

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** TITANIUM DIOXIDE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TITANIUM DIOXIDE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance TITANIUM DIOXIDE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of titanium dioxide not in excess of 15 milligrams per cubic meter (mg/M3) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for titanium dioxide.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which titanium dioxide is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of titanium dioxide at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of titanium dioxide.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to titanium dioxide;

(ii) Any measurements of titanium dioxide taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to titanium dioxide; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to titanium dioxide at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to titanium dioxide at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to titanium dioxide at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to titanium dioxide above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to titanium dioxide above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to titanium dioxide below the action level, the employer may terminate measurement for the employee.

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(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	$\pm 25\%$
At or below permissible exposure and above the action level	$\pm 35\%$
At or below the action level	$\pm 50\%$

(d) Compliance. (1) No employee shall be exposed to titanium dioxide above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of titanium dioxide shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of titanium dioxide.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

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(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of titanium dioxide to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR TITANIUM DIOXIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Dust or Mist Concentration	
75 mg/M3 or less	Any dust and mist respirator.
150 mg/M3 or less	Any dust and mist respirator except single-use or quarter mask respirator.
Dust, Mist, or Fume Concentration	
150 mg/M3 or less	Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
750 mg/M3 or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
7,500 mg/M3 or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure demand or other positive pressure or continuous-flow mode.
Greater than 7,500 mg/M3 or entry and	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

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escape from unknown concentrations	A combination respirator which includes a Type C supplied - air respirator with a full facepiece operated in pressure - demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for titanium dioxide.

(f) Reserved.

(g) Spills and disposal. In the event that titanium dioxide is spilled the employer shall immediately provide available ventilation and then clean up the spill.

(h) Reserved.

(i) Training and information. (1) Each employer who has a workplace in which titanium dioxide is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to titanium dioxide above the action level or employees who work where a spill of titanium dioxide may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for titanium dioxide (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to titanium dioxide.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to titanium dioxide which are listed in Appendix A of the section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to titanium dioxide.

(j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to titanium dioxide or airborne concentrations of titanium

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dioxide at or above the action level, information as to whether such employee has a history of chronic lung disease.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to titanium dioxide which are listed in Appendix A which the employee suspects are caused by exposure to titanium dioxide.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for titanium dioxide;

(ii) A description of the affected employee's duties as they relate to his exposure to titanium dioxide;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to titanium dioxide or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to titanium dioxide including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to titanium dioxide.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to titanium dioxide or airborne concentrations of titanium dioxide in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to titanium dioxide.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such

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refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to titanium dioxide.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to titanium dioxide which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to titanium dioxide;

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(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration and for one year after termination of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to titanium dioxide which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to titanium dioxide requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of titanium dioxide that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR TITANIUM DIOXIDE

I. SUBSTANCE IDENTIFICATION

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- A. Substance: Titanium dioxide
- B. Permissible Exposure: 15 milligrams of titanium dioxide per cubic meter of air (mg/M3) averaged over an eight-hour work shift.

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Titanium dioxide can affect your body if you inhale it.
- B. Effects of Overexposure:
 - 1. Exposure: Slight changes in the lungs may occur.
 - 2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to titanium dioxide.

III. EMERGENCY FIRST AID PROCEDURES

- A. Breathing: If you or any other person breathes in large amounts of titanium dioxide move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.
- B. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to titanium dioxide. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. Protective Clothing: Not applicable.
- C. Eye Protection: Not applicable.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Titanium dioxide must be stored in tightly closed containers in a well-ventilated area.
- B. Ask your supervisor where titanium dioxide is used in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

- A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for titanium dioxide. In addition, your employer must instruct

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- you in the safe use of titanium dioxide, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to titanium dioxide. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR TITANIUM DIOXIDE

- I. PHYSICAL AND CHEMICAL DATA
- A. Substance Identification
1. Synonyms: Rutile; anatase; brookite
 2. Formula: TiO_2
 3. Molecular weight: 79.9
- B. Physical Data
1. Boiling point (760 mm Hg): Less than 3000 C (less than 5432
 2. Specific gravity (water = 1): 3.9 - 4.2
 3. Vapor density (air = 1 at boiling point of titanium dioxide): Not applicable
 4. Melting point: 1640 C (2984 F)
 5. Vapor pressure at 20 C (68 F): Essentially zero
 6. Solubility in water, % by weight at 20 C (68 F): Insoluble
 7. Evaporation rate (butyl acetate = 1): Not applicable
 8. Appearance and odor: White powder with no odor
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
- A. Fire
1. Not combustible
- B. Reactivity
1. Conditions contributing to instability: None
 2. Incompatibilities: None
 3. Hazardous decomposition products: None.
 4. Special precautions: None.
- III. SPILL AND DISPOSAL PROCEDURES

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- A. If titanium dioxide is spilled, the following steps should be taken:
 - 1. Ventilate area of spill.
 - 2. Collect spilled material in the most convenient and safe manner for reclamation, or for disposal in a sanitary landfill. Liquid containing titanium dioxide should be absorbed in vermiculite, dry sand, earth or a similar material.
- B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
- C. Waste disposal methods: Titanium dioxide may be disposed of in a sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of the particulates using a high efficiency membrane filter with subsequent chemical analyses. The method of measurement must determine the concentration of titanium dioxide to plus or minus 35%.
- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of titanium dioxide to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set O" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store titanium dioxide in tightly closed containers in a well ventilated area.
- B. Employers should advise employees of all areas and operations where exposure to titanium dioxide could occur.

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VI. COMMON OPERATIONS

Common operations in which exposure to titanium dioxide is likely to occur are: During its use as a pigment for paper, plastics, polymers, textiles, gaskets for food products; during its use in the manufacture of ceramic capacitors, vitreous enamels, synthetic gems; during the mining of certain titanium ores; during the deployment of titanium tetrachloride smokes; and during its mining, purification, packaging and distribution.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Titanium dioxide dust is a mild pulmonary irritant. Rats repeatedly exposed to concentrations of 10 to 328 million particles per cubic foot of air for as long as 13 months showed small focal areas of emphysema which were attributed to large deposits of dust; there was no evidence of any specific lesion being produced by titanium dioxide. Three of 15 workers who had been exposed to titanium dioxide dust showed radiographic signs in the lungs resembling "slight fibrosis," but disabling injury did not occur; the magnitude and duration of exposure were not specified. In the lungs of 3 workers involved in processing titanium dioxide pigments, deposits of the dust in the pulmonary interstitium were associated with cell destruction and slight fibrosis; the findings indicated that titanium dioxide is a mild pulmonary irritant.

III. SIGNS AND SYMPTOMS

Slight lung fibrosis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

None specific.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Titanium dioxide is generally considered to be an innocuous particulate material and a nuisance dust, although, it has been reported to cause slight lung fibrosis in man and animals. It is important that the physician become familiar with plant operating conditions in which exposure to titanium dioxide occurs. Those with

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skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from titanium dioxide exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Chronic respiratory disease -- Titanium dioxide is a nuisance dust. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of titanium dioxide might cause exacerbation of symptoms due to its irritant properties.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Titanium Dioxide," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 259.
2. Hygienic Guide Series: "Titanium Dioxide," American Industrial Hygiene Association Journal, 27:206-207, 1966.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1154-1158.
4. Browning, Ethel: Toxicity of Industrial Metals (2d ed.), Butterworths, London, 1969, pp. 331-335.
5. Elo, R., et al: "Pulmonary Deposits of Titanium Dioxide in Man," Archives of Pathology, 94:417-424, 1972.
6. Christie, H., et al: "Pulmonary Effects of Inhalation of Titanium Dioxide by Rats," American Industrial Hygiene Association Journal, 24:42-46, 1963.

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REFERENCES AND SOURCES
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1910.93

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye"
Skin: Hygienic Guide Series, American Industrial Hygiene Association; Browning, "Toxicity of Industrial Metals;" Patty, "Industrial Hygiene and Toxicology;" Schwartz, Tulipan and Birmingham, "Occupational Diseases of the Skin"
Ingestion: Browning, "Toxicity of Industrial Metals;" Patty, "Industrial Hygiene and Toxicology;" International Labour Office, "Encyclopedia of Occupational Health and Safety;" Hamilton and Hardy, "Industrial Toxicology;" Hygienic Guide Series, American Industrial Hygiene Association

COMMENTS

Eye - Classification: 0

Output statement numbers: None

Exceptions: None

According to Grant, titanium dioxide is insoluble in water and "very inert." "It has been introduced by tattooing into the cornea of rabbits and patients having corneal scars, and has caused permanent white coloration but no irritation . . .

Most literature sources state that because of the chemical inertness of titanium dioxide, it is unlikely to cause any irritating or toxic effect on the eye. For this reason, it is concluded that a classification of zero is appropriate.

Skin - Classification: 0

Output statement numbers: None

Exceptions: None

The Hygienic Guide Series states, "the use of titanium dioxide in therapy of skin disorders indicates its blandness," and according to Browning, it "increases the defense mechanisms of the skin without causing irritation."

Patty notes that during World War II, titanium dioxide was used on exposed parts of the body as a protection against flash burns and was "without consequence indicating no capacity to produce contact dermatitis, allergic sensitization or appreciable dermal absorption."

Schwartz, Tulipan and Birmingham agree and state that titanium dioxide is devoid of toxicity and for this reason is used in the preparation of face powders and beauty creams.

Because titanium dioxide has a history of physiological inertness, and no skin reactions of any kind have been recorded, a classification of zero is concluded to be appropriate.

For informational purposes, it is noted that titanium dioxide is a white powder with a melting point of 1640 degrees C. It is insoluble in water, not a fire hazard, and, for all practical purposes, does not have a vapor pressure.

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Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

According to Browning, titanium dioxide is not regarded as highly toxic to animals nor to humans. Animals have a high toleration by mouth and injection. "Oral administration of large amounts of titanium salts mixed with the dust is stated by Ereau (1955) not only to have had no toxic effects but also actually to have caused an improvement in health." Comprehensive studies by Verneti - Blina (1928) on the toxicity by mouth and subcutaneous injection, in varying doses over a one to two month period, have concluded that "titanium dioxide acted in the body as an inert, innocuous substance. ." The only ill effect recorded by mouth was a weight loss and some congestion of the internal organs, "attributed to its poor absorption from the intestine."

Patty reports, "Lehmann and Zerget found no evidence, from histological study of organs of animals fed titanium dioxide for periods up to 16 months, of any tissue change or of appreciable quantities of titanium in the tissues, and concluded that titanium is not absorbed from the gastro-intestinal tract by the blood. ."

The ILO reports the substance to be "virtually inert" and ingestion experiments suggests it acts on the body as an innocuous material.

Hamilton and Hardy state, "because of its chemical and biological properties, industrial titanium exposures are considered harmless. ." The Hygienic Guide Series agrees saying, "titanium dioxide has not been shown conclusively to produce organic diseases and is generally considered to be an innocuous particulate material and a nuisance dust. ."

Because titanium dioxide is "virtually inert" and literature sources indicate that the material is considered harmless, a classification of zero is concluded to be appropriate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

E. I. duPont de Nemours and Company, Material Safety Data Sheet (duP)

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)

Kirk - Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 20, p. 392 (K-O)

"Lange's Handbook of Chemistry," 11th edition (Lange)

Sources of data items used:

- | | | | |
|----|----|----|---|
| I. | A. | 1. | Synonyms: Lange |
| | | 2. | Formula: Lange |
| | | 3. | Molecular weight: Lange |
| | B. | 1. | Boiling point: Langes Handbood of Chemistry and Physics |
| | | 2. | Specific gravity: K-O |
| | | 3. | Vapor density: Not applicable |
| | | 4. | Melting point: Lange |

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- 5. Vapor pressure: ADL
- 6. Solubility in water: Lange
- 7. Evaporation rate: Not applicable
- 8. Appearance and odor: duP
- II. A. 1. Flash point: Not applicable
- 2. Autoignition temperature: Not applicable
- 3. Flammable limits: Not applicable
- 4. Extinguishing media: Not applicable
- 5. Special fire fighting procedures: None
- 6. Unusual fire and explosion hazards: None
- B. 1. Conditions contributing to instability: ADL
- 2. Incompatibilities: NFPA-491M
- 3. Hazardous decomposition products: None
- 4. Special precautions: None
- III. A. Steps if released or spilled: duP
- C. Waste disposal method: ADL
- V. Miscellaneous precautions: duP

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- Bozsán, M., "Air Pollution Abatement in the Ceramic Industry," Journal Air Pollution Control Assoc., 16(6), p. 332 - 3, 1966 (NIOSH Technical Information Service NIOSH 12384)
- Elo, R., Maatta, K., Uksila, E. and Arstila, A. U., "Pulmonary Deposits of Titanium Dioxide in Man," Arch. Path., 94(5), p. 417 - 24, 1972 (Elo)
- International Labor Organization, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)
- Kirk, R. and Othmer, R., "Encyclopedia of Chemical Technology," Interscience, 2nd edition, 1972 (K-O)
- Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience, 1962 (Patty)
- Stanford Research Institute, "Chemical Economics Handbook," Menlo Park (SRI)
- "Titanium Dioxide," duPont Co., Material Safety Data Sheet (duPont MSDS)
- "Titanium Dioxide," American Conference of Governmental Industrial Hygienists, Hygienic Guide Series, April 1966 (Guide)
- "Titanium Dioxide," Hazard Process Index, Hazard Entry No. 189, NIOSH HSM-99-73-62 (HPI)
- U. S. Dept. Interior, Bu Mines Bulletin 650, "Mineral Facts and Problems," 1970 (Bu Mines)

References for Specific Use/Exposure

- 1. Patty, HPI, Bu Mines, SRI, K-O
- 2. Bu Mines, HPI, K-O, SRI
- 3. Bu Mines, HPI, K-O, SRI
- 4. Bu Mines, HPI, K-O, SRI
- 5. HPI, K-O, SRI
- 6. Bu Mines, K-O, SRI, NIOSH 12384 (Bozsán)
- 7. Bu Mines, HPI, K-O, SRI
- 8. HPI, K-O, SRI
- 9. Bu Mines, HPI, K-O, SRI
- 10. Bu Mines, K-O, SRI
- 11. K-O, SRI

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References for Specific Control Methods

Elo, ILO, Guide, Patty, and duPont MSDS were the references used in all the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Titanium dioxide

D. O. L. STANDARD: 15 mg/M3

Eye Irritation Level: According to Grant, titanium dioxide "is a white pigment which is insoluble in water and very inert. It has been introduced by tatooing into the cornea of rabbits and patients having corneal scars, and has caused permanent white coloration but no irritation." For the purposes of this standard, therefore, titanium dioxide is not treated as an eye irritant.

IDLH: There is no evidence in the available toxicological information that exposure to a high concentration of titanium dioxide would impede escape within one-half hour. For the purposes of this standard, therefore, on the basis of the protection factor afforded by each device. It is recognized, however, that for some substances for which there does not appear to exist a concentration immediately dangerous to life and health, the determination of allowable respiratory protection based on protection factors may result in the selection of a concentration which is not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only those respirators allowed for use above IDLH concentrations are permitted for use in concentrations exceeding 500 times the permissible exposure.

Other Toxicological Information: The AIHA Hygienic Guides state that the permissible exposure limit of 15 mg/M3 "is based on its (titanium dioxide's) nuisance dust propensities and bears no direct relationship to toxicity . . . (The short exposure tolerance is) unknown for man. Titanium dioxide was found to be essentially inert physiologically in animal studies by ingestion, inhalation and subcutaneous injection. (The) atmospheric concentration immediately hazardous to life (is) virtually unattainable. . . Slight fibrosis has been reported in human lungs from the industrial exposure to titanium dioxide pigment, but disabling injury was not caused."

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USE/EXPOSURE AND CONTROL DOCUMENT
TITANIUM DIOXIDE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of dust and skin contact with solid during mining, purification, packaging, and distribution	A	General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices)
2.	Inhalation of dust and skin contact with solid during use as a pigment in the manufacture of paints, varnishes, and lacquers (imparts whiteness, opacity, and brightness)	A	General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices)
3.	Inhalation of dust and skin contact with solid during use in manufacture of paper (used in coatings and fillers to improve opacity, brightness, and printing paper, photographic papers, paper packaging and cellophane coatings)	A	General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices)
4.	Inhalation of dust and skin contact with solid during use in manufacture of plastics: blow-molded plastic containers (bleach bottles); in polyethylene, polyvinyl chloride, polystyrene, polyolefin, and ABS as a white pigment	A	General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices)
5.	Inhalation of dust and skin contact with solid during use in manufacture of elastomers (natural and synthetic rubber used for tire sidewalls, footwear, floor mats, gloves, rainwear, wall coverings)	A	General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices)
6.	Inhalation of dust and skin contact with solid during use in manufacture	A	General dilution ventilation; personal protective equipment (gloves, goggles,

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of ceramics and glass
(ceramic capacitors and
electromechanical trans-
ducers, welding-rod
coatings, and glass
fibers)

respiratory protective
devices)

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|-----|--|---|---|
| 7. | Inhalation of dust and skin contact with solid during use in manufacture of floor coverings (vinyl asbestos tiles and sheets) | A | General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 8. | Inhalation of dust and skin contact with solid during use in manufacture of printing inks (flexographic, gravure, and letter press inks; packaging, publication, offset, and screen process inks) | A | General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 9. | Inhalation of dust and skin contact with solid during use in manufacture of coated fabrics and textiles (natural and artificial leather, oilcloth, upholstery materials, wall coverings; as a delustrant for acrylic, nylon, and spandex fibers) | A | General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 10. | Inhalation of dust and skin contact with solid during use for manufacture of building materials (roofing granules, ceiling tiles, cement curing aids, titanium carbide cutting tools) | A | General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 11. | Inhalation of dust and skin contact with solid during use for manufacture of cosmetics, food color additives, and synthetic diamonds (face creams and powders, dental waxes and impression compounds, soaps, shoe polish) | A | General dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |

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- A -- Inhalation
- B -- Skin and eye contact resulting in
localized irritation
- C -- Ingestion
- D -- Skin contact resulting in
absorption and subsequent
systemic poisoning

----- JES2 JOB STATISTICS -----

1,094 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

