



# **Advanced Ceramic Tubes and Insulators**

**For Thermocouples and RTD's**

# The CeramTec Chemical Applications Division

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**The experts for the chemicals industry, laboratory, environmental technology and foundry equipment**

CeramTec's Chemical Applications Division manufactures advanced ceramics components especially designed to meet the highest demands even under the most difficult working conditions in the chemicals industry, in laboratory and environmental technology, and in foundries. Additional application areas include pyrometry, pharmaceuticals, temperature control technology, galvanic technology and customised products found in nearly every branch of industry.

The division offers a wide range of ceramic materials for these application areas – including aluminum titanate – paired with comprehensive manufacturing and application engineering expertise and a broad portfolio of forming and processing methods.



## **CeramTec GmbH**

Chemical Applications Division  
CeramTec-Weg 1  
95615 Marktredwitz  
Germany

Phone: +49 9231 69-419  
Fax: +49 9231 69-217  
[chemical\\_applications@ceramtec.de](mailto:chemical_applications@ceramtec.de)  
[www.ceramtec.com](http://www.ceramtec.com)



# Advanced ceramics for tubes and insulators

Mostly drawn in use to a specific requirement, our manufactured protection tubes and insulators are primarily used within the industry of temperature measurement.

CeramTec's products are widely used on the aid of monitoring the stability and performance of production processes where hostile environments are to be found; aggressive chemical atmospheres and demanding application temperatures up to 1700°C.

## Advanced ceramics

are by definition of the standard DIN V ENV 12212, those ceramics which are both highly-developed and high-strength materials; that they are primarily non-metallic and organic, processing specific functional attributes.

Both Rubalit® C799 and Dimulit® C610 are dense materials which provide specific qualities

of high electrical insulation combined with mechanical strength. Pormulit® C530 is a porous material.

## Protection tubes

are used as outer-protection sheaths, each tube being completely "formed as a one-piece" ceramic item. The formed end-seal guarantees high resistance against any penetration of the outer atmosphere into the measurement system, avoiding any potential de-capping caused by thermo-shock.

## Insulating tubes

range from a single to ten-bore in design, in either round or oval forms. Slots can also be inserted.



## Aluminum oxide (Al<sub>2</sub>O<sub>3</sub>)

A highly dense technical oxide ceramic material that can be determined by characteristics of hardness and high strength in combination with that of temperature stability. High corrosion against and wear resistance defines the material for excellent usage in various chemical applications.

## Mullite / Aluminum silicate

Is a composition on material aluminum oxide and silicon oxide (Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub>). The material is defined by its mineralogical raw material mixture; the proportion of Al<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub> with other additives and the resultant component after sintering. These compounds are able to lend its attributes to high strength, good thermal shock and temperature resistances.

# Material data

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With more than a century of experience in development and production to draw upon, CeramTec has established itself as one of the world's top companies in the field of advanced ceramics. The current portfolio comprises of many different products, servicing the electrical and mechanical industries with a variety of ceramic materials.

Materials				
Pormulit®	Mullite / Al <sub>2</sub> O <sub>3</sub>	70.0% Al <sub>2</sub> O <sub>3</sub>	Porous	Max. 1400°C
Dimulit®	Mullite / Al <sub>2</sub> O <sub>3</sub>	60.0% Al <sub>2</sub> O <sub>3</sub>	Impervious	Max. 1500°C
Rubalit®	Aluminum Oxide	99.7% Al <sub>2</sub> O <sub>3</sub>	Impervious	Max. 1700°C

## Pormulit® C 530

- Manufactured in accordance to DIN VDE 0335
- Suitable for operating temperature of less than 1400°C
- Good temperature stability and adequate chemical resistivity
- Excellent thermal shock resistance
- Resistant to chemical attack and high electrical insulation
- Good refractory material, excellent for custom forming and moulding

## Dimulit® C 610

- In accordance to standards DIN VDE 0335
- Suitable for operating temperatures of less than 1500°C
- Very good temperature stability and chemical resistance
- Good mechanical strength
- Low thermal expansion and good thermal shock resistance
- Economical material for use on temperature measurement applications
- Main products are multi-bore insulators and protection sheaths

## Rubalit® C 799

- In accordance to standards DIN VDE 0335
- Suitable for temperatures of less than 1700°C
- Very high temperature stability and chemical resistance
- Recommended for extreme corrosive environments
- High mechanical strength
- High electrical resistivity



CeramTec manufactures tubes with a diameter range of 0.5 mm to 100 mm and a maximum length of 2.200 mm

## Material characteristics – typical data

Properties	Units	Test	Pormulit®	Dimulit®	Rubalit®
DIN VDE 0335 / IEC 672	-	-	C 530	C 610	C 799
Color	-	-	white	white	white
Specific gravity	kg/dm <sup>3</sup>	ASTM C 20	2.3	2.8	3.85
Water absorption	%	ASTM C 373	10	0	0
Hardness rockwell	R 45 N	ASTM E 18	-	-	80
Flexural strength	N/mm <sup>2</sup>	ASTM F 417	120	200	360
Max. Temp. use	°C	-	1400	1500	1700
Thermal conductivity	W/mK	ASTM C 408	1.5	4	28
Thermal expansion / Linear coefficient					
20–100°C	x 10 <sup>-6</sup> /°C	ASTM 372	3.6	4.5	5.4
20–300°C	-	-	5.0	5.2	6.5
20–600°C	-	-	5.6	5.8	7.7
20–1000°C	-	-	6.4	6.7	8.5
Dielectric constant	-	ASTM D 150	-	-	10
Dielectric strength	kV/mm	ASTM D 116	-	-	> 10
Dielectric factor	x 10 <sup>-3</sup>	ASTM D 150	-	-	0.2
Volume resistivity					
200°C	Ohm x cm	ASTM D 257	-	-	10 <sup>15</sup>
400°C	-	-	-	-	10 <sup>12</sup>
600°C	-	-	-	-	10 <sup>11</sup>

## Material compound – typical data

The grade of aluminum oxide used in all our materials is Alpha:  $\alpha\text{-Al}_2\text{O}_3$

Properties	Unit	Pormulit®	Dimulit®	Rubalit®
Aluminum oxide	Al <sub>2</sub> O <sub>3</sub>	70%	60%	> 99.7%
Silicon oxide	SiO <sub>2</sub>	28%	37%	0.05%
Ferric oxide	Fe <sub>2</sub> O <sub>3</sub>	0.5%	0.6%	0.06%
Magnesium oxide	MgO	-	0.15%	0.15%
Calcium oxide	CaO	-	0.025%	0.025%

# Extruded ceramic sheaths and tubes

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## Manufacturing tolerances data

Length mm	Deflection Tolerances [Fa] in mm
up to 30	+/- 0.15
over 30 to 40	+/- 0.20
over 40 to 50	+/- 0.25
over 50 to 60	+/- 0.30
over 60 to 70	+/- 0.35
over 70 to 80	+/- 0.40
over 80 to 90	+/- 0.45
over 90 to 100	+/- 0.50
over 100 to 110	+/- 0.55
over 110 to 125	+/- 0.60
over 125 to 140	+/- 0.70
over 140 to 155	+/- 0.80
over 155 to 170	+/- 0.85
over 170 to 185	+/- 0.90
over 185 to 200	+/- 1.00
over 200 to 250	+/- 1.25
over 250 to 300	+/- 1.50
over 300 to 350	+/- 1.75
over 350 to 400	+/- 2.00
over 400 to 450	+/- 2.25
over 450 to 500	+/- 2.50
over 500 to 600	+/- 3.00
over 600 to 700	+/- 3.50
over 700 to 800	+/- 4.00
over 800 to 900	+/- 4.50
over 900 to 1.000	+/- 5.00
over 1.000	+/- 0.5% x length

Diameter mm	Diameter Tolerances in mm
up to 4,0	+/- 0.15
over 4 to 6	+/- 0.20
over 6 to 8	+/- 0.25
over 8 to 10	+/- 0.30
over 10 to 13	+/- 0.35
over 13 to 16	+/- 0.40
over 16 to 20	+/- 0.45
over 20 to 25	+/- 0.55
over 25 to 30	+/- 0.55
over 30 to 35	+/- 1.30
over 35 to 40	+/- 1.33
over 40 to 45	+/- 1.35
over 45 to 50	+/- 1.65



Various forms and shapes of extruded parts are available from CeramTec's product range. Different customer requirements demand varied tool designs relating to their specific application.

#### Ceramic sheaths and tubes

Pormulit® C 530		Dimulit® C 610		Rubalit® C 799	
Ø Inside	Ø Outside	Ø Inside	Ø Outside	Ø Inside	Ø Outside
-	-	4	6	4	6
-	-	5	8	5	8
-	-	6	10	6	10
7	10	7	10	7	10
-	-	8	12	8	12
-	-	9	13	9	13
10	16	10	15	10	15
-	-	11	15	11	15
12	16	12	16	12	16
-	-	13	17	13	17
12	20	15	20	15	20
-	-	-	-	16	21
18	26	19	24	18	24
-	-	-	-	20	25

#### Rectangular tubes and thick-walled ceramic sheaths

Pormulit® C 530		Dimulit® C 610		Rubalit® C 799	
Ø Inside	Ø Outside	Ø Inside	Ø Outside	Ø Inside	Ø Outside
6 / 10	12 / 16	6	13	6	13
10 / 10	15 / 15	6	15	6	15
-	-	8	17	8	17
-	-	9	20	9	20

#### Insulating tubes for thermo-elements in accordance with EN 50113 standards

No. Bores	Dimulit® C 610		Rubalit® C 799	
	Ø Inside	Ø Outside	Ø Inside	Ø Outside
1 single-bore	1.7	2.7	1.7	2.7
1 single-bore	2	4	2	4
1 single-bore	4	6	4	6
2 & 4 multi-bore	1.2	5.5	1.2	5.5
2 & 4 multi-bore	1.5	8.5	1.5	8.5

6 & 10 bore insulating tubes available upon request.

CeramTec has a vast range of tools available. For further details please contact us at the address shown overleaf.



**Indexes and parameters for ceramic substances:** In order to profile ceramic substances certain parameters are indicated. The crystalline nature of these substances, statistical fluctuations in the composition of the substances and in the factors that impact on the production processes indicate that the figures quoted are typically mean values and hence the substance parameters quoted in this brochure are only standard, recommended or guide values that might differ given dissimilar dimensions and production processes.

**CeramTec GmbH**  
Chemical Applications Division  
CeramTec-Weg 1  
95615 Marktredwitz  
Germany  
Phone: +49 9231 69-419  
Fax: +49 9231 69-217  
[chemical\\_applications@ceramtec.de](mailto:chemical_applications@ceramtec.de)  
[www.ceramtec.com](http://www.ceramtec.com)