

Freecor[®] EV Micro 10

Low electrical conductivity fuel cell coolant

Arteco's **Freecor[®] EV Micro 10** is a low electrical conductivity coolant mixture of ultra-pure water and high-purity antifreeze grade ethylene glycol. The coolant contains non-ionic additives for corrosion protection and electrical conductivity control. **Freecor[®] EV Micro 10** is compatible with stainless steel, aluminium, copper, brass and common elastomers as well as thermoplastics found in cooling systems

Freecor[®] EV Micro 10 is specifically designed as a low electrical conductivity coolant for fuel cell applications.



PRODUCT BENEFITS



5 fold protection



Excellent flow characteristics

- Low viscosity
- Reduced backpressure
- Less wear on parts, bipolar plate protection and crack prevention



Operation safety for fuel cell

- Stable and low electrical conductivity (< 5 $\mu\text{S}/\text{cm}$)



Ready to use

- No further manipulation nor dilution needed



Compatibility

- Compatible with fuel cell cooling system components such as the ion exchanger, radiators and hoses



Material protection

- Corrosion protection for fuel cell system components, i.e. stainless steel, aluminium, copper, brass and common elastomers as well as thermoplastics found in fuel cell cooling systems

Application

Arteco's **Freecor® EV Micro 10** is designed as a liquid heat transfer medium for fuel cell applications. Its use is not intended for traditional and conventional engine coolant applications. The use of carbon steel alloys, cast iron, zinc and galvanised parts is not recommended.

Storage

- To be stored in original unopened containers at max. 30°C, away from direct sunlight
- Shelf life of **Freecor® EV Micro 10** is 1 year. When the storage period has exceeded one year, it is strongly recommended to test the coolant on pH and electrical conductivity before the product is added to the system.

Toxicity & safety

For Toxicity and Safety Data we refer to the Safety Data Sheet. The information and advice given should be observed and due attention should be given to the precautions necessary for handling chemicals. This product should not be used to protect the inside of drinking water systems against freezing.

Key approvals, standards and specifications

Freecor® EV Micro 10 is approved for:

- Renault-Hyvia Fuel Cell Hydrogen vehicles

Packaging

Arteco's **Freecor® EV Micro 10** is available as ready-mix in the following packs:



IBC 1000L



20L



**Bottle
5L**



Plastic Drum

Contact details

Should you have questions on Arteco's **Freecor® EV Micro 10**, available packages or colours or one of the other Arteco solutions, please do not hesitate to contact your local Area Sales Manager or send your inquiry to info@arteco-coolants.com.

Addendum - Technical information

Chemical and Physical Properties

Property	Typical value	Unit	Specification
Appearance	Clear liquid		
eConductivity (25°C)	< 2	µS/cm	ASTM D1125
eConductivity (80°C)	< 5	µS/cm	ASTM D1125
Density (20°C)	1,065	g/ml	ASTM D5931
Density (80°C)	1,027	g/ml	ASTM D5931
pH as such	5,0 - 7,0		ASTM D1287
Freezing point	-35	°C	ASTM D1177
Kinematic viscosity (20°C)	3,6	mm ² /s	ASTM D445
Kinematic viscosity (80°C)	1,0	mm ² /s	ASTM D445
Boiling point	108	°C	ASTM D1120
Pour point	-46	°C	ASTM D97

Engineering data

Temp.	Density ASTM D5931	Specific Heat	Thermal Conductivity	Volume Expansion
	Observed	Observed	Theoretical*	Theoretical*
°C	g/ml	kJ/kg.K	W/mK	V(T)/V(20°C)
0	1,077	3,28	0,381	0,99
20	1,065	3,35	0,392	1,00
40	1,052	3,42	0,403	1,01
60	1,040	3,49	0,415	1,02
80	1,027	3,56	0,426	1,04
100	1,014	3,64	0,437	1,05

* Ethylene glycol-water mixture with same freezing point

Addendum - Laboratory test results

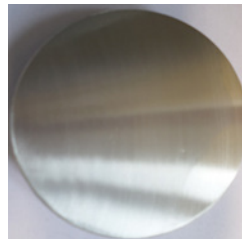
Arteco's **Freecor® EV Micro 10** has been submitted to various lab tests. For more details, please contact your local Area Sales Manager.

Inhibitor stability

The inhibitor stability tests under heating conditions for extended period of time show that **Freecor® EV Micro 10** remains stable and maintains its electrical conductivity level.



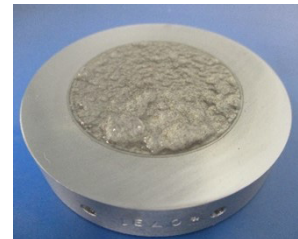
Test setup:
ASTM D4340
Adapted to fuel cell
operating conditions



Test specimen
Before test



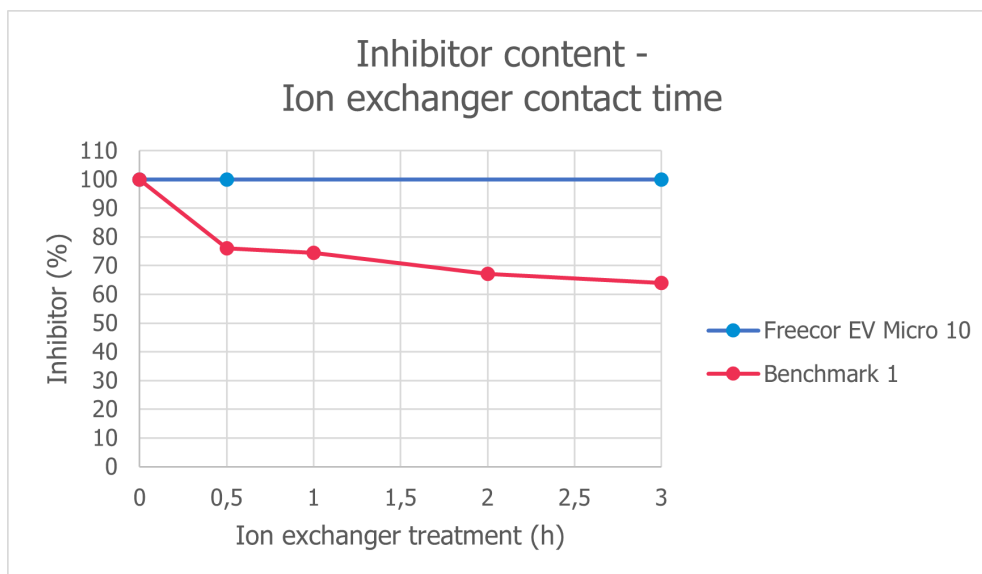
Freecor® EV Micro 10
Showing good protection



Benchmark product inhibitor package
Showing instability

Ion exchanger

Arteco's main performance additive package is not removed by the ion exchanger. This keeps it available for active operation.



Bench test results - measuring electrical conductivity while running without ion exchanger

To test the limits of **Freecor® EV Micro 10**, the coolant has been evaluated in a 70kW fuel cell stack in 4 different test procedures: IV curve measurement, hot operation test (90°C), WLTP driving cycles and electrical conductivity stability tests.

During this electrical conductivity stability test running 12 hours with 25kW of continuous output, the ion exchanger was bypassed. In this demanding test cycle, an excellent electrical conductivity stability versus the initial electrical conductivity could be demonstrated.

The hot operation test demonstrated that **Freecor® EV Micro 10** has an outstanding resistance to thermal stress, a key element in the preservation of the required low electrical conductivity. The test results also clearly showed that **Freecor® EV Micro 10** was able to maintain its performance, and more specifically and importantly, it maintained its electrical conductivity levels at actual load conditions.

Handling instructions

Arteco strongly recommends to rinse the cooling system with **Freecor® EV Micro 10** or ultra-pure water (electrical conductivity below 5 µS/cm) prior to (re)filling the cooling system. A full drain after rinsing is required. Any other engine coolant which can not guarantee the required low electrical conductivity level (< 5 µS/cm) should not be used for rinsing the fuel cell cooling system.

A conventional engine coolant has an electrical conductivity level of more than 1000 times higher, which causes damage to the fuel cell system. Therefore, **Freecor® EV Micro 10** should not be mixed with any conventional engine coolant. A conventional coolant can equally not be used to top up the fuel cell coolant. In case of doubts, please contact your local Area Sales Manager.

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