

Antistatic additives

based on quaternary ammonium compounds.

 **Deuteron[®]**
ADDITIVES TO YOUR SUCCESS



Conductivity promoter by Deuteron

Additives for the antistatic adjustment of coatings and plastics.

Since 1980 Deuteron is well-known for the production of antistatic additives for coatings and plastics. Our antistatic additives based on quaternary ammonium compounds are well established and proven products in the paint industry, as well as in many other applications. They can be used to improve the spray application of paints, for anti-static shoe soles and floor coverings as well as to anti-statically modify polyurethane foams and castings.

Depending on the application, **electrostatic charge** can cause processing issues, lead to safety issues or even electrical defects. In order to reduce the electrostatic charge a suitable additive can be used either during processing or in a second step as part of an anti-static coating. Many different materials like metal powders, conductive fibres and pigments (e.g. carbon black) or quaternary ammonium salts can be used across a broad range of different applications including plastics, coatings, inks and PU-applications.

If used properly (right dosage level and careful selection of the right grade) the potential dangers of static charge can be fully eliminated.

The term static electricity mainly refers to triboelectric charge caused by friction between non-conductive materials. Electrons are transferred from one surface onto another which ultimately leads to a local disbalance between positive and negative charges. This disbalance remains until the possibility of charge equalisation arises – typically through contact with a grounded material.

As a result, the excess electrons are transferred in form of a sudden high voltage discharge. This can lead to an unpleasant or painful feeling, the destruction of electronics or the ignition of flammable gases.

Anti-static additives differ significantly in their performance profile. It is important to carefully evaluate the pros and cons of the different approaches for each application in order to select the most suitable technology. Important factors are the final appearance, economic viewpoints and the overall technical performance.

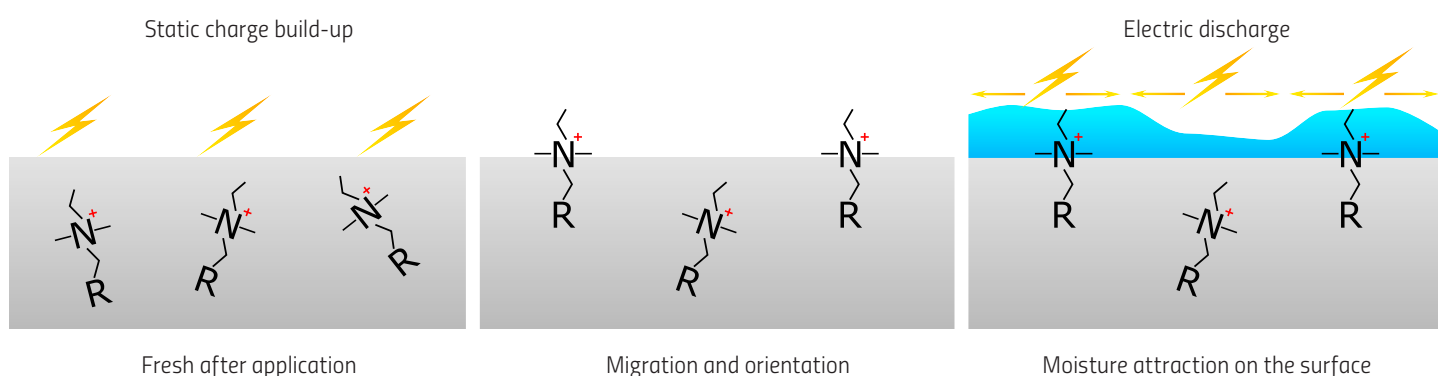
	Carbon			Doped fillers and Mica	Metalpowder	Quats
	(Nano) Tubes	Fibres	Pigments			
Effectivity	very high	high				medium
Required dosage	high dosage required (perkolation-PVC)					low
Processing	difficult	medium	normal		medium	easy
Permanent Effect	yes					not generally
Transparency	no					high
Influence on coloured coatings	very high	high		possible	yes	no
Treatment cost	very high	high	medium			low

Application & Properties

Antistatic properties of quaternary ammonium salts (quats) are based on the attraction of humidity and formation of a very thin water layer. The conductivity is based on the ionic character of the additive and the adsorbed water, together both form an electrolyte on the surface. Therefore, humidity is an important factor for the functionality of quat based additives.

The antistatic effect depends on the additive's surface migration within the plastic or coating matrix. Surface-active molecules partially migrate to the surface and align themselves. Based on the molecule's polarity the hydrophobic tail remains in the matrix whereas the hydrophilic head of the anti-static additive aligns on the surface. The polar, hydrophilic part increases the wettability and imparts a hygroscopic effect.

Schematic view of how quaternary ammonium salts work



Due to their mobility and migrating character quaternary ammonium salts are considered as non-permanent additives. Anyhow the effectiveness of quat based anti-statics typically lasts for several years, even decades, as the volume of a coating or plastic acts as a reservoir. The type and duration of the effect is different in each system and must be checked individually on the basis of the individual requirements and regulations. Due to their cationic character, our ammonium salts are only compatible with non-ionic and cationic systems. The compatibility with anionic systems is limited and can be checked easily by a mixing test – in case of incompatibilities a "kick-out" effect becomes visible. Eventually a pre-dilution of our ammonium salts in a suitable solvent can improve the incorporation and compatibility.

As they are polar materials, our quats are usually soluble (or form stable emulsions) in water and polar solvents. Insolubility may occur in highly non-polar solvents. It is highly recommended to check the compatibility with a desired solvent or solvent mixtures in a pre-testing step.

Typically, in low polarity systems our quat based products form stable emulsions – easily visible by its translucent appearance. In highly unpolar systems such as mineral oils or greases a phase separation occurs over time. In such a case it is not recommended to use the quat chemistry.

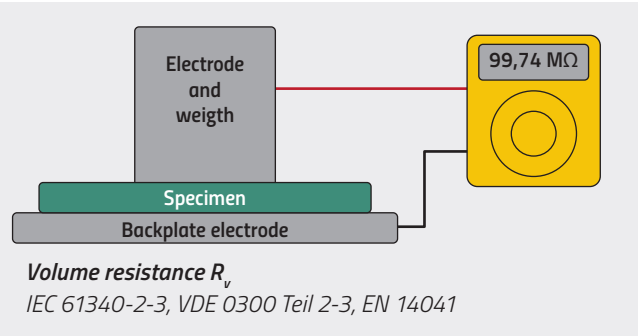
Compatibility chart for tetraalkylammonium ethyl sulphates (**TAAES**) and tetraalkylester ammonium methyl sulphates (**TAeAMS**). Solid and pasty grades might need additional shear force and processing time.

	TAAES		TAeAMS
	Liquid	Solid	
Water	Yes	Yes	Emulsion
Isopropanol	Yes	Yes	Yes
Butanol	Yes	Yes	Yes
Ethyl- Butylacetate	Yes	Yes	Yes
Propylene carbonate	Yes	Yes	Yes
Acetone	Yes	Yes	Yes
Xylene	Yes	No	Yes
Toluene	Yes	Yes	Yes
Shellsol A150 aliph, HC	Yes	No	Yes
Solvesso arom. mix	Yes	No	Yes
White spirit	Yes	Yes	Yes
Butyl glycol	Yes	Yes	Yes
Butanediol	Yes	No	No
Lauryl acrylate	Yes	No	Yes
DPGDA	Yes	Yes	No
TMP(EO)3TA	Yes	No	No
Dowanol DPM	Yes	Yes	Yes

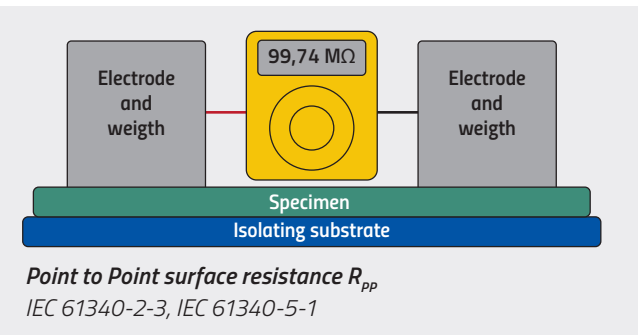
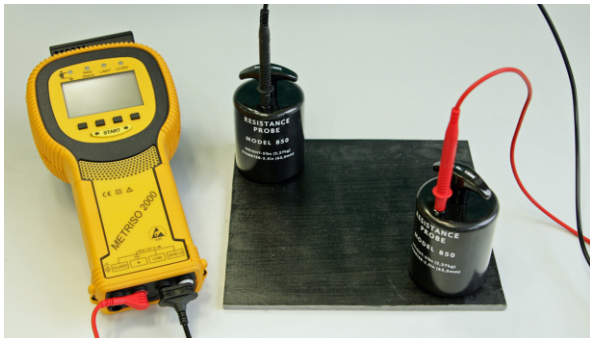
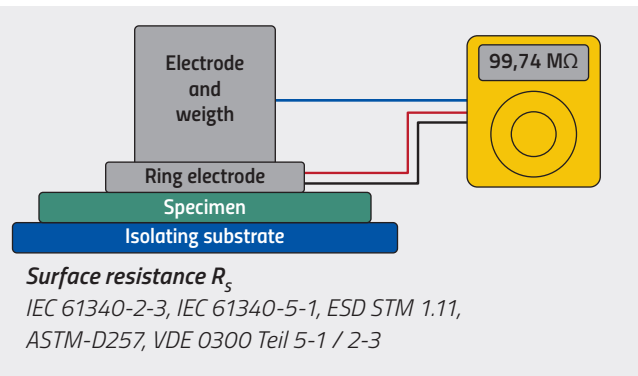
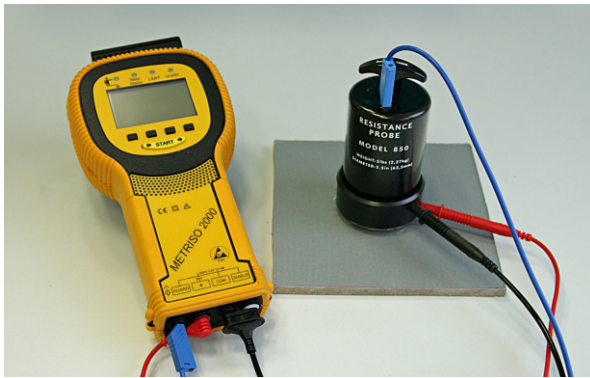
Resistivity measurement

Several standards describe the measurement of dissipative samples. The most relevant ones are:

Setup for measuring the volume resistivity:



Setup for measuring the surface resistivity:



The moisture attraction and formation of an anti-static layer leads to a resistivity of approx. 105 Ω. As stand-alone additives quats do not reach true conductivity.

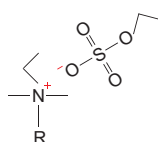
Resistance	High resistivity	$>10^9 \Omega$ ($>1 \text{ G}\Omega$)
	Antistatic	$10^5 - 10^9 \Omega$ (100 kΩ - 1 GΩ)
	Dissipating	$10^5 - 10^8 \Omega$ (100 kΩ - 100 MΩ)
	Conductive	$<10^5 \Omega$ ($<100 \text{ k}\Omega$)

Under normal atmospheric conditions the anti-static effect of quat based additives is sufficient for many different applications including anti-static floorings, anti-dust coatings or prevention of triboelectric charge in industrial cutting and milling processes. For applications under dry air conditions or in cases where a resistivity well below $10^6 \Omega$ is needed we highly recommend the combination of our quaternary ammonium salts with other conductive pigments such as metal pigments, carbon blacks or carbon nanotubes. The combination of both technologies can lead to significant synergistic effects caused by excellent wetting of the pigments by our quat based additives.

Quaternary Ammonium Compounds

Quaternary ammonium compounds contain quaternary nitrogen atoms, this means that all four hydrogen atoms of the ammonium ion are replaced by alkyl groups. Deuteron's quat additives are ammonium salts of the amine type $NR_4^+X^-$. These substances are cationic surfactants, which adsorb strongly on surfaces and particles due to their permanent positive charge.

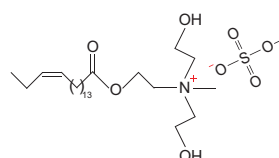
The Deuteron LE product family is based on tetraalkylammonium ethyl sulfate (TAAES) and tetraalkylester ammonium methyl sulfate (TAeAMS). We offer three 100% grades as well as several dilutions in different solvents. Our Deuteron LE products are suitable for many applications ranging from coatings, plastics, PU foams, castings or even for electronic packaging.



TAAES-Type: The classic!

Carbon chain distribution (R) between 8-18, primary C12.

Chemistry	Linear quaternary ammonium compound	Branched quaternary ammonium compound ester
Based on	Fatty acid amine C8-C18, mainly C12	Unsaturated C18 fatty acid polyol amine
Chemical name	Tetraalkylammonium-ethylsulphat	Tetraalkylesterammonium-methylsulphat
Abbreviation	TAAES	TAeAMS
Polarity	High	Medium
Solubility in water	Soluble	Emulsifiable
Solubility in polar solvents	High	High
Solubility in inorganic solvents	Soluble/ Emulsifiable	Moderate
Biological effect	Ecotoxic	100 % Biodegradable
Plant based renewable content	~ 40%	~ 70%



TAeAMS -Type:

Unsaturated C18 carbon chain.

100 % - grades

Deuteron LE 512 – classic TAAES type with waxy appearance and a melting point of approx. 88°C – needs to be molten or diluted prior to use.

Deuteron LE 100 LV – easy to use liquid version of Deuteron LE 512.

Deuteron LE 200 – TAeAMS type with pasty appearance. The product is easily diluted in several solvents and needs only moderate shear forces for incorporation.

Solvent-based dilutions

Deuteron LE 80 – 80% dilution of Deuteron LE 512 in Butanol. Especially suitable for electrostatic spray applications.

Deuteron LE 50 – 50% dilution of Deuteron LE 512 in Butanol. Especially suitable for electrostatic spray applications. Less critical labelling requirements compared to our other TAAES grades.

Deuteron LE 292 – 90 % dilution of Deuteron LE 200 in Isopropanol. Easier to use and suitable for systems with low solvent or alcohol tolerance.

Reactive solvent dilutions

Deuteron LE 50 UV – 50% dilution of Deuteron LE 100 LV in DPGDA. Especially suitable for 100% UV curable formulations. Less critical labelling requirements compared to our other TAAES grades.

Deuteron LE 829 – 85% dilution of Deuteron LE 512 in Butanediol. Especially suitable for polyurethane applications with moderate increase of the overall hardness.

Deuteron LE 151 – 85% dilution of Deuteron LE 512 in Ethanediol. Especially suitable for polyurethane applications with large increase of the overall hardness.

Powdered grades

Deuteron LE 15P – 50% Deuteron LE 100 LV absorbed onto a silica carrier. Suitable for extrusion processes (e.g. powder coatings and plastics) and other applications where liquids are not suitable. Particle size of the silica carrier is approx. 18 µm.



Conductivity promoter by Deuteron

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Properties at a glance

- Cationic materials, compatible with non-ionic and cationic systems
- Efficiency depends on humidity
- Anti-static additives suitable for the resistivity range between 100 kΩ - 1 GΩ
- Suitable for clear systems and light colours
- Synergistic effects in combination with conductive pigments and fibres
- Act as a surfactant due to their polar molecule design
- Highly economic compared to other anti-static additives

Technische Daten

	Active content %	Solvent Reactive Thinner	Supply form	Viscosity mPa*s	Specific weight kg/L	Quat-Type
DEUTERON LE 100 LV	100	-	Liquid	3500	1.05	TAAES
DEUTERON LE 200			Paste	44000	1.02	TAeAMS
DEUTERON LE 512			Waxy	-	0.96	TAAES
DEUTERON LE 50	50	Butanol	Liquid	20	0.89	
DEUTERON LE 80	80			150	0.94	TAeAMS
DEUTERON LE 292	90	Isopropanol		700	0.98	
DEUTERON LE 50 UV	50	DPGDA		150	1.05	TAAES
DEUTERON LE 151	85	1.2-Ethandiol		300	0.99	
DEUTERON LE 829	85	1.4-Butandiol		400	0.98	
DEUTERON LE 15P	50	-	Powder	-	240*	

* Bulk density g/L



Deuteron: First-class products for the coating industry

Deuteron successfully develops and sells innovative additives since 1977. Our product range consists of matting agents, anti-static additives, texturing additives, thickeners and UV initiators. In the course of our company history we have become an important partner of the national and international paint, lacquer and coating industry with sales agencies around the globe.

Visit us on the Internet

Our documents such as product datasheets, safety datasheets, regulatory information and brochures are available in the download area of our website without registration.

This leaflet intends to give technical advice without warranty and does not claim to be complete.

