: 5.5 µm Pore size: 2000 Å Crosslinking (%DVB): 55%
Guard columns:	Microporous resin Particle diameter: 11 µm Pore size: < 10 Å Crosslinking (%DVB): 55%
Functional group:	Alkanol quaternary ammonium
Hydrophobicity:	Medium-Low
Capacity:	477 µeq (4 x 250 mm column) 119 µeq (2 x 250 mm column) 6 µeq (4 x 50 mm column) 1.5 µeq (2 x 50 mm column)
Column construction:	Dionex IC Viper PEEK fittings with 10-32 threaded ferrule-style end fittings. All components are nonmetallic.

Ordering information

To order in the U.S., visit thermofisher.com, call (800) 532-4752, or contact the nearest Thermo Fisher Scientific office. Outside the U.S., order through your local Thermo Fisher Scientific office or distributor. Refer to the following part numbers.

Product	Cat. No.
Analytical and guard columns	
Dionex IonPac AS30 Analytical Column (4 x 250 mm)	303159
Dionex IonPac AG30 Guard Column (4 x 50 mm)	303160
Dionex IonPac AS30 Analytical Column (2 x 250 mm)	303161
Dionex IonPac AG30 Guard Column (2 x 50 mm)	303162
Inorganic anion and oxyhalide standards	
Dionex Fluoride Standard, 1000 mg/L, 100 mL	037158
Dionex Chlorite Standard, 1000 mg/L, 125 mL	303167
Dionex Bromate Standard, 1000 mg/L, 125 mL	303168
Dionex Chloride Standard, 1000 mg/L, 100 mL	037159
Dionex Nitrite Standard, 1000 mg/L, 125 mL	303169
Dionex Chlorate Standard, 1000 mg/L, 125 mL	303170
Dionex Nitrate Standard, 1000 mg/L, 100 mL	056497
Dionex Phosphate Standard, 1000 mg/L, 125 mL	303172
Dionex Sulfate Standard, 1000 mg/L, 100 mL	037160
Dionex Nine Anion Standard, 50 mL	303173
Nine anion standard contains 20 mg/L fluoride; 30 mg/L chloride; 100 mg/L nitrite, bromide, nitrate, bromate, and chlorate; 150 mg/L phosphate and sulfate	
Eluent generator accessories	
Dionex EGC 500 KOH Eluent Generator Cartridge	075778
Dionex CR-ATC 600 Continuously Regenerated Anion Trap Column (for Dionex ICS-6000 HPIC and Integrion HPIC systems)	088662
Dionex CR-ATC 500 Continuously Regenerated Anion Trap Column (for Dionex ICS-5000⁺ HPIC systems)	075550
Dionex IC PEEK Viper Fittings Kits	
Dionex IC PEEK Viper Fittings Kit for Dionex ICS-6000 and ICS-5000⁺ 4 mm systems with conductivity detectors	088803
Dionex IC PEEK Viper Fittings Kit for Dionex ICS-6000 and ICS-5000⁺ 2 mm systems with conductivity detectors	302965
Dionex IC PEEK Viper Fittings Kit for Dionex Integrion RFIC systems with conductivity detectors	088798
Dionex IC PEEK Viper Sample Loop, 2.5 µL	302899
Dionex IC PEEK Viper Sample Loop, 5 µL	302897
Dionex IC PEEK Viper Sample Loop, 10 µL	302895
Dionex IC PEEK Viper Sample Loop, 25 µL	302893
Suppressors	
Dionex ADRS 600 (4 mm) Anion Dynamically Regenerated Suppressor	088666
Dionex ADRS 600 (2 mm) Anion Dynamically Regenerated Suppressor	088667

Find out more at **thermofisher.com/ICColumns**

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