

Pigments & Additives Division
Specialties Business



Exactly your chemistry.

Exolit[®] for Thermosets

Applications of the Exolit grades

Exolit for Thermosets

> Applications of the Exolit grades

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Exolit for thermoset resins

With its Exolit grades Clariant offers an extensive range of flame retardants for thermosets on a non-halogen base. The Exolit grades exhibit following characteristics:

In the case of fire

Low smoke gas corrosivity

- > Reduced damage of installations and buildings

Low smoke density

- > Extended escape time

In the final product

High effectiveness

- > Low impact on mechanical properties

Excellent UV stability

- > Excellent suitability for outdoor applications

Good electrical properties

- > In particular suited for the E&E industry

Good recyclability

- > Meets current and future consumer recycling requirements

Attractive price/performance ratio

- > Competitive systems




Because of these properties Exolit flame retardants contribute to meeting the customer requirement regarding environmental impact and image.

Thermoset systems which incorporate Exolit flame retardants can obtain the most demanding fire tests, whilst retaining good mechanical properties. These features allow the materials to be used in new and demanding fields of application.

Flame retardants for thermosets

Under the brand name Exolit, Clariant supplies non-halogen, environmentally friendly flame retardants with an assured future for thermoset resin systems.

Their advantage lies in their effectiveness, which enables very low concentrations to be used, while at the same time meeting the most stringent requirements. As a result favourable processing properties are imparted, accompanied by low specific weight and excellent mechanical values of the finished articles. In the event of fire involving Exolit-containing systems, a reduction in smoke density is apparent. Since no halogen-containing flame retardants are required, no corrosive fumes such as HCl are given off. These properties are of great importance in modern vehicle manufacture.

Application area		Test	Description	Classifications
Construction and building		DIN 4102 (Germany)	Chimney test	B1 > B2
		NF P 92-501 (France)	Epiradiateur	M1 > M2 > M3
		BS 476 (UK)	Surface spread of flame	1 > 2 > 3
		ASTM E 84 (USA)	Steiner tunnel	Flame spread value
Mass transportation		DIN 5510 (Germany)	Fire behaviour and side effects	S4 > S3 SR1 & SR2, ST1 & ST2
		NF F 16-101 (France)	Epiradiateur + smoke	M & F-Class
		ASTM E 162 (USA)	Surface flammability	A > B > C
		ASTM E 662 (USA)	Smoke box	Smoke density (Ds) value
Electrical engineering		UL 94 (International)	Flammability test	5V, V-0, V-1, V2, HB

The addition rate of Exolit flame retardants should be adjusted to reflect the resin and glass fibre types used in the thermoset resin.

Thermosets product overview

Flame retardant grades	Form of supply	Thermoset resin types			
		UP Resins	EP Resins	PU Casting resins	Phenolic resins
Exolit AP 421	White powder				<input type="checkbox"/>
Exolit AP 422	Fine white powder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exolit AP 423	Micronized white powder	<input type="checkbox"/>	<input type="checkbox"/>		
Exolit AP 462	White powder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exolit AP 740	White powder	<input type="checkbox"/>		<input type="checkbox"/>	
Exolit AP 742 (TP)	White powder	<input type="checkbox"/>		<input type="checkbox"/>	
Exolit AP 750	White powder	<input type="checkbox"/>	<input type="checkbox"/>		
Exolit OP 550	Medium-viscosity liquid			<input type="checkbox"/>	<input type="checkbox"/>
Exolit OP 560	Medium-viscosity liquid			<input type="checkbox"/>	<input type="checkbox"/>
Exolit OP 920 (TP)	Viscous liquid				<input type="checkbox"/>
Exolit OP 930	Fine white powder		<input type="checkbox"/>		
Exolit RP 6500	Red thixotropic dispersion		<input type="checkbox"/>		
Exolit RP 6520	Red thixotropic dispersion			<input type="checkbox"/>	
Exolit RP 6540	Red thixotropic dispersion	<input type="checkbox"/>			

TP = Test product, scale-up in commercial quantities possible shortly

UP resins (unsaturated polyester resins)

Lightweight construction achieved by using Exolit

About 70 % of UP resin consumption in Europe is employed in fibreglass-reinforced applications, e.g. construction (about 27 %), transport (about 23 %), tanks and pipes (about 18 %) and electrical components (about 10 %). For all these applications, construction or safety regulations specify flammability classifications, necessitating the use of flame retardants. To meet these requirements, the use of halogenated UP resins (frequently combined with antimony trioxide as a synergist) and alumina trihydrate (flame-retardant filler) has become standard practice in recent years. But alumina trihydrate (ATH) in particular is likely to bring an increase in viscosity (owing to higher filler levels to reach the required fire retardation) and higher densities of the components.

The Exolit grades offer major advantages here especially in applications in the construction, electrical and rolling stock sectors. By combining the Exolit products with ATH* high flammability requirements can be met even with low filler levels:

* Alumina trihydrate

Advantages of the systems

- > **Low density of the components**
- > **Low processing viscosity**
- > **High glass contents are possible**
- > **Halogen-free hand lay-up, resin transfer moulding, pultrusion and spray lay-up possible**
- > **Exolit RP 6540 is compatible with CaCO_3 (chalk) in filled UP resin systems**
- > **Exolit RP 6540 does not affect the electrical properties**
- > **Low smoke density, no corrosive combustion gases**

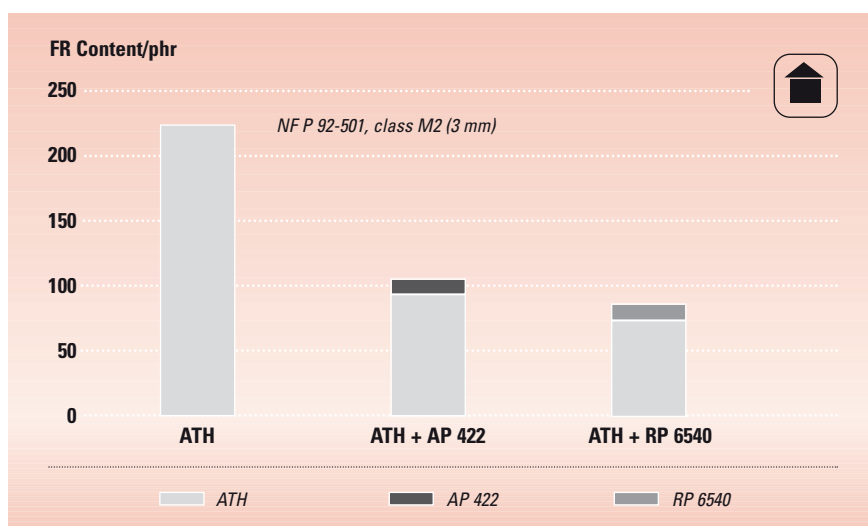


Figure 1: NF P 92-501 – Construction industry

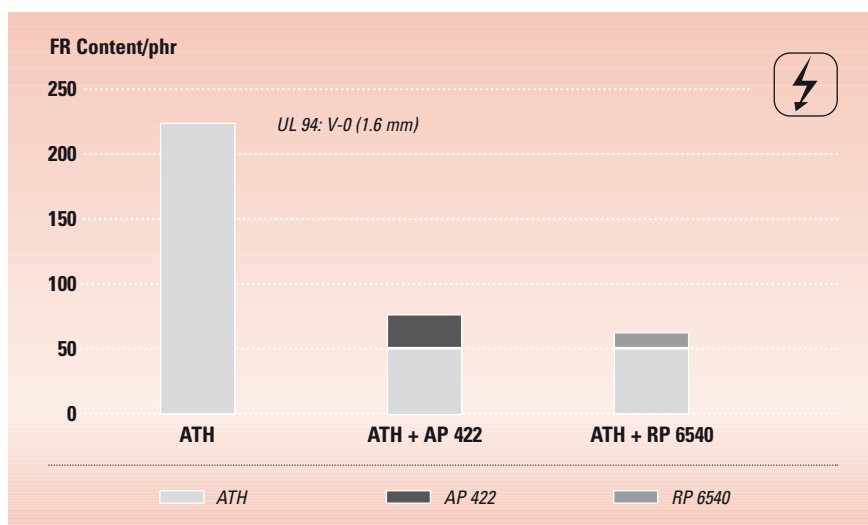


Figure 2: UL 94 – Electrical industry

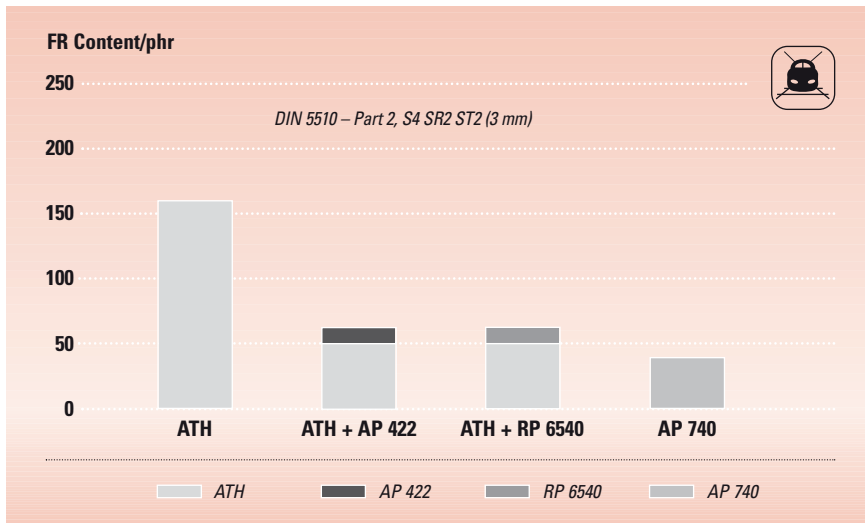


Figure 3: DIN 5510 – Rolling stock



Figures 1-3: Flame retardant concentration in UP resins
Combinations of Exolit with ATH* compared to pure ATH*.

Further results for other flame retardant classifications are available.

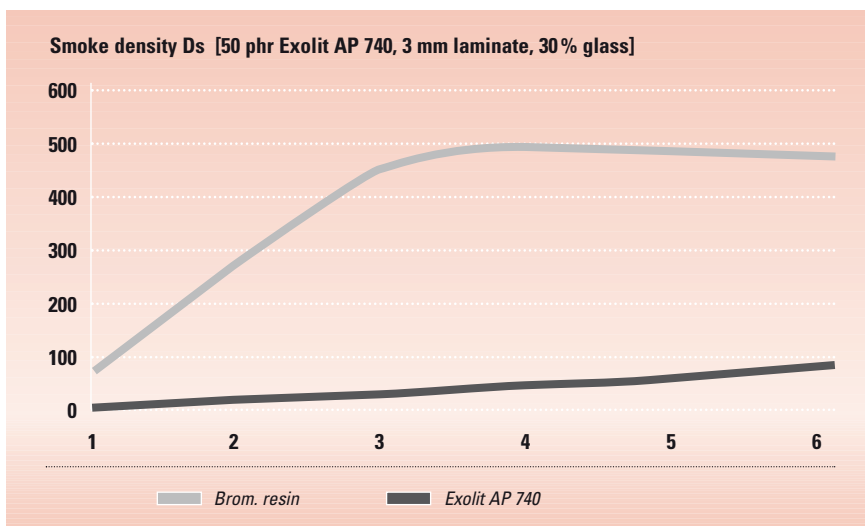
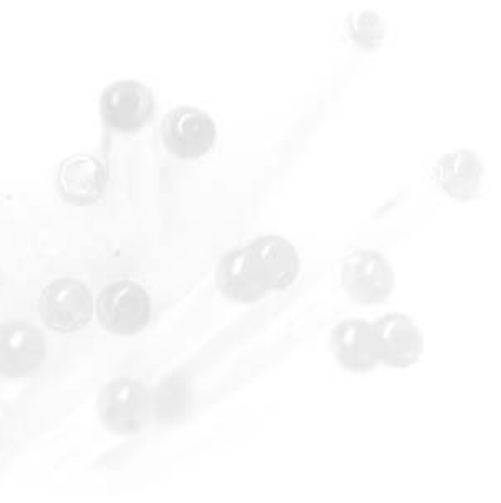


Figure 4: Smoke density of Exolit AP 740 in comparison to brominated resin (NBS Smoke chamber ASTM E 662)



Airbus-Industry requirement
(ATS 1000.001) for interior parts:
CO: < 3500 ppm, HCN: < 150 ppm,
NO_x: < 100 ppm, HCl: < 150 ppm

FAR 25.853: passed
ABD 0031: passed

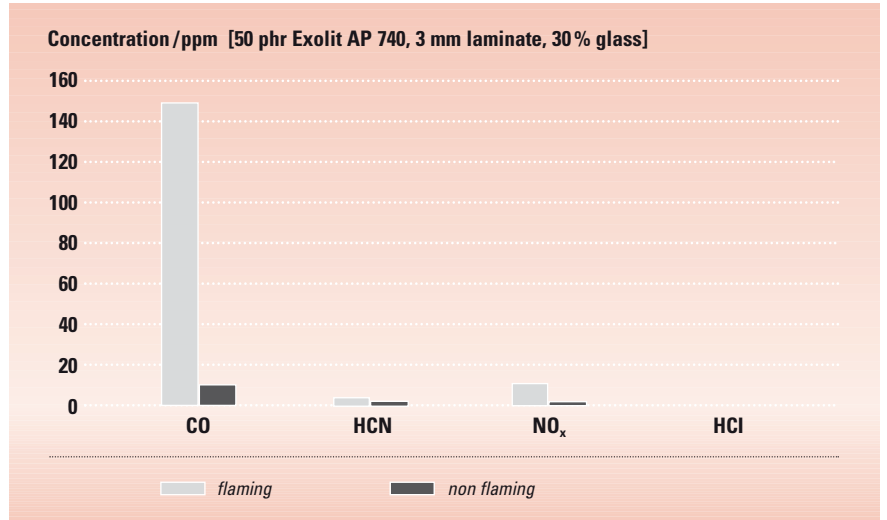


Figure 5: Smoke toxicity of Exolit AP 740 (NBS Smoke chamber ASTM E 662)

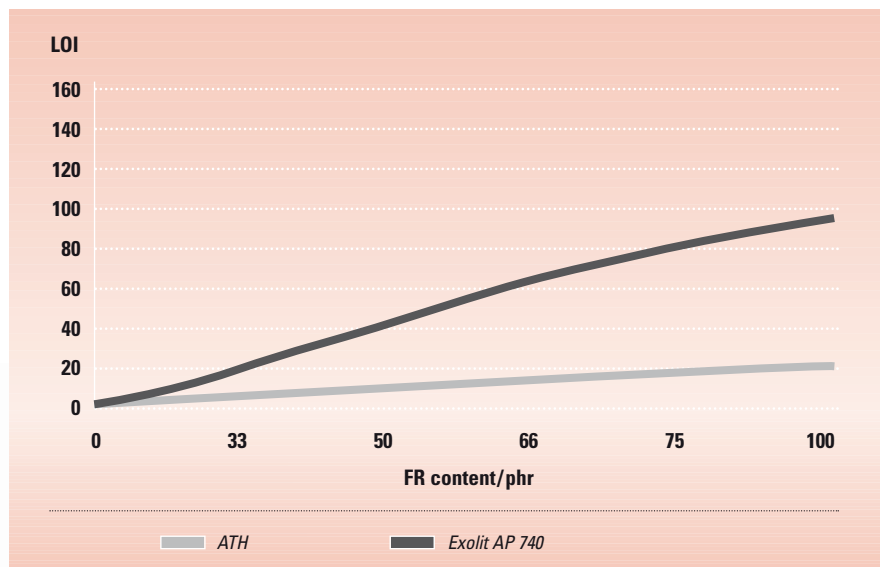





Figure 6: Limit oxygen index of UP resin containing Exolit AP 740 in comparison to alumina trihydrate (ATH)

UPR recommended products

Exolit AP 422	White powder D ₅₀ 15 µm, standard product
Exolit AP 423	Fine white powder D ₅₀ 8 µm
Exolit AP 462	White powder D ₅₀ 20 µm microencapsulated for moisture sensitive applications
Exolit AP 740	White powder, intumescent system
Exolit AP 742 (TP)	White powder, intumescent system
Exolit RP 6540	Red thixotropic dispersion carrier: unsaturated, styrene-free polyester resin

Application area	Classification	Addition rate
Construction 	NF P 92 501 (Epiradiateur) Class M2, 3 mm ----- NF P 92 501 (Epiradiateur) Class M1 ----- NF P 92 501 (Epiradiateur) Class M1 ----- DIN 4102 Class B2, 3 mm ----- DIN 4102 Class B1, 4 mm ----- BS 476 Class 1	20-30 phr Exolit AP 422 with 100-130 phr ATH ----- 25-35 phr Exolit AP 422 with 200-225 phr ATH ----- > 75 phr Exolit AP 740 ----- 5-15 phr Exolit RP 6540 with 20-40 phr ATH ----- > 75 phr Exolit AP 740 ----- 75-100 phr Exolit AP 740
Electro 	UL 94 V-0, 1.6 mm ----- UL 94 V-0, 1.6 mm ----- UL 94 V-0, 1.6 mm	15-25 phr Exolit AP 422 with 50-100 phr ATH ----- 10-15 phr Exolit RP 6540 with 50-100 phr ATH ----- 20-50 phr Exolit AP 740
Transport 	DIN 5510 Class S3, SR2, ST2, 4 mm ----- DIN 5510 Class S4, SR2, ST2, 3 mm ----- DIN 5510 Class S4, SR2, ST2, 3 mm ----- DIN 5510 Class S4, SR2, ST2, 3 mm ----- NF P 92-501 (Epiradiateur) Class M2, 4 mm ----- ASTM E 162 Class A ----- ASTM E 162 Class A	2-5 phr Exolit AP 422 with 20-40 phr ATH ----- 10-12 phr Exolit AP 422 with 50-60 phr ATH ----- 30-50 phr Exolit AP 740 ----- 8-12 phr Exolit RP 6540 50-60 phr ATH ----- 10-15 phr Exolit RP 6540 with 60-80 phr ATH ----- 10-20 phr Exolit AP 422 with 80-120 phr ATH ----- 75-100 phr Exolit AP 740

Additional comments

Exolit AP 422 can be replaced with an equivalent quantity of either Exolit AP 423 (fine grained material) or Exolit AP 462 (reduced water solubility) as required.

Exolit AP 740 can be replaced with an equivalent quantity of Exolit AP 742 (TP).

Exolit AP range are commonly used in combination with alumina trihydrate (ATH) in many halogen-free thermoset systems.

The addition rate to achieve a specific fire classification depends heavily on the the resin and glass content of the system.

EP resins (epoxy resins)

High flame retardant standards with excellent electrical properties achieved by using Exolit

Due to their higher price and better performance epoxy resins are used in applications which require high performance. These applications are often in the E&E industry or construction where fire regulations are mostly prescribed. Here it is necessary to use flame retardants. Current practice is to use brominated EP resins based on tetrabrombisphenol A. In the event of fire corrosive smoke gases occur, due especially to the halogen compounds. Another common solution is the use of high levels of ATH which negatively impacts the performance of epoxy based composites. Exolit flame retardants for EP resins allow substitution of bromine flame retardants or a significant reduction of filler content which broadens the application spectra of the resins.

Exolit AP types are designed for high requirements in composites for e.,g. rolling stock and the Exolit RP types show outstanding electrical performance in casting resins at minimal dosage.

Advantages of the systems

- > **No corrosive smoke in the case of fire**
- > **Use of higher glass contents is possible**
- > **Low filler content, therefore lower processing viscosity**
- > **Lower density of the components**
- > **Low smoke density**
- > **Exolit RP 6500 does not affect the electrical properties**

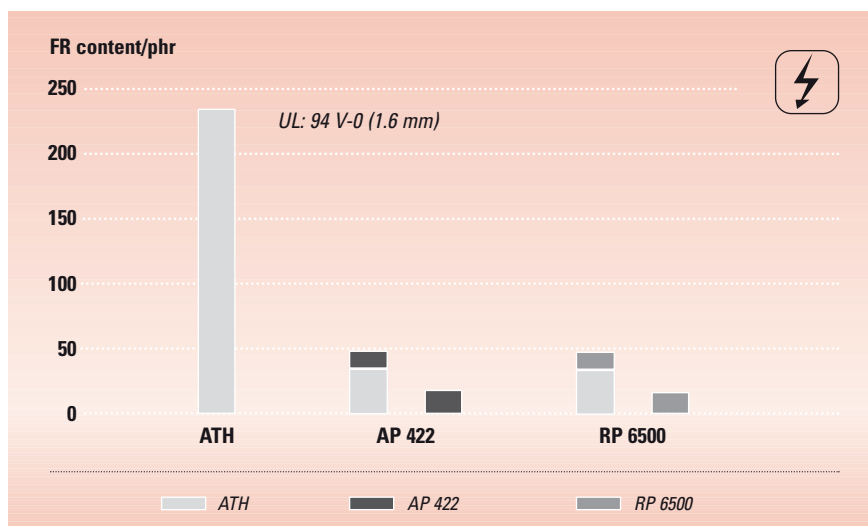





Figure 7: Flame retardant concentration in EP resins: Combinations of Exolit with ATH * compared to pure ATH *

Exolit products for EP applications

Exolit AP 422	White powder D ₅₀ 15 µm, standard product
Exolit AP 423	Fine white powder D ₅₀ 8 µm
Exolit AP 462	White powder D ₅₀ 20 µm, microencapsulated for moisture sensitive applications
Exolit AP 750	White powder, intumescent flame retardant system
Exolit OP 930	Fine white powder D ₅₀ 5 µm
Exolit RP 6500	Red thixotropic dispersion carrier: epoxy resin

* Alumina trihydrate

Application area	Classification	Addition rate
E&E 	UL 94 V-0, 1.6 mm low filler content ----- UL 94 V-0, 1.6 mm low filler content ----- UL 94 V-0, 1.6 mm UL 94 V-1, 1.6 mm ----- UL 94 V-0, 1.6 mm ----- UL 94 V-0, 1.6 mm ----- UL 94 V-0, 1.6 mm ----- UL 94 V-0, 1.6 mm	10-15 phr Exolit AP 422 with polyamine hardener ----- 4-8 phr Exolit AP 422 with 30-40 phr ATH with polyamine hardener ----- 30-50 phr Exolit AP 750 10 phr Exolit OP 930 for EP resins V-0 reached when used with other synergists ----- 25-30 phr Exolit OP 930 for standard EP resins ----- 10-20 phr Exolit OP 930 for highly aromatic EP resins with high Tg ----- 8-12 phr Exolit RP 6500 with fibre glass reinforcement and Dicyandiamide hardener ----- 5-10 phr Exolit RP 6500 with 30-40 phr ATH and polyamine, carboxylic anhydride hardener
Construction  Construction coating	NF P 92-501 Class M1, 4 mm ----- DIN 4102 part 8 Class F30/F60	8-12 phr Exolit RP 6500 with 50-60 phr ATH and polyamine hardener ----- 60-75 phr Exolit AP 750 and polyamine hardener
Transport 	DIN 5510 Class S3/S4, SR2, ST2, 4 mm	15-25 phr Exolit AP 422 with polyamine hardener

Additional comments

Exolit AP 422 can be replaced with an equivalent quantity of either Exolit AP 423 (fine grained material) or Exolit AP 462 (reduced water solubility) when required.

Exolit AP range are commonly used in combination with alumina trihydrate (ATH) in many thermoset systems.

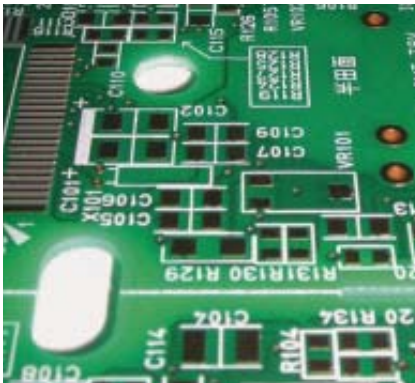
The addition rate to achieve a specific fire classification depends heavily on the the resin and glass content of the system.

Polyurethane casting resins (PU casting)

UL 94 – V-0 for thin components achieved by using Exolit

PU casting resins are used largely as construction and insulating materials in electrical applications. Mineral fillers are often used to modify the properties, e.g. to increase the hardness and rigidity of components, to lower the coefficient of thermal expansion or to reduce shrinkage. To reach UL 94 classification V-0, which is usually required in the electrical sector for components with high specific requirements, large amounts of fillers which also have flame-retardant properties are added, e.g. ATH*.

Adding Exolit AP 422, Exolit AP 462, Exolit RP 6520 or Exolit OP 550 substantially reduces the amounts of ATH* required to reach V-0 classification. This makes it much easier to process the systems and manufacture the components.



* Alumina trihydrate

Advantages of the systems

- > **No corrosive smoke in the case of fire**
- > **Low processing viscosity and good flow properties**
- > **Low filler content**
- > **Exolit RP 6520 does not affect the electrical properties**
- > **Low smoke density**

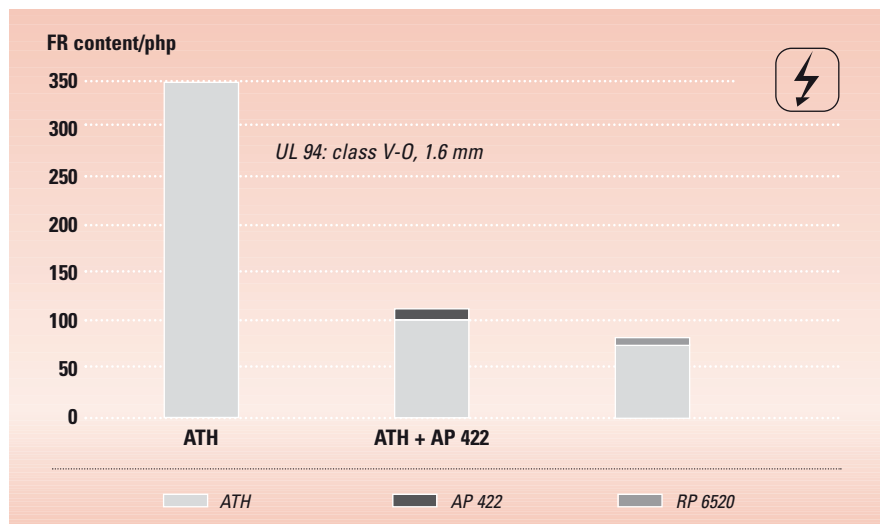


Figure 8: Flame retardant concentration in PU casting resins: Combinations of Exolit with and without ATH*

Exolit products for PU casting applications

Exolit AP 422	White powder D ₅₀ 15 µm, standard product
Exolit AP 423	Fine white powder D ₅₀ 8 µm
Exolit AP 462	White powder D ₅₀ 20 µm, microencapsulated for moisture sensitive applications
Exolit AP 740	White powder, intumescent system
Exolit AP 750	White powder, intumescent system
Exolit OP 550	Viscose liquid, reactive phosphorus polyol
Exolit OP 560	Viscose liquid, reactive phosphorus polyol
Exolit RP 6520	Red thixotropic dispersion, carrier: castor oil

Application area	Classification	Addition rate
E&E 	UL 94 V-1, 1.6 mm UL 94 V-0, 1.6 mm UL 94 V-0, 1.6 mm	15-25 phr Exolit AP 422 low filler content 20-30 phr Exolit AP 422 with 70-120 phr ATH 15-25 phr Exolit RP 6520 with 50-100 phr ATH
Transport 	DIN 5510 Class S4, SR2, ST2	25-35 phr Exolit AP 422 with 20 phr Exolit RP 6520 with 100 phr ATH
Construction 	DIN 4102 Class B2 DIN 4102 Class B2 DIN 4102 Class B2	50-100 phr Exolit AP 422 50-100 phr Exolit AP 740 50-100 phr Exolit AP 750



Additional comments

Exolit AP 422 can be replaced with an equivalent quantity of either Exolit AP 423 (fine grained material) or Exolit AP 462 (reduced water solubility) when required.

Exolit AP products are commonly used in combination with alumina trihydrate (ATH) in many thermoset systems.

Phenolic resins

Exolit products for Phenolic resin applications

The Exolit AP range of flame retardants can be used to reduce the smoke density and enhance the inherently good fire behavior.

Exolit AP 421	Coarse grained white powder
Exolit AP 422	White powder D ₅₀ 15 µm, standard product
Exolit AP 423	Fine white powder D ₅₀ 8 µm
Exolit AP 462	White powder D ₅₀ 20 µm, microencapsulated for moisture sensitive applications
Exolit OP 550	Reactive, phosphorus containing polyol



Please note

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as guaranteeing specific properties of the products described or their suitability for a particular application. Any existing industrial property rights must be observed. The quality of our products is guaranteed under our General Conditions of Sale.

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