

# Certified Reference Material

## BAM-P115

Pore size parameters of nanoporous Titanium dioxide  
calculated from the nitrogen sorption isotherm at 77.3 K

### Certified Values

Property		Value	$U^a$	$2 \cdot s_x^b$	Unit
Specific Surface Area <sup>c</sup>	$A_{\text{BET}}$	147.3	2.8	7.3	m <sup>2</sup> /g
Specific pore volume <sup>d</sup>	$V_{\text{p},0.99}$	0.214	0.004	0.007	cm <sup>3</sup> /g
Hydraulic pore diameter	$4V_{\text{p},0.99}/A_{\text{BET}}$	5.79	0.07	0.07	nm
Modal pore diameter	$D_{\text{BJH,des}}^e$	4.75	0.21	0.46	nm
Modal pore diameter	$D_{\text{BJH,ads}}^f$	5.40	0.24	0.61	nm

<sup>a</sup> Uncertainty  $U = k \cdot u_c$  calculated according to ISO Guide 35 and ISO/IEC Guide 98-3 with the coverage factor  $k = 2$  (giving a level of confidence of approximately 95%). The value of the combined standard uncertainty  $u_c$  of the certified property includes both an uncertainty contribution resulting from the inter-laboratory characterization, the study of inhomogeneities, stability of the material and the uncertainty contribution due to variation in the measurement results from individual instruments (mean data set).

<sup>b</sup> Standard deviation of accepted laboratory mean values (reported as twice the standard deviation).

<sup>c</sup> Specific surface area calculated in a relative adsorption pressure range of  $0.05 \leq p/p_0 < 0.3$  as multi point BET model with minimum of five points as described in ISO 9277.

<sup>d</sup> Single point total pore volume according to the Gurvich rule determined from the adsorption branch of the isotherm at relative pressure  $p/p_0 = 0.990$

<sup>e</sup> Pore size at maximum of the differential pore size distribution calculated from the desorption branch of the isotherm applying the BJH model as described in ISO 15901-2

<sup>f</sup> Pore size at maximum of the differential pore size distribution calculated from the adsorption branch of the isotherm applying the BJH model as described in ISO 15901-2

### Validity of the Certificate

This certificate is valid for two years from the date of shipment provided the reference material is stored under the recommended conditions.

### Date of Shipment from BAM:

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## Material Description

A unit of the CRM BAM-P115 consists of a single glass bottle containing approximately 12 g of crystalline titanium dioxide powder in the modification anatase with a mean particle size of about 30 µm.

## Recommended Use

Prior to the measurement, outgassing of the sample is necessary. Outgassing must be carried out in vacuum with a final pressure of < 10 Pa. For degassing in vacuum, the sample is to be heated with a rate of about 5 K/min to 453.15 K, then this temperature must be maintained for at least three hours. Afterwards, the sample is to be allowed to slowly cool down to ambient temperature.

The adsorption and desorption branch of the N<sub>2</sub> isotherm must be measured at 77.3 K. The analysis should be performed following the instrument manufacturer's instructions. The recommended minimum sample intake is 0.8 g.

The sample preparation station should have a separate vacuum circuit in addition to the analysis station or the preparation should be carried out in a separate heating station. For instruments with a combined vacuum system, measurements and sample preparation should not be performed together, as condensation in glass vessels can occur during sample preparation.

The certified value  $2s_x$  "Standard deviation of accepted laboratory mean values" can be used to validate gas sorption instruments in test laboratories and to carry out monitoring that is required according to ISO/IEC 17025.

This uncertainty represents the range of accepted measurement data observed in the certification interlaboratory comparison.

## Transport, Storage and Handling

CRM BAM-P115 can be shipped at ambient temperature. Upon receipt the material should be stored at a temperature below 30°C in its original tightly closed bottle. When handling the sample, the bottle should be opened as briefly as possible. Care should be taken to avoid moisture pick-up once the bottle is opened. BAM cannot be held responsible for changes that happen during storage of the material at the customer's premises, especially of opened bottles. The material should be used as it is from the bottle. However, before taking a sub-sample re-homogenisation by manual shaking of the closed bottle is strongly recommended.

## Analytical Method

The reference material is intended for performance testing of gas sorption instruments operating by the static-volumetric method. For this purpose, the instrument must perform the nitrogen gas adsorption and desorption at 77 K.

## Participating Laboratories

3P INSTRUMENTS GmbH & Co. KG, Odelzhausen (Germany)

Anton Paar QuantaTec Inc., Boynton Beach (USA)

Bundesanstalt für Materialforschung und -prüfung (BAM), Div. 6.3, Berlin (Germany)

Bundesanstalt für Materialforschung und -prüfung (BAM), Div. 5.4, Berlin (Germany)

Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin (Germany)

Institute of Chemical and Engineering Sciences (ICES), Jurong Island (Singapore)

Instituto Nacional de Técnica Aeroespacial, Madrid (Spain)

Instituto Pedro Nunes, Coimbra (Portugal)

Particle Testing Authority - Micromeritics GmbH, Unterschleißheim (Germany)

Particle Testing Authority - Micromeritics Instrument Corp., Norcross, GA (USA)

University Industry Research Laboratory (UIRL), Johor Bahru (Malaysia)

Ural Scientific Research Institute for Metrology (UNIIM), Yekaterinburg (Russian Federation)

## Means of Accepted Data Sets

Property ( $x$ )→	$A_{\text{BET}}$	$V_{\text{p},0.99}$	$4V_{\text{p}}/A_{\text{BET}}$	$D_{\text{BJH(des)}}$	$D_{\text{BJH(ads)}}$
Data set no.↓	$\text{m}^2/\text{g}$	$\text{cm}^3/\text{g}$	nm	nm	nm
C01	143.77	0.2093	5.827	4.414	4.913
C04	150.17	0.2146	5.735	4.548	4.936
C06	148.62	0.2152	5.791	4.560	5.100
C07	143.75	0.2085	5.802	4.578	5.292
C08	151.05	0.2169	5.744	4.585	5.304
C10	148.67	0.2160	5.808	4.619	5.324
C11	144.73	0.2108	5.826	4.805	5.328
C13	139.20	-	5.766	4.805	5.417
C15	145.59	0.2116	5.812	4.809	5.523
C17	149.83	0.2190	5.847	4.884	5.625
C19	151.46	0.2181	5.760	4.901	5.719
C21	147.36	0.2134	5.793	5.011	5.781
C27	150.25	0.2172	5.782	5.240	5.884

## Metrological Traceability

The certified values of specific surface area and porosity parameters are determined according ISO 9277 and ISO 15901-2 and are traceable to the base units of the SI via calibrated measurements of the quantities pressure, volume and mass.

## Literature

A detailed technical report describing the production, characterization and the treatment of the analytical data used to certify BAM-P115 is available on request or can be downloaded from BAM website (<https://rrr.bam.de>).

**Accepted as a BAM-CRM on July 1, 2020**

## Bundesanstalt für Materialforschung und -prüfung (BAM)

Dr. Silke Richter  
Committee for Certification

Dr. Franziska Emmerling  
Project Coordinator  
Head of Division 6.3  
Structure Analysis

BAM holds an accreditation as a reference material producer according to ISO 17034. This accreditation is valid only for the scope as specified in the certificate D-RM-11075-01-00.

DAkkS is a signatory of the multilateral agreement (MLA) between EA, ILAC and IAF for mutual acceptance.



This Reference Material is offered by:

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**Section 1: Identification of the substance/mixture and of the company/undertaking**

**1.1. Product identifier**

Product name:	BAM-P115
REACH Registration Number:	01-2119489379-17-XXXX
Substance name:	Titanium dioxide
CAS-No.:	13463-67-7
EC-No.:	236-675-5

**1.2. Relevant identified uses of the substance or mixture and uses advised against**

Titanium dioxide as a candidate material for certification of reference material. Any other use is not recommended.

**1.3. Details of the supplier of the safety data sheet**

Supplier / Producer:	Bundesanstalt für Materialforschung und -prüfung (BAM) Unter den Eichen 87, D-12205 Berlin, Germany
Contact person:	Division 1.3, Dr. Franziska Emmerling Phone +49-30-8104-1133, Telefax +49-30-8104-71133 e-mail: <a href="mailto:franziska.emmerling@bam.de">franziska.emmerling@bam.de</a>

**1.4. Emergency telephone number**

Emergency telephone:	+49-30-8104-1133 only available during office hours
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National Information:	Giftnotruf Berlin Charité-Universitätsmedizin Berlin / Campus Benjamin Franklin Hindenburgdamm 30 12203 Berlin +49 (0)30 30686700 (German, English)
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Information on national poison control centres within the EU can be found under the member states information on their national helpdesks:  
<http://echa.europa.eu/de/support/helpdesks/national-helpdesks/list-of-national-helpdesks>

Global information on poison centres can be found at the WHO homepage:  
[http://www.who.int/gho/phe/chemical\\_safety/poisons\\_centres/en/](http://www.who.int/gho/phe/chemical_safety/poisons_centres/en/)

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**2. Hazards identification**

**2.1. Classification of the substance or mixture**

*Classification (REGULATION (EC) No 1272/2008)*  
Not a hazardous substance or mixture.

**2.2. Label elements**

*Labelling according to Regulation (EC) No 1272/2008*  
Not a hazardous substance or mixture.

**2.3. Other hazards**

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This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Handling and/or processing of this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose and throat.

### Section 3: Composition/information on ingredients

#### 3.1. Substances

Substance name: Titanium Dioxide  
EC-No.: 236-675-5  
Chemical nature: inorganic

Chemical name	CAS-No. EC-No.	Concentration (% w/w)
No hazardous ingredients:		
Titanium dioxide	13463-67-7 236-675-5	95 - 99

### Section 4: First aid measures

#### 4.1. Description of first aid measures

General advice: Do not leave the victim unattended.  
Treat symptomatically.

Protection of first-aiders: No action shall be taken involving any personal risk or without suitable training.

For effective first-aid, special training / education is needed.

If inhaled: Remove person to fresh air. If signs/symptoms continue, get medical attention.

If unconscious, place in recovery position and seek medical advice.

In case of skin contact: Wash off with soap and water.

In case of eye contact: Rinse immediately with plenty of water, also under the eyelids.

Remove contact lenses.

Protect unharmed eye.

If eye irritation persists, consult a specialist.

If swallowed: Rinse mouth with water.

If conscious, make the victim drink the following:

Give small amounts of water to drink.

Do not induce vomiting without medical advice.

Consult a physician if necessary.

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**4.2. Most important symptoms and effects, both acute and delayed**

Symptoms:	Eye contact Dust contact with the eyes can lead to mechanical irritation. Inhalation may provoke the following symptoms: Symptoms of Overexposure Inhalation of dust may cause shortness of breath, tightness of the chest, a sore throat and cough. Skin contact may provoke the following symptoms: The product is not irritant but as with all fine powders can absorb moisture and natural oils from the surface of the skin during prolonged exposure. Individuals with sensitive skin may experience skin drying on prolonged or repeated exposure.
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**4.3. Indication of any immediate medical attention and special treatment needed**

Treatment:	No specific measures identified.
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**Section 5: Fire-fighting measures**

**5.1. Extinguishing media**

Suitable extinguishing media:	Product is compatible with standard fire-fighting agents.
Unsuitable extinguishing media:	High volume water jet

**5.2. Special hazards arising from the substance or mixture**

Specific hazards during firefighting:	No information available. No data is available on the product itself.
Hazardous combustion products:	No hazardous combustion products are known

**5.3. Advice for fire fighters**

Special protective equipment for firefighters:	Wear self-contained breathing apparatus for firefighting if necessary.
Specific extinguishing methods:	Cool containers/tanks with water spray.
Further information:	Standard procedure for chemical fires. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. No action shall be taken involving any personal risk or without suitable training

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**Section 6: Accidental release measures**

**6.1. Personal precautions, protective equipment and emergence procedures**

Personal precautions:	No action shall be taken involving any personal risk or without suitable training. Prevent unauthorised persons entering the zone. Avoid dust formation. Remove all sources of ignition. Ventilate the area. Avoid breathing dust. Keep people away from and upwind of spill/leak. Only qualified personnel equipped with suitable protective equipment may intervene. Never return spills in original containers for re-use. Treat recovered material as described in the section "Disposal considerations". For disposal considerations see section 13. The danger areas must be delimited and identified using relevant warning and safety signs.
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**6.2. Environmental precautions**

Environmental precautions	Try to prevent the material from entering drains or water courses. If the product contaminates rivers and lakes or drains inform respective authorities.
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**6.3. Methods and materials for containment and cleaning up**

Methods for cleaning up:	Clean-up methods - small spillage Clean up promptly by sweeping or vacuum. Keep in suitable, closed containers for disposal.  Clean-up methods - large spillage Approach release from upwind. Clean up promptly by sweeping or vacuum. Avoid creating dusty conditions and prevent wind dispersal.
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**6.4. Reference to other sections**

See Section 1 for emergency contact information., For personal protection see section 8., for disposal considerations see section 13.

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**Section 7: Handling and storage**

**7.1. Precautions for safe handling**

Technical measures:	Ensure that eyewash stations and safety showers are close to the workstation location.
Local/Total ventilation:	Use only with adequate ventilation.
Advice on safe handling:	For personal protection see section 8. Avoid creating dust.



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Smoking, eating and drinking should be prohibited in the application area.

Manual handling guidelines should be adhered to when handling sacks.

In the manufacture of titanium dioxide, product is packaged at temperatures of approximately 100 to 120° C (212 to 248° Fahrenheit). When pigment is shipped shortly after manufacture, it may stay hot for a very long time depending on ambient temperatures and inventory storage practices. Due to the potential of elevated pigment temperature, caution should be used while handling pigment and in solvent applications. Each work environment must be assessed to determine hazards.

Emptying of flexible intermediate bulk containers (FIBC's) can generate static electricity. Customers using FIBC's should consult leaflet "Tiotainer® Handling Guidelines". Empty FIBC's by gravity only (do not empty pneumatically). Remove all wrapping prior to emptying FIBC's. In all cases, the protective cover or wrapping should remain in place during storage and only be removed immediately prior to use.

Care should be taken to avoid moisture, particularly with a partly used pallet of material.

When transferring from one container to another apply earthing measures and use conductive hose material.

Advice on protection against fire and explosion:

Normal measures for preventive fire protection.

Hygiene measures:

Handle in accordance with good industrial hygiene and safety practice.

Smoking, eating and drinking should be prohibited in the application area. Wash face, hands and any exposed skin thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas. Barrier creams may help to protect the exposed areas of skin, they should however not be applied once exposure has occurred. Wash hands before breaks and at the end of workday.

**7.2. Conditions for safe storage, including any incompatibilities**

Requirements for storage areas and containers:

Store in accordance with the particular national regulations.

Keep only in the original container in a cool, well ventilated place away from oxidizing agents. Keep in a dry place. Keep cool. Protect from sunlight. Eliminate all ignition sources if safe to do so. Keep container closed when not in use. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Use appropriate container to avoid environmental contamination. When using standard pallets, those containing paper or plastics bags can be stacked to a maximum of 2 high.

Advice on common storage:

No materials to be especially mentioned.

Storage class (TRGS 510):

13, Non-Combustible Solids

Further information on storage stability:

Keep in a dry place. No decomposition if stored and applied as directed.

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### 7.3. Specific end use(s)

Specific use(s):

Consult the technical guidelines for the use of this substance/mixture.

## Section 8: Exposure controls/personal protection

### 8.1. Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
titanium dioxide	13463-67-7	AGW (Inhalable fraction)	10 mg/m <sup>3</sup> (Titanium dioxide)	DE TRGS 900
Peak-limit: excursion factor (category)	2;(II)			
Further information	General dust value. For this substance no specific occupational exposure limit value is established, since the AGS does not yet have information regarding unspecific action on the respiratory organs in excess of the normal values., Commission for dangerous substances, Senate commission for the review of compounds at the work place dangerous for the health (MAK-commission).			
		AGW (Alveolate fraction)	1,25 mg/m <sup>3</sup> (Titanium dioxide)	DE TRGS 900
Peak-limit: excursion factor (category)	2;(II)			
Further information	General dust value. For this substance no specific occupational exposure limit value is established, since the AGS does not yet have information regarding unspecific action on the respiratory organs in excess of the normal values., Commission for dangerous substances, Senate commission for the review of compounds at the work place dangerous for the health (MAK-commission).			

### Derived No Effect Level (DNEL) according to Regulation (EC) No. 1907/2006:

Substance name	End Use	Exposure routes	Potential health effects	Value
titanium dioxide	Workers	Inhalation	Long-term local effects	10 mg/m <sup>3</sup>
	Consumers	Oral	Long-term systemic effects	700 mg/kg bw/day
	Workers	Inhalation	Long-term local effects	10 mg/m <sup>3</sup>
	Consumers	Oral	Long-term systemic effects	700 mg/kg bw/day

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### Predicted No Effect Concentration (PNEC) according to Regulation (EC) No. 1907/2006:

Substance name	Substance name	Substance name
titanium dioxide	Marine water	0,0184 mg/l
Remarks	Assessment Factors	
	Fresh water sediment	1000 mg/kg
	Assessment Factors	
	Fresh water	0,184 mg/l
	Assessment Factors	
	Marine sediment	100 mg/kg
	Assessment Factors	
	Soil	100 mg/kg
	Assessment Factors	
	Sewage treatment plant	100 mg/l
	Assessment Factors	
	Freshwater - intermittent	0,193 mg/l
	Assessment Factors	
	Marine water	0,0184 mg/l
	Assessment Factors	
	Fresh water sediment	1000 mg/kg
	Assessment Factors	
	Fresh water	0,184 mg/l
	Assessment Factors	
	Marine sediment	100 mg/kg
	Assessment Factors	
	Soil	100 mg/kg
	Assessment Factors	
	Sewage treatment plant	100 mg/l
	Assessment Factors	
	Freshwater - intermittent	0,193 mg/l
	Assessment Factors	

### 8.2. Exposure controls

#### Engineering measures

Ensure adequate ventilation, especially in confined areas.

Use engineering controls to keep exposures below the OEL or DNEL

Personal protective equipment

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Eye protection:	Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts. Ensure that eyewash stations and safety showers are close to the workstation location.
Hand protection Directive:	Use gloves approved to relevant standards e.g. EN 374 (Europe), F739 (US).
Remarks:	For prolonged or repeated contact use protective gloves.
Skin and body protection:	Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection:	Use respiratory protection unless adequate local exhaust ventilation is provided or exposure assessment demonstrates that exposures are within recommended exposure guidelines
Filter type:	P2 filter
Protective measures:	Wear suitable protective equipment.

## Section 9: Physical and chemical properties

### 9.1. Information on basic physical and chemical properties

Appearance	powder, Packed powder, tablet, granules, extrudate
Colour	white
Odour	none
Odour threshold	Not relevant
pH	4 – 8; Concentration: 111 g/l
Melting point/range	> 1800 °C
Boiling point/boiling range	Not applicable
Flash point	Not applicable
Evaporation rate	no data available
Flammability	no data available
Upper/lower flammability or explosive limits	no data available
Vapour pressure	Not applicable
Vapour density	no data available
Relative density	ca. 4,1 g/cm <sup>3</sup> (20 °C)
Water Solubility(ies)	< 0,01 g/l (20 °C)
Partition coefficient: n-octanol/water	Not applicable
Auto-ignition temperature	The product itself does not burn.
Decomposition temperature	no data available
Viscosity	Not applicable
Explosive properties	no data available
Oxidizing properties	no data available

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### 9.2. Other information

Self-ignition: does not ignite.

## Section 10: Stability and reactivity

### 10.1. Reactivity

No dangerous reaction known under conditions of normal use.

### 10.2. Chemical stability

No decomposition if stored and applied as directed.  
Stable under normal conditions.

### 10.3. Possibility of hazardous reactions

Hazardous reactions: Stable under recommended storage conditions.  
No hazards to be specially mentioned.

### 10.4. Conditions to avoid

Conditions to avoid: No data available

### 10.5. Incompatible materials

Materials to avoid: None known.

### 10.6. Hazardous decomposition products

None known.

## Section 11: Toxicological information

### 11.1. Information on toxicological effects

*Acute toxicity*

Components:

titanium dioxide

Acute oral toxicity:

LD50 (Rat, female): > 5 000 mg/kg

Method: OECD Test Guideline 425

Assessment: The substance or mixture has no acute oral toxicity.

Components:

titanium dioxide

Acute inhalation toxicity:

LC50 (Rat, male and female): 3,43 - 5,09 mg/l

Exposure time: 4 h

Test atmosphere: dust/mist

Method: OECD Test Guideline 403

Assessment: The substance or mixture has no acute inhalation toxicity.

Components:

titanium dioxide

Acute dermal toxicity:

LD50 Dermal (Rabbit): > 10 000 mg/kg

Acute toxicity (other routes  
of administration):

No data available

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*Skin corrosion/irritation*

Components:

titanium dioxide:

Species: Rabbit

Assessment: No skin irritation

Method: OECD Test Guideline 404

Result: Normally reversible injuries

*Serious eye damage/eye irritation*

Components:

titanium dioxide:

Species: Rabbit

Assessment: No eye irritation

Method: OECD Test Guideline 405

Result: Normally reversible injuries

*Respiratory or skin sensitisation*

Components:

titanium dioxide:

Test Type: Local lymph node assay (LLNA)

Exposure routes: Skin

Species: Mouse

Assessment: Does not cause skin sensitisation.

Method: OECD Test Guideline 429

Result: Does not cause skin sensitisation

Exposure routes: Skin

Species: Guinea pig

Assessment: Does not cause skin sensitisation.

Method: OECD Test Guideline 406

Result: Does not cause skin sensitisation.

Components:

titanium dioxide:

Assessment:

No skin irritation, No eye irritation

Does not cause skin sensitisation., Does not cause respiratory sensitisation.

*Germ cell mutagenicity*

Components:

titanium dioxide:

Genotoxicity in vitro:

Test Type: Ames test

Concentration: 100 - 200 µg/plate

Metabolic activation: with and without metabolic activation

Method: OECD Test Guideline 471

Result: negative

Test Type: In vitro mammalian cell gene mutation test

Concentration: 31 - 500 µg/L

Metabolic activation: with and without metabolic activation

Method: OECD Test Guideline 476

Result: negative

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Test Type: Chromosome aberration test in vitro  
Concentration: 125 - 2500 µg/L  
Metabolic activation: with and without metabolic activation  
Method: OECD Test Guideline 473  
Result: negative

Components:

titanium dioxide:

Genotoxicity in vitro:

Test Type: Micronucleus test  
Test species: Mouse (males)  
Application Route: Inhalation  
Exposure time: 5 consecutive days  
Dose: 0.8, 7.2, and 28.5 mg/m<sup>3</sup>  
Method: OECD Test Guideline 474  
Result: negative

Test Type: Micronucleus test  
Test species: Rat (male and female)  
Application Route: Oral  
Exposure time: once  
Dose: 500, 1000, and 2000 mg/kg bw  
Method: OECD Test Guideline 474  
Result: negative

Components:

titanium dioxide:

Germ cell mutagenicity-

Assessment:

Tests on bacterial or mammalian cell cultures did not show mutagenic effects., Animal testing did not show any mutagenic effects.

Germ cell mutagenicity-

Assessment:

No data available

*Carcinogenicity*

Components:

titanium dioxide:

Species: Rat, (male and female)

Application Route: Oral

Exposure time: 103 weeks

Dose: 0, 25000, 50000 ppm

Frequency of Treatment: 7 days/week

No observed adverse effect level: > 50,000 ppm

Method: No information available.

Remarks: Titanium Dioxide: based on the results of chronic inhalation studies (with positive results only in a single species - rat), IARC has concluded that: "There is inadequate evidence in humans for the carcinogenicity of titanium dioxide." but that: "There is sufficient evidence in experimental animals for carcinogenicity of titanium dioxide". IARC's overall evaluation was that "titanium dioxide is possibly carcinogenic to humans (Group 2B)."

Venator has examined all of the available animal carcinogenicity and mechanistic data together with workplace epidemiology data for titanium dioxide and concludes that the weight of scientific evidence indicates that there is no causative link between titanium dioxide exposure and cancer risk in humans and that workplace exposures in compliance with applicable exposure standards will not result in lung cancer or chronic respiratory diseases in humans.

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Components:

titanium dioxide:

Carcinogenicity -

Assessment:

Not classifiable as a human carcinogen.

*Reproductive toxicity*

Effects on fertility:

No data available

Components:

titanium dioxide:

Effects on foetal

development:

Species: Rat, male and female

Application Route: Oral

Dose: 100, 300, and 1000 mg/kg bw/

Duration of Single Treatment: 20 d

Frequency of Treatment: 7 days/week

General Toxicity Maternal: No observed adverse effect level: 1  
000 mg/kg body weight

Developmental Toxicity: No observed adverse effect level: 1  
000 mg/kg body weight

Method: OECD Test Guideline 414

Result: No adverse effects

Components:

titanium dioxide:

Reproductive toxicity -

Assessment:

No evidence of adverse effects on sexual function and fertility,  
or on development, based on animal experiments.

*STOT - single exposure*

No data available

*STOT - repeated exposure*

No data available

*Repeated dose toxicity*

Components:

titanium dioxide:

Species: Rat, male and female

: 3500

Application Route: Ingestion

Test atmosphere: dust/mist

Exposure time: 2 yrNumber of exposures: 5 d

Method: Chronic toxicity

Species: Rat, male and female

: 10 - 50

Application Route: Inhalation

Exposure time: 2 yrNumber of exposures: 6 hours/day, 5 days/week

Method: Chronic toxicity



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Components:

titanium dioxide:

Repeated dose toxicity -

Assessment:

No skin irritation, No eye irritation

No adverse effect has been observed in chronic toxicity tests.

*Aspiration toxicity*

No data available

*Experience with human exposure*

General Information:

No data available

Inhalation:

No data available

Skin contact:

No data available

Eye contact:

No data available

Ingestion:

No data available

*Toxicology, Metabolism, Distribution*

No data available

*Neurological effects*

No data available

*Further information*

Ingestion:

No data available

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**Section 12: Ecological information**

**12.1. Toxicity**

Components:

titanium dioxide:

Toxicity to fish

LC50 (Cyprinodon variegatus (sheepshead minnow)): > 10  
000 mg/l

Exposure time: 96 h

Test Type: semi-static test

Test substance: Marine water

Method: OECD Test Guideline 203

Plant toxicity:

NOEC: 100 000 mg/kg

Exposure time: 480 h

Sediment toxicity:

> 100000 mg/kg sedimentdw

Study: Acute

Test Type: semi-static test

Water: Fresh water

Exposure duration: 28 d

Species: Gammarus pulex (Amphipod)

Method: ASTM Method, other

100000 mg/kg sedimentdw

Study: Chronic

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Test Type: semi-static test  
Water: Fresh water  
Exposure duration: 28 d  
Species: Gammarus pulex (Amphipod)  
Method: ASTM Method, other

14989 mg/kg sediment dw  
Study: Acute  
Test Type: semi-static test  
Water: Marine water  
Exposure duration: 10 d  
Species: Gammarus pulex (Amphipod)

Toxicity to terrestrial  
organisms:

NOEC: 10 000 mg/kg  
Exposure time: 672 h

**12.2. Persistence and degradability**

Product:  
Biodegradability

Remarks: The methods for determining biodegradability are not applicable to inorganic substances.

**12.3. Bio accumulative potential**

Components:  
titanium dioxide:  
Bioaccumulation:

Species: Oncorhynchus mykiss (rainbow trout)  
Exposure time: 14 d  
Bioconcentration factor (BCF): 19 – 352  
Test substance: Fresh water  
Method: semi-static test  
Remarks: Does not bioaccumulate.

**12.4. Mobility in soil**

Components:  
titanium dioxide:  
Distribution among  
environmental compartments:

Remarks: No data available

**12.5. Results of PBT and vPvB assessment**

Product:  
Assessment:

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher..

**12.6. Other adverse effects**

Product:  
Additional ecological  
information:

No data available

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**Section 13: Disposal considerations**

**13.1. Waste treatment methods**

Product:	The product should not be allowed to enter drains, water courses or the soil. This material and its container must be disposed of in a safe way. In accordance with local and national regulations. Dispose of wastes in an approved waste disposal facility. If recycling is not practicable, dispose of in compliance with local regulations.
Contaminated Packaging:	Empty containers should be taken to an approved waste handling site for recycling or disposal. Packaging that is not properly emptied must be disposed of as the unused product.

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**Section 14: Transport information**

IATA
Not regulated as dangerous goods
IMDG
Not regulated as dangerous goods
ADR
Not regulated as dangerous goods
RID
Not regulated as dangerous goods
Transport in bulk according to Annex II of Marpol and the IBC Code
Not applicable for product as supplied.

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**Section 15: Regulatory information**

**15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59).	This product does not contain substances of very high concern (Regulation (EC) No 1907/2006 (REACH), Article 57).
REACH - List of substances subject to authorisation (Annex XIV):	Not applicable
Water contaminating class (Germany):	nwg not water endangering

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The components of this product are reported in the following inventories:

TSCA:	On the inventory, or in compliance with the inventory
DSL:	All components of this product are on the Canadian DSL
AICS:	On the inventory, or in compliance with the inventory
NZIoC:	On the inventory, or in compliance with the inventory
ENCS:	On the inventory, or in compliance with the inventory
KECI:	On the inventory, or in compliance with the inventory
PICCS:	On the inventory, or in compliance with the inventory
IECSC:	On the inventory, or in compliance with the inventory
TCSI:	On the inventory, or in compliance with the inventory

### Inventories

AICS (Australia), DSL (Canada), IECSC (China), ENCS (Japan), KECI (Korea), NZIOEC (New Zealand), PICCS (Philippines), TCSI (Taiwan), TSCA (United States of America (USA))

## **15.2 Chemical safety assessment**

A Chemical Safety Assessment has been carried out for this substance.

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## **Section 16: Other information**

DE TRGS 900: Germany. TRGS 900 - Occupational exposure limit values.

DE TRGS 900 / AGW: Time Weighted Average

Further information

Other information: The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Sources of key data used to compile the Safety Data Sheet:

Information taken from reference works and the literature.,  
Information derived from practical experience.

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The information contained herein is based on data considered to be accurate and on the present state of our knowledge. It characterizes the sample with regard to the appropriate safety precautions. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

IN ALL CASES, IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE THE APPLICABILITY OF SUCH INFORMATION AND RECOMMENDATIONS AND THE SUITABILITY OF ANY PRODUCT FOR ITS OWN PARTICULAR PURPOSE.

THE PRODUCT MAY PRESENT HAZARDS AND SHOULD BE USED WITH CAUTION. WHILE CERTAIN HAZARDS ARE DESCRIBED IN THIS PUBLICATION, NO GUARANTEE IS MADE THAT THESE ARE THE ONLY HAZARDS THAT EXIST.

Hazards, toxicity and behaviour of the products may differ when used with other materials and are dependent upon the manufacturing circumstances or other processes. Such hazards, toxicity and behaviour should be determined by the user and made known to handlers, processors and end users.