

METRIC

MIL-STD-1209B

23 June 1993

SUPERSEDING

MIL-STD-1209A

30 March 1988

MIL-STD-1209

8 May 1967

MILITARY STANDARD

INORGANIC SALTS AND COMPOUNDS, TECHNICAL GRADE

(STRONTIUM CARBONATE THROUGH ZIRCONIUM CARBIDE)



AMSC N A

ESC 6810

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FOREWORD

Inorganic Salts and Compounds, Technical Grade (Strontium Carbonate through Zirconium Carbide)

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to :
Commander, U.S. Army Edgewood Research, Development and Engineering
Center, Attn: SMCCR-PET-S, Aberdeen Proving Ground, MD 21010-5423, by
using the self-addressed Standardization Document Improvement Proposal (DD
Form 1426) appearing at the end of this document or by letter.
3. This standard is approved for use by all Departments and Agencies of the
Department of Defense in the selection of items for application. It is intended to
prevent the entry of unnecessary items (sizes, types, varieties) into the Department
of Defense logistics system. This document is not intended to restrict any service
in selecting new items resulting from state-of-the-art changes.

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1. SCOPE

1.1 Coverage. This standard is a presentation of nomenclature, Chemical Abstracts Service Registry Numbers, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for inorganic salts and compounds, technical grade (strontium carbonate through zirconium carbide). This standard does not include all of the items represented by the title or all those items which are commercially available. It does contain items preferred for use in the selection of inorganic salts and compounds, technical grade (strontium carbonate through zirconium carbide), for application by the Department of Defense.

1.2 Application. Inorganic salts and compounds, technical grade (strontium carbonate through zirconium carbide), are used in pyrotechnics, tracer compositions, fireproofing textiles, smoke mixtures, polymerization and as catalysts.

1.3 Classification. The items in this standard are classified on the basis of chemical composition as inorganic salts and compounds, technical grade.

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2. APPLICABLE DOCUMENTS2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

PPP-C-2020 Chemicals, Liquid, Dry and Paste, Packaging of

MILITARY

MIL-S-12060 Sulfur Monochloride, Technical (Metric)
 MIL-Z-12061 Zinc Carbonate, Basic, Technical
 MIL-Z-12063 Zinc Borate, Technical (Metric)
 MIL-S-20322 Strontium Nitrate, Anhydrous
 MIL-T-50059 Titanous Sulfate Solution, 20 Percent (Metric)
 MIL-Z-82674 Zirconium Carbide, Powdered, Technical
 MIL-Z-85500 Zirconium Carbide

STANDARDS

FEDERAL

FED-STD-313 Material Safety Data Sheets, Preparation And The Submission Of. (MSDS)

MILITARY

MIL-STD-12 Abbreviations For Use On Drawings, And In Specifications, Standards And Technical Documents

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Naval Publications and Forms Center, (ATTN: DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094).

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2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

CODE OF FEDERAL REGULATIONS (CFR)

Title 29	Department of Labor, Occupational Safety and Health Agency (OSHA); General Industry Standards And Interpretations
Title 40	Environmental Protection Agency (EPA); Hazardous Waste And Consolidated Permit Regulations
Title 49	Department Of Transportation (DOT); Hazardous Materials Regulations

DEPARTMENT OF DEFENSE

DOD 4145.19-R-1	Storage And Materials Handling
DOD 4160.21-M	Defense Utilization And Defense Disposal Manual
DOD 6050.5-LR	DOD Hazardous Materials Information System, Hazardous Item Listing.
TB MED 502 (DLAM 1000.2)	Occupational And Environmental Health Respiratory Protection Program.
TB MED 506	Occupational And Environmental Health Occupational Vision

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

Registry of Toxic Effects of Chemical Substances
Recommendation for Environmental Exposure Limits

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Non-Government publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

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AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

Threshold Limit Values (TLVs) for Chemical Substances in the Work Environment Adopted by American Conference of Governmental Industrial Hygienists (ACGIH) with Intended Changes.

(Application for copies should be addressed to American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Bldg D-7, Cincinnati, OH 45211-4438.)

ASTM

- ASTM E 11 - Standard Specification for Wire-Cloth Sieves For Testing Purposes
- ASTM E 323 - Standard Specification For Perforated - Plate Sieves For Testing Purposes
- ASTM E 380 - Standard For Metric Practice

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

CHEMICAL ABSTRACTS SERVICE REGISTRY

The Chemical Abstracts Service (CAS) Registry number provides a key to access the wealth of information available through CAS.

(For details on how to search the CAS files and database using the registry number, contact Chemical Abstracts Services, Customer Service, P.O. Box 3012, Columbus, OH 43210.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

National Fire Codes

(Application for copies should be addressed to National Fire Protection Association, Battery March Park, Quincy, MA 02269.)

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MINE SAFETY APPLIANCE COMPANY (MSA)

Mine Safety Appliance Company (MSA) Analysis

(Application for copies should be addressed to Mine Safety Appliance Company, 600 Penn Center Boulevard, Pittsburgh, PA 15235.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

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3. DEFINITIONS

3.1 Definitions of Technical Terms.

3.1.1 Technical grade - Denotes a quality of chemicals which are generally used for industrial, solvent, and manufacturing applications. Generally, specific processes are not employed by the manufacturer to limit all the impurities, aside from the normal precautions which are taken in the manufacturing process. A technical chemical may be specially processed to reduce specific impurities so as to suit the chemical to a given industrial application. In such cases, the identification of the items must be further expanded to indicate the specific impurities limitation.

3.1.2 pH - A numerical measure of the hydrogen ion concentration, indicating degree of acidity or alkalinity of a solution. It is expressed as $\text{pH} = -\log_{10}[\text{H}^+]$. At the neutral point, $\text{pH} = 7$. At a pH lower than 7, a solution is acidic. At a pH higher than 7, a solution is basic.

3.1.3 Oxidizing agent - A substance that gains electrons as a result of an oxidation-reduction reaction. It causes an increase in the oxidation state of another substance.

3.1.4 Reducing agent - A substance that loses electrons during an oxidation-reduction reaction. It causes a decrease in the oxidation state of another substance.

3.2 Definitions of abbreviations. The use of abbreviations shall be in accordance with MIL-STD-12 where applicable. Metric system abbreviations and symbols shall be in accordance with ASTM E 380.

Additional abbreviations are as follows:

CAS	Chemical Abstracts Service Registry Number
DRMO	Defense Reutilization and Marketing Office
FW	Formula Weight
HMIS	Hazardous Materials Information System
TCLP	Toxic Characteristic Leaching Procedure

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4. GENERAL REQUIREMENTS

4.1 Packaging data and labeling. All chemicals included in this standard shall be packaged in accordance with Federal Specification PPP-C-2020 and all applicable documents referenced therein. Shipping containers shall be labeled in accordance with current Department of Transportation (DOT) Hazardous Materials Regulations applicable to each chemical. When shipping by military aircraft, the requirements of TM 38-250 shall apply. In addition, each item shall be packaged and labeled as specified in the applicable contract or order. All labels shall also comply with Hazard Communication Standard, 29 CFR 1910.1200 (f).

4.2 Hazardous materials information. DOD 6050.5, DOD Hazardous Materials Information System (HMIS) acquires, reviews, stores, and disseminates Material Safety Data Sheet (MSDS) information for all hazardous materials used by DOD. The contractual acquisition of an MSDS is accomplished through use of Federal Acquisition Regulation, paragraph 52.223-3, Hazardous Material Identification and Material Safety Data. The MSDS is prepared in accordance with the instructions in FED-STD-313 and shall comply with the requirements of Hazard Communication Standard, 29 CFR 1910.1200 (g).

4.3 Safety.

4.3.1 Personal protective measures. The necessary respiratory, eye and skin protection to be used when handling chemicals shall be prescribed by the responsible installation industrial hygiene, medical and safety authorities.

4.3.1.1 Respiratory protection. Respirators, approved by the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA) or by particular respiratory schedules of the Bureau of Mines (BM) for the compounds being used, may be employed for intermittent, non-routine exposure not exceeding one hour per week, when the installation medical authority determines that there are no feasible engineering or work practice controls, during interim periods when engineering controls are being designed and/or installed, during emergencies, or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation containment, process controls, or other feasible engineering controls shall be adequate to remove hazardous concentrations. Respiratory protection shall not be used in place of feasible engineering controls.

4.3.1.2 Skin protection. Personnel using these compounds shall be provided with and required to use impervious gloves, sleeves, aprons, and boots whenever indicated. Protective creams and ointments commonly known as "barrier creams" may

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be of value in certain cases. However, barrier creams shall not be used to replace protective clothing. During use avoid contact with eyes, skin, and clothing. Wash with soap and water after handling. When not in use, keep in a tightly closed container. In case of contact with the eyes, remove any contact lenses and irrigate with copious amounts of water for at least 20-30 minutes, and obtain medical attention. Eye lavages and emergency showers shall be located where there is a potential for direct contact with harmful chemicals.

4.3.1.3 Face and eye protection. Personnel using these compounds shall be provided with and required to wear chemical splash-proof safety goggles. In addition, face shields shall be provided and worn over the goggles if splashing could occur. In case of contact with the eyes, immediately irrigate with copious amounts of water for at least 20-30 minutes, and obtain medical attention. (Refer to TB MED 506.)

4.3.1.4 Training. Employers shall provide employees with training and information, including MSDSs, on all chemical items in their work area, in accordance with 29 CFR 1910.1200 (h) and, 49 CFR 172 Subpart H, as may be applicable, to ensure that employees know potential hazards of the chemicals with which they come in contact and the symptoms of exposure, as well as how these chemicals affect the body and bodily functions. Employees shall be adequately trained to render first aid.

4.3.1.5 Exercises. Participation in training exercises shall be stressed to demonstrate skills in the use of personal protective equipment and emergency response equipment.

4.3.2 Storage conditions. DOD 4145.19-R-1 describes general storage practices and requirements for hazardous materials in the DOD supply system. Specific requirements provided in the following paragraphs are supplementary in nature and shall be observed in consonance with the DOD storage regulations.

4.3.2.1 Flammable, combustible, pyrophoric and ignitable materials. A flammable material is generally any solid, liquid, vapor or gas that ignites easily and burns rapidly. Combustible materials are generally those that are difficult to ignite and burn slowly. The DOT, in Part 173, Subpart D, Section 173.115 of 49 CFR, defines a flammable liquid as one having a closed cup flash point below 37.8°C (100°F). A combustible liquid is defined, by DOT in the above reference, as one having a closed cup flash point at or above 37.8°C (100°F) and below 93.3°C (200°F). A pyrophoric liquid is defined, by DOT in the above reference, as one that ignites spontaneously in dry or moist air at or below 54.5°C (130°F). Materials with flash points of 93.3°C (200°F) or

*Refers only to materials that have become waste.

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higher are to be considered as burnable. The Environmental Protection Agency (EPA), in Part 261, Subpart C, Section 261.21 of 40 CFR*, designates the criteria for flammable and combustible materials and oxidizers that exhibit the characteristic of ignitability (I). Liquids with closed cup flash points of less than 60°C (140°F) are defined by EPA as ignitable. The autoignition point (temperature) of a substance is generally defined as the minimum temperature required to initiate or cause self-sustained combustion in the absence of a spark or flame. Materials that ignite easily under normal industrial conditions are considered to be dangerous fire hazards. Such materials shall be stored in a manner to prevent ignition and combustion. Easily ignitable substances, such as reducing agents, shall be kept away from strong oxidizing agents. All containers shall be tightly sealed. It is important to provide adequate ventilation in storage areas, and to locate the storage areas of these items away from fire hazards. Ample fire-control equipment shall be easily accessible. Storage buildings, rooms and cabinets shall comply with provisions of the National Fire Codes. The building shall be electrically grounded and signs posted to prevent the lighting of matches or smoking in the area. Flammable storage areas shall be equipped with smoke or fire detection equipment.

4.3.2.2 Water-sensitive fire and explosive hazardous materials. These are materials that react on contact with water or steam to ignite or evolve heat or explosive gases. Such materials exhibit the characteristic of reactivity (R) as designated by the EPA in Section 261.23 of the above reference.* These materials shall be stored in well-ventilated, cool, dry areas. All containers shall be tightly sealed. These materials are a fire hazard in contact with water or moisture; therefore, it is essential that no sprinkler be used. Otherwise, the building shall conform to that required for storage of flammable materials. The building shall be waterproof, located on high ground, separated from other storage areas and meet National Fire Codes.

4.3.2.3 Incompatible materials. Materials that are chemically incompatible shall be segregated in the storage of both serviceable and unserviceable items. The degree of segregation will depend upon DOD 4145.19-R-1 and local supplementary requirements that insure safe storage conditions. Hazardous storage compatibility codes are provided in the HMIS referred to in 4.2.

4.3.3 Chemical hazardous exposure limits. Chemical hazardous exposure limits for airborne concentrations of substances are obtained from the current TLVs in Threshold Limit Values for Chemical Substances in the Work Environment adopted by the American Conference of Governmental Industrial Hygienists (ACGIH); current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits

*Refers only to materials that have become waste.

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(PEL), 29 CFR, Part 1910, Section 1910.1000; and NIOSH Recommended Exposure Limits. Such information is also shown in MSDSs and the HMIS referred to in 4.2. The identity of sources establishing if a chemical is a carcinogen or potential carcinogen, for hazard communication purposes, is shown in 29 CFR 1910.1200 (d)(4). The more stringent standard shall apply when there is a conflict between standards.

4.3.4 Toxicity. Toxicity information for chemical compounds is available from various publications and from MSDSs, which are collected in DOD 6050.5-LR Hazardous Materials Information System.

4.3.4.1 EPA Toxic (T). Some chemical compounds have been designated by the EPA as toxic (T) in accordance with the criteria shown in Part 261, Subpart B, Section 261.11(a)(3) of 40 CFR.* Some commercial chemical products are listed as toxic under Subpart D, Section 261.33 (f).

4.3.4.2 EPA Acute Hazardous Toxicity (H). Some chemical compounds have been designated by the EPA as acutely hazardous (H) in toxicity in accordance with the criteria shown in Subpart B, Section 261.11(a)(2) of the above reference.* Some commercial chemical products are listed as acutely hazardous in toxicity under Subpart D, Section 261.33(e).

4.3.4.3 EPA Toxicity Characteristic Leaching Procedure (TCLP). This is a procedure used to determine the properties of a waste that are directly related to the potential of the waste to pose a hazard to groundwater when disposed of in a landfill environment. It replaces the EPA EP toxicity test. The TCLP procedure is contained in EPA Method No. 1311, SW -846. Some 40 chemical contaminants have been designated by the EPA as being a hazard to groundwater in a landfill environment. (See Section 261.24 of 40 CFR.)*

4.4 Pollution and disposal.

4.4.1 Pollution potential. All items described in this standard shall be assumed to have a pollution potential. However, to minimize this potential, the proper use, storage and disposal methods shall be strictly followed.

4.4.2 Disposal of excess or unserviceable material. To minimize disposal problems, it is recommended that no more than a one year's supply of each item listed in this standard be stocked. When stocks have been declared excess or

*Refers only to material that have become waste.

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unserviceable, they will be disposed of in accordance with the Defense Utilization and Disposal Manual, DOD 4160.21-M, and applicable DOD Policy Memoranda. Guidance can be obtained from your servicing Defense Reutilization and Marketing Office (DRMO) on procedures required for proper reporting and turn-in.

4.4.3 Disposal and storage of hazardous wastes. Items are classified and managed as hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580). Items have been identified as meeting the characteristics (i.e., ignitable, corrosive, reactive or are subject to Toxicity Characteristic Leaching Procedure (TCLP)) or are listed (i.e., toxic or acutely hazardous) according to Identification and Listing of Hazardous Waste, Part 261, 40 CFR; or have been determined to be hazardous wastes by declaration of the Defense Reutilization and Marketing Service (DRMS) in accordance with procedures set forth in DOD 4160.21-M. Disposal of such items shall be managed in accordance with the Installation Environmental Office, the DRMO, or the Safety and Health Office to insure proper reporting of disposal and treatment actions to the US EPA and State, and shall be managed in accordance with Federal, State and local laws. The three main disposal methods are turn-in to the DRMO, on-post disposal by installation personnel, or disposal by commercial contract. Hazardous wastes that cannot be used or disposed of as stated in 4.4.3.2 shall be stored under environmentally safe conditions until suitable methods of disposal are determined. Short-term storage (less than 90 days) requires proper containment (i.e., packaging and facilities) in accordance with Section 262.34, Part 262, of the above reference. Long-term storage (greater than 90 days) requires permitting by the EPA or by the state under Public Law 94-580 (RCRA), in compliance with the requirements of 40 CFR, Parts 264 and 265. Physical custody will be accomplished by the activity with conforming storage or most nearly conforming storage. When physical custody is in question, the Post Commander will make the final decision. In all cases where the wastes are to be collected, stored, transported and disposed of at a state or local permitted disposal facility, the identity and description of the waste shall be maintained and recorded in accordance with Part 262 of the above reference. Transportation of the waste must be in accordance with Part 263 of the above reference, Standards Applicable to Transporters of Hazardous Waste.

4.4.3.1 Cleanup of liquid spills. To control the migration of spilled or leaking liquids, dike around the item with an inert, dry absorbent (e.g., clay or vermiculite) or follow installation spill plans (Spill Prevention Control and Countermeasure Plan and Installations Spill Contingency Plan). Control entry to the spill site and segregate salvageable materials away from the spill area. Initiate waste cleanup operations immediately in accordance with local procedures. The residue shall be safely handled and transported to an approved or permitted disposal or storage facility. Packaging, labeling, transportation and record-keeping requirements for this waste material are

determined by the appropriate Federal and State agencies and local procedures. It is recommended that all activities involving disposal preparation and transportation to commercial facilities be properly coordinated with the appropriate Federal and State agencies responsible for health and environmental aspects of hazardous materials. It is imperative that the proper description of waste accompany the packaged item at all times. Final disposal of the waste item shall be accomplished by reutilization, transfer, donation or sales by DRMS in accordance with DOD 4160.21-M or by ultimate disposal as described in 4.4.3.2. Spill residue, including contaminants, to be turned into the DRMO shall first be properly identified, containerized, and labeled. For large scale spills that grossly contaminate the environment, the Chemical Transportation Emergency Center (CHEMTREC) can be called for assistance (1-800-424-9300). Applicable procedures of the local spill control plan shall be followed. Necessary respiratory, eye, and skin protection measures are to be used while performing cleanup operations.

4.4.3.2 Ultimate disposal. Ultimate disposal shall be accomplished at a permitted or approved hazardous waste treatment or disposal facility designated by the Installation Environmental Office, DRMO, or Safety and Health Offices.

4.4.4 DISCLAIMER. RECOMMENDED DISPOSAL INSTRUCTIONS ARE FORMULATED FOR USE BY ELEMENTS OF THE DEPARTMENT OF DEFENSE, THE UNITED STATES OF AMERICA IN NO MANNER WHATSOEVER, EITHER EXPLICITLY OR IMPLICITLY, WARRANTS, STATES, OR INTENDS SAID INSTRUCTION TO HAVE ANY APPLICATION, USE OR VIABILITY BY OR TO ANY PERSON OR PERSONS CONTRACTING OUTSIDE THE DEPARTMENT OF DEFENSE OR ANY PERSON OR PERSONS CONTRACTING WITH ANY INSTRUMENTALITY OF THE UNITED STATES OF AMERICA, AND DISCLAIMS ALL LIABILITY FOR SUCH USE. ANY PERSON USING THESE INSTRUCTIONS WHO IS NOT A MILITARY OR CIVILIAN EMPLOYEE OF THE UNITED STATES OF AMERICA SHOULD SEEK COMPETENT PROFESSIONAL ADVICE TO VERIFY AND ASSUME RESPONSIBILITY FOR THE SUITABILITY OF THESE INSTRUCTIONS TO HIS PARTICULAR SITUATION, REGARDLESS OF SIMILARITY TO A CORRESPONDING DEPARTMENT OF DEFENSE OR OTHER GOVERNMENT SITUATION.

5. DETAILED REQUIREMENTS

- 5.1 Name. STRONTIUM CARBONATE, TECHNICAL SrCO_3 FW 147.63
 Natural strontionite
 CAS 1633-05-2

5.1.1 Technical description. Strontium carbonate (pure) exists as colorless, rhombic crystals or white powder, and it transforms to hexagonal crystals at 926°C. It has a density of 3.70 g/cm³. It loses CO₂ at 1340°C and has a melting point of 1497°C at 69 atmospheres. Its solubility in water is 0.0011 g/100 cm³ at 18°C and 0.065 g/100cm³ at 100°C. It is soluble in solutions of ammonium salts and acids with decomposition.

5.1.2 Specification. Manufacturer's requirements. (No Government specification.)

5.1.3 Requirements. Strontium carbonate, technical, is available commercially with a minimum assay of 92.0%. The typical chemical analysis is shown in Table I.

TABLE I. Strontium carbonate, technical - typical chemical analysis.

Requirement	% by Wt
Assay (SrO_3)	92.34
Barium carbonate (BaCO_3)	1.32
Calcium carbonate (CaCO_3)	3.25
Insoluble in HCl	2.16
Aluminum oxide (Al_2O_3)	None
Moisture	~0.04

5.1.3 Use. Strontium carbonate, technical, is used in pyrotechnics and in the manufacture of iridescent glass.

5.1.4 Safety. Strontium carbonate has a low toxicity and is nonflammable. Overexposure may cause slight irritation of eyes, skin and mucous membranes. Inhalation of dusts or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Strontium carbonate shall be used with adequate ventilation to keep airborne dust at a minimum and below the currently adopted maximum exposure level for nuisance particulates.

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Strontium carbonate is unstable in the presence of strong acids. Upon decomposition, it emits carbon dioxide.

5.1.5 Storage. Strontium carbonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids and acid fumes.

5.1.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2 Name. STRONTIUM CHLORIDE, TECHNICAL SrCl_2 FW 158.52

CAS 10476-85-4

5.2.1 Technical description. Strontium chloride (pure) exists as colorless cubic crystals with a refractive index of 1.650 at 25°C. It effloresces in air and deliquesces in moist air. Its melting point is 868°C and its boiling point is 1250°C. Its solubility in water is 53.8 g/100 cm³ at 20°C and 100.8 g/100 cm³ at 100°C. It is slightly soluble in absolute alcohol and acetone and insoluble in ammonia.

5.2.2 Specification. Manufacturer's requirements. (No Government specification.)

5.2.2.1 Requirements. Strontium chloride, technical, is available commercially with a specification and typical chemical analysis as shown in Table II.

TABLE II. Strontium chloride, technical - specification and typical chemical analysis.

Requirement	% by Wt	
	Specification	Typical Analysis
Assay (as SrCl_2)	95.0	99.8
Ferric oxide (Fe_2O_3)	0.02 max	0.002
Barium chloride (BaCl_2)	0.5 max	0.20
Calcium chloride (CaCl_2)	0.4 max	0.20

5.2.3 Use. Strontium chloride, technical, is used in pyrotechnics and in the manufacture of other strontium salts.

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5.2.4 Safety. Strontium chloride has a low toxicity. It is irritating to the eyes, skin and mucous membranes. Inhalation of dusts or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Strontium chloride shall be used with adequate ventilation.

If heated to decomposition or on contact with acids or acid fumes, strontium chloride can emit toxic chloride fumes.

5.2.5 Storage. Strontium chloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids and acid fumes.

5.2.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.3 Name. STRONTIUM CHLORIDE, HEXAHYDRATE, FW 266.62
 TECHNICAL $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ CAS 10025-70-4

5.3.1 Technical description. Strontium chloride, hexahydrate (pure), exists as colorless, trigonal crystals with a melting point of 115°C and a density of 1.93 g/cm³. It loses four molecules of water at 60°C and six molecules of water at 100°C. Its water solubility is 106.2 g/100 cm³ at 0°C and 205.8 g/100 cm³ at 40°C. Its solubility in alcohol is 3.8 g/100 cm³ at 40°C.

5.3.2 Specification. Manufacturer's requirements. (No Government specification.)

5.3.2.1 Requirements. Strontium chloride, hexahydrate, technical, is available commercially with a typical chemical analysis as shown in Table III.

TABLE III. Strontium chloride, hexahydrate, technical - typical chemical analysis.

Requirement	% by Wt
Assay (as SrCl_2)	95.0
Ferric oxide (Fe_2O_3)	0.02
Barium chloride (BaCl_2)	0.5
Calcium chloride (CaCl_2)	0.4

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5.3.3 Use. Strontium chloride, hexahydrate, technical, is used in pyrotechnics, the manufacture of other strontium salts, in electronic tubes and in the manufacturing of paint and varnish.

5.3.4 Safety. Strontium chloride, hexahydrate, has a low toxicity. It is irritating to the eyes, skin and mucous membranes. Inhalation of dusts or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Strontium chloride, hexahydrate, shall be used with adequate ventilation.

If heated to decomposition or on contact with acids or acid fumes, strontium chloride can emit toxic chloride fumes.

5.3.5 Storage. Strontium chloride, hexahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids and acid fumes.

5.3.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.4	<u>Name</u> . STRONTIUM NITRATE, TECHNICAL	FW 211.63
	Sr(NO ₃) ₂	
		CAS 10042-76-9

5.4.1 Technical description. Strontium nitrate (pure) exists as colorless cubic crystals with a density of 2.986 g/cm³. Its melting point is 570°C. Its solubility in water is 70.9 g/cm³ at 18°C and 100 g/cm³ at 90°C. Its solubility in absolute alcohol is 0.012 g/100 cm³. It is very soluble in NH₃ and slightly soluble in acetone.

5.4.2 Specification. Military, MIL-S-20322, Strontium Nitrate, Anhydrous.

This specification covers two grades of strontium nitrate, technical:

Grade A
Grade B

5.4.2.1 Requirements. The military specification chemical, physical and granulation requirements for strontium nitrate, technical, are shown in Table IV and Table V.

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TABLE IV. Strontium nitrate, technical - chemical and physical requirements.

Requirement	% by Wt	
	Grade A	Grade B
Strontium nitrate (including any barium nitrate), min	99.5	99.5
Moisture, max	0.05	0.05
Hygroscopicity, max	0.05	0.05
Acidity (pH)	6.0 - 7.0	6.0 - 7.0
Water - insoluble matter, max	0.02	0.02
Grit, max	0.02	0.02
Chloride (as Cl), max	0.003	0.003
Ammonium compounds (as NH ₃), max	0.01	0.01
Sulfur (total), max	0.01	0.01
Barium, max	0.05	1.5
Calcium, max	0.003	0.003
Magnesium, max	0.003	0.003
Sodium, max	0.003	0.003
Iron, max	0.003	0.003
Bismuth, max	0.003	0.003
Lead, max	0.003	0.003
Copper, max	0.003	0.003

TABLE V. Strontium nitrate, technical - granulation requirements.

U S Standard Sieve, Retained <u>1/</u>	% by Wt	
	Grade A	Grade B
150 micrometer (No. 100), max	5	--
300 micrometer (No. 50), max		0.1
106 micrometer (No. 140), min	--	70.0

1/ Standard sieve designation in accordance with ASTM E 11 or ASTM E 323 as applicable.

5.4.3 Use. Strontium nitrate, technical, grade A is intended for use in pyrotechnic compositions, such as flares. Grade B is intended for military use in tracer compositions.

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5.4.4 Safety. Strontium nitrate is moderately toxic and a strong oxidizer. It is irritating to the eyes, skin and mucous membranes. Inhalation of dusts or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Strontium nitrate shall be used with adequate ventilation.

If heated to decomposition, strontium nitrate may emit toxic fumes. Strontium nitrate can react with reducing materials.

5.4.5 Storage. Strontium nitrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from heat, sparks, open flame and reducing materials. Protect containers against shock.

5.4.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Strontium nitrate has an EPA Hazardous Waste Classification - Ignitable; Waste Number D001.

5.5 Name. SULFUR MONOCHLORIDE, TECHNICAL S_2Cl_2 FW 135.03
Sulfur chloride
Sulfur subchloride CAS 10025-67-9

5.5.1 Technical description. Sulfur monochloride (pure) exists as a yellowish-red liquid with a penetrating odor and a refractive index of 1.670 at 20°C. Its density is 1.6885 g/cm³ at 15.5°/15.5°C. Its melting point is -77°C and boiling point is 138°C. It is soluble in alcohol, benzene, ether, oils, and carbon disulfide.

5.5.2 Specification. Military, MIL-S-12060, Sulfur Monochloride, Technical (Metric).

5.5.2.1 Requirements. The military specification chemical requirements for sulfur monochloride, technical, are shown in Table VI.

TABLE VI. Sulfur monochloride, technical - chemical requirements.

Requirement	% by Wt
Sulfur content, min	47.0
Chlorine content, min	52.0

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5.5.3 Use. Sulfur monochloride is intended for use in the manufacture of chemical agent. Commercially it is used in the manufacture of sulfur dyes, insecticides and as a polymerization catalyst for vegetable oils.

5.5.4 Safety. Sulfur monochloride is a corrosive, combustible liquid and very irritating to the eyes, skin and mucous membranes. Inhalation of vapors shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Sulfur monochloride shall be used with adequate ventilation to keep airborne concentrations at or below the currently adopted maximum exposure level.

Sulfur monochloride is decomposed by water yielding sulfur, hydrogen sulfide, sulfite and thiosulfate. In acid solution pentathionic and other polythionic acids are formed. If heated to decomposition, sulfur monochloride emits toxic fumes of chloride and sulfur oxides.

5.5.5 Storage. Sulfur monochloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers.

5.5.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Sulfur monochloride has an EPA Hazardous Waste Classification - Corrosive; Waste Number D002.

5.6	<u>Name</u> . TITANIUM TETRACHLORIDE, TECHNICAL	$TiCl_4$	FW 189.71
	Titanic chloride		
	Titanium (IV) chloride		CAS 7550-45-0

5.6.1 Technical description. Titanium tetrachloride (pure) exists as a colorless liquid with a refractive index of 1.61 and a density of 1.730 g/cm³. Its melting point is -25°C and boiling point is 136.4°C. It is soluble in water with hydrolysis, forming hydrochloric acid. It is soluble in alcohol.

5.6.2 Specification. Manufacturer's requirements. (No Government specification.)

5.6.2.1 Requirements. Titanium tetrachloride, technical, is available commercially with the chemical requirement as shown in Table VII.

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TABLE VII. Titanium tetrachloride, technical - chemical requirement.

Requirement	% by Wt
Assay (TiCl ₄), min	95

5.6.2.1.1 Appearance. The material shall be a colorless to reddish-brown liquid, free from sediment.

5.6.2.1.2 Specific gravity. The specific gravity shall not be less than 1.71 or more than 1.74 at 20°/4°C.

5.6.3 Use. Titanium tetrachloride, technical, is intended for use in pyrotechnic compositions. Commercially it is used for the manufacture of iridescent glass and as a polymerization catalyst.

5.6.4 Safety. Titanium tetrachloride is highly toxic and irritating. Inhalation may cause injury to the upper respiratory tract and acute bronchitis. Skin exposure may cause irritation and burns, and even brief contact with the eyes may cause conjunctivitis and keratitis followed by clouding of the cornea. Inhalation of titanium tetrachloride vapors or mists shall be avoided. Titanium tetrachloride shall be used with adequate ventilation.

Titanium tetrachloride reacts violently with water with the evolution of heat. It fumes strongly when exposed to moist air, forming a dense and persistent white cloud.

5.6.5 Storage. Titanium tetrachloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers.

5.6.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Titanium tetrachloride has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002; Reactive, Waste Number D003.

5.7 Name. TITANIUM TRICHLORIDE, TECHNICAL TiCl₃ FW 154.26
Titanous chloride
Titanium (III) chloride CAS 7705-07-9

5.7.1 Technical description. Titanium trichloride (pure) exists as dark violet, deliquescent crystals with a density of 2.640 g/cm³. It decomposes at 440°C. It is

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soluble in cold and hot water with hydrolysis and the evolution of heat. It is soluble in cold and hot water with hydrolysis and the evolution of heat. It is soluble in alcohol and slightly soluble in chloroform. It is insoluble in ether and hydrocarbons.

5.7.2 Specification. Manufacturer's requirements. (No Government specification.)

5.7.2.1 Requirements. Titanium trichloride, technical, is usually available commercially as a solution. It is available from one supplier as a 13% solution in approximately 20% hydrochloric acid with a density of 1.199 g/cm³ at 20°/4°C. It is also available as 20% solution (by weight) in aqueous hydrochloric acid.

5.7.3 Use. Titanium trichloride, technical, is used as a reducing agent and as a cocatalyst in the polymerization of polyolefins. It is also used to remove stains, etc. (stripper) in laundering.

5.7.4 Safety. Titanium trichloride in solution is a strong reducing agent and corrosive. The solid titanium trichloride is flammable. Inhalation of dusts or mists may cause injury to the upper respiratory tract and acute bronchitis. Skin exposure to the solid or solution may cause irritation and burns, and even brief contact with the eyes may cause conjunctivitis followed by clouding of the cornea. Inhalation of titanium trichloride dust or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Titanium trichloride shall be used with adequate ventilation.

Titanium trichloride decomposes in the presence of air and water with the evolution of heat. It is a fire risk in the presence of oxidizing materials.

5.7.5 Storage. Titanium trichloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from oxidizing materials.

5.7.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Titanium trichloride has an EPA Hazardous Waste Classification -Corrosive, Waste Number D002.

5.8	<u>Name</u> . TITANOUS SULFATE SOLUTION, 20 PERCENT, TECHNICAL $Ti_2(SO_4)_3$ Titanium sesquisulfate	FW 383.98 CAS 10343-61-0
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5.8.1 Technical description. Titanous sulfate (pure) exists as a green crystalline powder which is insoluble in cold or hot water, alcohol, ether, or concentrated sulfuric acid. It is soluble in dilute hydrochloric or sulfuric acid.

5.8.2 Specification. Military, MIL-T-50059, Titanous Sulfate Solution, 20 Percent (Metric).

5.8.2.1 Requirements. The military specification chemical requirement for titanous sulfate solution, 20 percent, is shown in Table VIII.

TABLE VIII. Titanous sulfate solution, 20 percent - chemical requirement.

Requirement	% by Wt
Assay ($Ti_2(SO_4)_3$), min-max	19 - 22

5.8.2.1.1 Stabilizer. Titanous sulfate solution shall contain sufficient stabilizer (citric acid or sodium citrate) to prevent hydrolysis of the titanous sulfate when diluted for use.

5.8.3 Use. Titanous sulfate solution is intended for use as a stripping agent in laundries.

5.8.4 Safety. Titanous sulfate solution is a strong reducing agent and corrosive. It is irritating to the eyes, skin and mucous membranes. Inhalation of vapor or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Titanous sulfate solution shall be used with adequate ventilation.

Titanous sulfate can react with oxidizing materials.

5.8.5 Storage. Titanous sulfate solution shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from oxidizing materials.

5.8.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Titanous sulfate solution has an EPA Hazardous Waste Classification of Corrosive, Waste Number D002.

5.9 Name. ZINC BORATE, TECHNICAL $3ZnO \cdot 2B_2O_3$ FW 383.35

CAS 1332-07-6

5.9.1 Technical description. Zinc borate (pure) exists as white triclinic crystals or amorphous powder. The crystals have a density of 4.22 g/cm³ and the powder has a density of 3.64 g/cm³. Its melting point is 980°C. It is soluble in cold water. The crystalline form is insoluble in hydrochloric acid; the amorphous form is soluble in hydrochloric acid.

5.9.2 Specification. Military, MIL-Z-12063, Zinc Borate, Technical (Metric).

5.9.2.1 Requirements. The military specification chemical requirements for zinc borate, technical, are shown in Table IX. The granulation requirements are shown in Table X.

TABLE IX. Zinc borate, technical - chemical requirements.

Requirement	% by Wt	
	Min	Max
Zinc (as ZnO)	---	46.0
Boron (as B ₂ O ₃)	32.0	---
Loss in weight at 110°C	---	0.5
Loss in weight at 600°C	21.0	---
Sulfur (as SO ₃)	---	0.5

TABLE X. Zinc borate, technical - granulation requirements.

Granulation <u>1/</u>	% by Wt
Retained on 53 micrometer sieve (No. 270)	0.5
Retained on 45 micrometer sieve (No. 325)	1.0

1/ Sieve designation in accordance with ASTM E 11 or ASTM E 323 as applicable.

5.9.3 Use. Zinc borate, technical, is intended for use in smoke mixtures. Commercially it is used in fireproofing textiles, and as a fungistat and mildew inhibitor.

5.9.4 Safety. Zinc borate is nonflammable and has a low toxicity. It presents little immediate health hazard. It may cause some irritation to the eyes. Zinc borate shall be used with ordinary precautions and cleanliness. Zinc borate shall be used with adequate ventilation.

If heated to decomposition, zinc borate may emit toxic fumes.

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5.9.5 Storage. Zinc borate shall be stored in a cool, dry, well-ventilated place in tightly closed containers.

5.9.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Zinc borate has been designated by the EPA as a hazardous material.

5.10 Name. ZINC CARBONATE, BASIC, TECHNICAL $ZnCO_3$ FW 125.38
Zinc hydroxide carbonate

CAS 3486-35-9

5.10.1 Technical description. No technical description available due to variability in composition of the ratio of $ZnCO_3$ to $Zn(OH)_2$.

5.10.2 Specification. Military, MIL-Z-12061, Zinc Carbonate, Basic, Technical.

5.10.2.1 Requirements. The military specification chemical requirements for zinc carbonate, basic, technical, are shown in Table XI. The granulation requirement is shown in Table XII.

TABLE XI. Zinc carbonate, basic, technical - chemical requirements.

Requirement	% by Wt	
	Min	Max
Assay (as Zn)	54.0	64.0
Loss on ignition	20.0	28.0
Soluble alkali (as Na_2CO_3)	---	0.25
Cadmium (Cd)	---	0.10
Water (uncombined)	---	3.0

TABLE XII. Zinc carbonate, basic, technical - granulation requirements.

Granulation <u>1/</u>	% by Wt
Retained on 45 micrometer sieve (No. 325)	1.0

1/ Sieve designation in accordance with ASTM E 11 or ASTM E 323 as applicable.

5.10.2.1.1 Appearance. Zinc carbonate, basic, technical, shall be free from large lumps, cakes or agglomerates.

5.10.3 Use. Zinc carbonate, basic, technical, is intended for use in the manufacture of smoke mixtures.

5.10.4 Safety. Zinc carbonate, basic, has a low toxicity. It presents little immediate health hazard. It may cause some irritation to the upper respiratory system. Zinc carbonate, basic, shall be used with ordinary precautions and cleanliness. Zinc carbonate, basic, shall be used with adequate ventilation.

If heated to decomposition, zinc carbonate, basic, may emit irritating fumes.

5.10.5 Storage. Zinc carbonate, basic, shall be stored in a cool, dry, well-ventilated place in tightly closed containers.

5.10.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Zinc carbonate has been designated by the EPA as a hazardous material.

5.11 Name. ZINC CHLORIDE, TECHNICAL $ZnCl_2$ FW 136.28
Butter of zinc CAS 7646-85-7

5.11.1 Technical description. Zinc chloride (pure) exists as white hexagonal, deliquescent crystals with a density of 2.907 g/cm^3 at 25°C . Its melting point is 283°C and boiling point is 732°C . Its solubility in water is 432 g/100 cm^3 at 25°C and 615 g/100 cm^3 at 100°C . It is soluble in alcohol and ether and insoluble in ammonia.

5.11.2 Specification. Manufacturer's requirements. (No Government specification.)

5.11.2.1 Requirements. Zinc chloride, technical, is available commercially with a zinc chloride content as shown in Table XIII.

TABLE XIII. Zinc chloride, technical - chemical requirement.

Requirement	% by Wt
Assay ($ZnCl_2$), min	94

5.11.3 Use. Zinc chloride, technical, is used as a catalyst, a dehydrating and condensing agent in organic synthesis, in soldering fluxes, and in burnishing and polishing compounds for steel and electroplating.

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5.11.4 Safety. Zinc chloride is a corrosive material. It is irritating to the eyes, skin and mucous membranes. Inhalation of dusts shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Zinc chloride shall be used with adequate ventilation. Solutions of zinc chloride are also irritating to the eyes and skin. Inhalation of mist is irritating to the respiratory tract. The degree of irritation is dependent upon the concentration of the solution and the length of exposure. Airborne concentrations of zinc chloride fumes will be kept at or below the currently adopted maximum exposure level.

If heated to decomposition or on contact with acids or acid fumes, zinc chloride can emit irritating and toxic fumes.

5.11.5 Storage. Zinc chloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids and acid fumes.

5.11.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Zinc chloride has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.12 Name. ZINC PHOSPHIDE, TECHNICAL Zn_3P_2 FW 258.06
CAS 1314-84-7

5.12.1 Technical description. Zinc phosphide (pure) exists as dark gray, tetragonal crystals with a density of 4.55 g/cm^3 at 18°C . Its melting point is $>420^\circ\text{C}$ and boiling point is 1100°C . When strongly heated with the exclusion of air it melts and finally sublimes. It is insoluble in water and alcohol and soluble in HCl and H_2SO_4 , with evolution of spontaneously flammable phosphine. When kept dry it is quite stable.

5.12.2 Specification. Manufacturer's requirements. (No Government specification.)

5.12.2.1 Requirements. Zinc phosphide, technical, is commercially available with specifications and typical chemical analysis as shown in Table XIV. The granulation requirements are shown in Table XV.

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TABLE XIV. Zinc phosphide, technical - specification and typical chemical analysis.

Requirement	% by Wt	
	Specification	Typical Analysis
Zinc phosphide (Zn_3P_2) Insoluble in HCl	94.0 min 2.0 max	95.0 0.8

TABLE XV. Zinc phosphide, technical - granulation requirements.

Granulation Requirement <u>1/</u>	% by Wt	
	Max	Min
Retained on 150 micrometer sieve (No. 100)	0.5	0.2
Retained on 45 micrometer sieve (No. 325)	99.2	98.0

1/ Sieve designation in accordance with ASTM E 11 or ASTM E 323 as applicable.

5.12.3 Use. Zinc phosphide, technical, is used as a source for generation of phosphine gas by reaction with acids. It is also used in the manufacture of bait formulations for rodent control.

5.12.4 Safety. Zinc phosphide is toxic and irritating to the eyes, skin and respiratory system. Contact with the eyes, skin and clothing shall be avoided. Zinc phosphide shall be used with adequate ventilation.

Zinc phosphide reacts violently with oxidizing agents. It produces toxic and flammable phosphine by reaction with water and acids. When heated, zinc phosphide may emit toxic oxides of phosphorous fumes. Do not re-use container. Completely empty the container and rinse several times with clean water.

5.12.5 Storage. Zinc phosphide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids and acid fumes and oxidizing materials.

5.12.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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Zinc phosphide has the following EPA Hazardous Waste Classifications - Zinc phosphide, Acute Hazardous Toxic (when present at concentrations greater than 10%), Waste Number P122; zinc phosphide, Toxic (when present at concentrations of 10% or less), Waste Number U249.

5.13 Name. ZIRCONIUM CARBIDE, POWDERED,
TECHNICAL ZrC

FW 103.23

CAS 12070-14-3

5.13.1 Technical description. Zirconium carbide (pure) exists as gray metallic cubic crystals with a density of 6.730 g/cm³. Its melting point is 3540°C and boiling point is 5100°C. It is insoluble in water and slightly soluble in concentrated sulfuric acid.

5.13.2 Specification. Military, MIL-Z-82674, Zirconium Carbide, Powdered, Technical.

5.13.2.1 Requirements. The military specification chemical requirements are shown in Table XVI. The physical requirements are shown in Table XVII.

TABLE XVI. Zirconium carbide, powdered, technical - chemical requirements.

Requirement	Min	Max
Zirconium (Zr plus Hf)	87.4	88.5
Hafnium (Hf)	---	2.0
Total carbon (C)	10.8	11.9
Free carbon (C)	---	1.5
Iron (Fe)	---	0.05
Oxygen (O)	---	0.6
Nitrogen (N)	---	0.8

TABLE XVII. Zirconium carbide, powdered, technical - physical properties.

Requirement	Min	Max
Apparent density, g/cm ³	1.46	1.83
Average particle diameter, micrometer	1.5	3.0
Volatiles content, % by wt	---	0.10

5.13.3 Use. Zirconium carbide, powdered, technical, is intended for use as a propellant ingredient for the Mark 56 Mod 2 Dual Thrust Rocket Motor.

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5.13.4 Safety. Zirconium carbide, powdered, may be irritating to the eyes, skin and mucous membranes. Inhalation of dust or powder shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Zirconium carbide shall be used with adequate ventilation to keep airborne concentrations at or below the currently adopted maximum exposure level for zirconium compounds.

Zirconium carbide, powdered, will react with oxidizers. Zirconium carbide powder or dust will ignite spontaneously.

5.13.5 Storage. Zirconium carbide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from oxidizing materials.

5.13.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Zirconium carbide, powdered, has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001; Reactive, Waste Number D003.

5.14 Name. ZIRCONIUM CARBIDE, TECHNICAL ZrC FW 103.23

CAS 12070-14-3

5.14.1 Technical description. Zirconium carbide (pure) exists as gray metallic cubic crystals with a density of 6.730 g/cm³. Its melting point is 3540°C and boiling point is 5100°C. It is insoluble in water and slightly soluble in concentrated sulfuric acid.

5.14.2 Specification. Military, MIL-Z-85500, Zirconium Carbide.

5.14.2.1 Requirements. The military specification chemical and physical requirements are shown in Table XVIII.

TABLE XVIII. Zirconium carbide, technical - chemical and physical requirements.

Requirement	Min	Max
Weight median diameter, micrometers 1/ Fisher average particle diameter, micrometers	6.0	10.0
Zirconium plus hafnium, % by wt	2.0	5.0
Hafnium (Hf), % by wt	87.9	--
Total carbon, % by wt wt	--	2.0
	11.3	--

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TABLE XVIII. Zirconium carbide, technical - chemical and physical requirements (continued).

Requirement	Min	Max
Free carbon, % by wt	--	0.5
Iron (Fe), % by wt	--	0.05
Oxygen (O)	--	0.6
Nitrogen (N)	--	0.8

1/ MSA analysis (Mine Safety Appliance Company, Pittsburgh, PA).

5.14.2.1.1 Stability. The zirconium carbide (when protected from contamination) shall have a storage life of 18 months from date of delivery to the procuring activity.

5.14.2.1.2 Storage life extension. The storage life of an individual lot may be extended for an additional 18 months provided the zirconium carbide, upon retest, successfully meets the requirement for weight mean diameter.

5.14.2.1.3 Workmanship. Workmanship shall be such that the zirconium carbide is uniform in appearance, of consistent high quality and free from visible contamination.

5.14.3 Use. Zirconium carbide, technical, is intended for use as an ingredient in solid propellant formulations for rocket motors.

5.14.4 Safety. Zirconium carbide may be irritating to the eyes, skin and mucous membranes. Inhalation of dust or powder shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Zirconium carbide shall be used with adequate ventilation to keep airborne concentrations at or below the currently adopted maximum exposure level for zirconium compounds. Zirconium carbide may be irritating to the eyes, skin and mucous membranes. If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately. If this chemical contacts the skin, wash with soap and water. If a person breathes in a large amount of this chemical, move the exposed person to fresh air at once and perform artificial respiration and seek medical attention.

Zirconium carbide will react with oxidizers. Zirconium carbide powder or dust will ignite spontaneously.

5.14.5 Storage. Zirconium carbide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from oxidizing materials.

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5.14.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Zirconium carbide has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001; Reactive, Waste Number D003.

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6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard is intended to cite nomenclature, Chemical Abstracts Services registry numbers, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for Inorganic Salts and Compounds, Technical Grade (Strontium Carbonate through Zirconium Carbide) preferred for application by the Department of Defense.

6.2 Subject term (key word) listing.

Exposure limits, hazardous chemicals
 Hazardous wastes, disposal and storage of
 Information, hazardous chemicals
 Safety, hazardous chemicals
 Strontium Carbonate, Technical
 Strontium Chloride, Hexahydrate, Technical
 Strontium Chloride, Technical
 Strontium Nitrate, Technical
 Sulfur Monochloride, Technical
 Titanium Tetrachloride, Technical
 Titanium Trichloride, Technical
 Titanous Sulfate Solution, 20 Percent, Technical
 Zinc Borate, Technical
 Zinc Carbonate, Basic, Technical
 Zinc Chloride, Technical
 Zinc Phosphide, Technical
 Zirconium Carbide, Powdered, Technical
 Zirconium Carbide, Technical

6.3 Changes from previous issue. Asterisks or vertical lines are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

MIL-STD-1209B

Project Number 6810-1291

Custodians:

Army - EA
Navy - SH
Air Force - 68

Preparing Activity

Army - EA

Review activities:

Army- AR, MD, SM
Navy- SH
DLA - DP, GS

User activities:

Army - ME
Navy - MS, OS

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-1209B	2. DOCUMENT DATE (YYMMDD) 930623
3. DOCUMENT TITLE INORGANIC SALTS AND COMPOUNDS, TECHNICAL GRADE (STRONTIUM CARBONATE THROUGH ZIRCONIUM CARBIDE)		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (if applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME U.S. Army Edgewood Research, Development and Engineering Center	b. TELEPHONE (Include Area Code) (1) Commercial (410) 671-3259	(2) AUTOVON DSN 584-3259
c. ADDRESS (Include Zip Code) Tech Dir, U.S. Army ERDEC ATTN: SCBRD-ENE-S (Std/Specs/Pkg) Aberdeen Proving Ground, MD 21010-5423	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	