

INCH-POUND

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MILITARY STANDARD  
INORGANIC SALTS AND COMPOUNDS, TECHNICAL GRADE  
(CADMIUM CARBONATE THROUGH CUPRIC SULFATE)



AMSC N/A

FSC 6810

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MIL-STD-1204C

DEPARTMENT OF DEFENSE  
Washington, DC 20301

Inorganic Salts and Compounds, Technical Grade  
(Cadmium Carbonate through Cupric Sulfate)

MIL-STD-1204C

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 Chemical Research, Development and Engineering Center, Attn: SMCCR-SPD-TS, 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.

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F O R E W A R D

This military 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, 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 (cadmium carbonate through cupric sulfate). 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 (cadmium carbonate through cupric sulfate) for application by the Department of Defense.

1.2 Application. Inorganic salts and compounds, technical grade (cadmium carbonate through cupric sulfate) are used in synthesis and pyrotechnics and as neutralizing agents, desiccating agents, clarifying agents and as pigments and corrosion inhibitors.

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. REFERENCED DOCUMENTS

2.1 Government Documents.

2.1.1 Specifications, Standards, and Handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

## SPECIFICATIONS

## FEDERAL

A-A-169	Calcium Chloride, Technical
O-C-101	Calcium Carbide
O-C-105	Calcium Chloride, Dihydrate and Calcium Chloride, Anhydrous Technical
O-C-110	Calcium Hydroxide
O-C-114	Calcium Hypochlorite, Technical
O-C-303	Chromium Trioxide, Technical
O-C-828	Cupric Sulfate, Pentahydrate, Technical
RR-S-366	Sieve, Test
PPP-C-2020	Chemicals, Liquid, Dry and Paste, Packaging of

## MILITARY

MIL-C-293	Calcium Carbonate
MIL-C-324	Calcium Silicide, Technical
MIL-C-3539	Calcium Phosphide
MIL-C-12056	Calcium Oxide (Metric)
MIL-C-14264	Calcium Phosphate, Tribasic, Technical
MIL-C-48038	Calcium Chromate, Technical
MIL-C-48344	Gypsum, Dead Burned
MIL-C-51067	Calcium Magnesium Carbonate, Technical (Metric)
MIL-C-51077	Calcium Silicate, Technical
MIL-C-51264	Cuprous Cyanide, Technical
MIL-C-51407	Chlorinated Lime, Technical
MIL-C-51511	Calcium Chloride, Technical

## STANDARDS

## FEDERAL

FED-STD-313	Material Safety Data Sheets, Preparation and the Submission of
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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 standard to the extent specified herein.



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## PUBLIC LAW

PL 94-580 Resource Conservation and Recovery Act (Title 94)

## CODE OF FEDERAL REGULATIONS (CFR)

Title 29 Department of Labor, Occupational Safety and Health  
Administration  
Title 40 Protection of the Environment; Environmental Protec-  
tion Agency  
Title 49 Department of Transportation; Hazardous Materials  
Regulations

## DEPARTMENT OF DEFENSE (DOD)

DOD 4145.19-R-1 Storage and Materials Handling  
DOD 4160.21-M Defense Utilization and Disposal Manual  
DOD 6050.5 DOD Hazardous Materials Information System, Hazardous  
Item Listing  
TB MED 502 Occupational and Environmental Health Respiratory  
(DLAM 1000.2) Protection Program  
TB MED 506 Occupational and Environmental Health Occupational  
Vision  
TM 38-250 Packaging, Materials Handling - Preparation of  
Hazardous Materials for Military Air Shipment

## 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 Other Publications. The following document(s) form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of DODISS specified in the solicitation. The issues of documents which have not been adopted shall be those in effect on the date of the cited DODISS.

## AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH)

TLVs\* Threshold Limit Values for Chemical Substances in the Work Environ-  
ment Adopted by American Conference of Government Industrial Hygienists (ACGIH)  
with Intended Changes.

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

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AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM D 1199            Standard Specification for Calcium Carbonate, Pigments  
ASTM E 11             Standard Specification For Wire-Cloth Sieves For  
                         Testing Purposes

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

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.)

(Nongovernment standards are generally available for reference from libraries. They are also distributed among nongovernment standards bodies and using Federal agencies.)

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 (Not applicable)

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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 a 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 of FED-STD-313; and shall comply with 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) for the compounds being used, may be employed for intermittent exposure or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation shall be adequate to remove hazardous concentrations.

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 be of value in certain cases. However, barrier creams shall not be used to replace protective clothing. In case of contact with the skin, wash affected areas thoroughly with water. Eye lavages and emergency showers shall be located within 50 feet of where there is a potential for direct contact with harmful chemicals. When transferring chemicals, eye lavages and emergency showers shall be within 50 feet of the transfer point. Emergency showers shall be equipped with a valve that will fully open with one pull and deliver 30 gallons of water per minute.

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 MSDS on all chemical items in their work area, in accor-

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dance with 29 CFR 1910.1200(h), 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 Exercise. 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 100°F (37.8°C). A combustible liquid is defined, by DOT in the above reference, as one having a closed cup flash point at or above 100°F and below 200°F (93.3°C). A pyrophoric liquid is defined, by DOT in the above reference, as one that ignites spontaneously in dry or moist air at or below 130°F (54.4°C). Materials with flash points of 200°F or higher are not considered to be nonflammable or noncombustible, but are to be considered as burnable. The Environmental Protection Agency (EPA), in Part 261, Subpart C, Section 261.21 of 40 CFR (refers only to materials that have become waste materials), 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 140°F (60°C) 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. (Refers only to materials that have become waste materials.) 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, and separated from other storage areas.

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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 Threshold Limit Values for Chemical Substances in the Work Environment, adopted by the American Conference of Government Industrial Hygienists (ACGIH); current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), 29 CFR, Section 1910.1000; and NIOSH Recommendation for Environmental Exposure Limits. Such information is also shown in MSDSs and the HMIS referred to in 4.2. Carcinogenic substances are listed by OSHA in Category I for confirmed carcinogens, and in Category II for suspected carcinogens. Category I substances have standard exposure limits set at the lowest possible levels. Category II substances have standard exposure limits set to prevent acute or chronic effects.

4.3.4 Toxicity. Toxicity information for chemical compounds is available from various publications and from MSDSs, which are collected in DOD 6050.5 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 261.119(a)(3) of 40 CFR. (Refers only to materials that have become waste materials.) 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 acute hazardous (H) in toxicity in accordance with the criteria shown in Subpart B, Section 261.11(a)(2) of the above reference. (Refers only to materials that have become waste materials.) Some commercial chemical products are listed as acute hazardous in toxicity under Subpart D, Section 261.33(e).

#### 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 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 EP toxic) or are listed



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(i.e., toxic or acute 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 4.4.3.4.2, 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 shall 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, sawdust or vermiculite) or follow installations 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 in to 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. 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.

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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 THEIR PARTICULAR SITUATION REGARDLESS OF SIMILARITY TO A CORRESPONDING DEPARTMENT OF DEFENSE OR OTHER GOVERNMENT SITUATION.



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## 5. DETAILED REQUIREMENTS

5.1 Name. Cadmium Carbonate, Technical CdCO<sub>3</sub> FW 172.41

5.1.1 Technical Description. Cadmium carbonate (pure) exists as white trigonal crystals with a density of 4.258 g/cm<sup>3</sup> at 4°C. It decomposes at <500°C. It is insoluble to hot and cold water. It is soluble in ammonium salts and insoluble in ammonia.

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

5.1.2.1 Requirements. Cadmium carbonate, technical is available commercially with specification requirements as shown in Table I.

TABLE I. Cadmium carbonate, technical - manufacturer's specification requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Cadmium (Cd)	62.0	---
Iron (Fe)	---	0.01
Copper (Cu)	---	0.01
Zinc (Zn)	---	0.05
Lead (Pb)	---	0.05
Sulfate (SO <sub>4</sub> )	---	0.25
Insoluble in dilute HCl	---	0.1

5.1.3 Use. Cadmium carbonate, technical is used in the preparation of other cadmium salts.

5.1.4 Safety. Cadmium carbonate is highly toxic and irritating to the eyes, skin, upper respiratory tract and mucous membranes. Excessive inhalation of cadmium compounds may, after several hours, cause coughing, chest pain, sweating, chills, shortness of breath and possible death due to pulmonary edema. Prolonged exposure to cadmium compounds may cause kidney damage. Contact with eyes, skin and clothing shall be avoided. Cadmium carbonate shall be used with adequate ventilation. Avoid generating dust. Wash thoroughly after handling. Cadmium and its compounds are carcinogenic. The TLV for cadmium dusts and salts, as Cd, is 0.05 mg/m<sup>3</sup>. (Refer to 4.3.1)

On contact with strong acids, cadmium carbonate evolves CO<sub>2</sub>.

5.1.5 Storage. Cadmium carbonate shall be stored in a cool, well ventilated place in tightly closed containers. (Refer to 4.3.2)

5.1.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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Cadmium carbonate has an EPA Hazardous Waste Classification - EP Toxic, Waste Number D006.

5.2 Name. Cadmium Nitrate, Tetrahydrate, Technical  
 $\text{Cd}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  FW 308.47

5.2.1 Technical Description. Cadmium nitrate (pure) exists as white hygroscopic prisms or needles with a density of 2.455 g/cm<sup>3</sup> at 17°/4°C. Its melting point is 59.4°C and boiling point is 132°C. Its solubility in cold water is 215 g/100 cm<sup>3</sup>. It is soluble in ammonia and alcohol and insoluble in nitric acid.

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

5.2.2.1 Requirements. Cadmium nitrate, tetrahydrate, technical is available commercially with manufacturer's specification requirements as shown in Table II.

TABLE II. Cadmium nitrate, tetrahydrate, technical - manufacturer's specification requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Cadmium (Cd)	36.0	---
Iron (Fe)	---	0.002
Copper (Cu)	---	0.005
Lead (Pb)	---	0.005
Zinc (Zn)	---	0.05
Chloride (Cl)	---	0.005
Sulfate (SO <sub>4</sub> )	---	0.005

5.2.3 Use. Cadmium nitrate, tetrahydrate, technical is used in the preparation of other cadmium salts.

5.2.4 Safety. Cadmium nitrate, tetrahydrate is an oxidizer and highly toxic by inhalation and skin absorption. It is irritating to the eyes, skin, upper respiratory tract and mucous membranes. It may also cause burns to the eyes and skin. Excessive inhalation of cadmium compounds may, after several hours, cause coughing, chest pain, sweating, chills, shortness of breath and possible death due to pulmonary edema. Prolonged exposure to cadmium compounds may cause kidney damage. Inhalation of dusts and mists shall be avoided. Contact with eyes, skin and clothing shall be avoided. Cadmium nitrate, tetrahydrate shall be used with adequate ventilation. Avoid generating dust. Wash thoroughly after handling. Cadmium and its compounds are carcinogenic. The TLV for cadmium dusts and salts, as Cd, is 0.05 mg/m<sup>3</sup>. (Refer to 4.3.1)

If heated to decomposition, cadmium nitrate, tetrahydrate may evolve toxic oxides of nitrogen.

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5.2.5 Storage. Cadmium nitrate, tetrahydrate shall be stored in a cool, dry, well ventilated place in tightly closed containers away from sources of heat, open flame and combustible and oxidizable materials. (Refer to 4.3.2)

5.2.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Cadmium nitrate has an EPA Hazardous Waste Classification - EP Toxic, Waste Number D006.

5.3 Name. Calcium Carbide, Technical CaC<sub>2</sub> FW 64.10  
Acetylenogen

5.3.1 Technical Description. Calcium carbide (pure) exists as colorless, tetragonal crystals with a refractive index of 1.75 and a density of 2.22 g/cm<sup>3</sup>. Its melting point is 2300°C. It is decomposed by cold or hot water.

5.3.2 Specification. Federal, O-C-101, Calcium Carbide.

5.3.2.1 Requirements. The Federal Specification requirements for calcium carbide are shown in Table III.

TABLE III. Calcium carbide - federal specification requirements.

Size Designation	Pass through sieve with square openings <sup>1/</sup>	Retained on sieve with square openings <sup>1/</sup>	Volumes of acetylene gas <sup>2/</sup> evolved per pound at 60°F (15.56°C) and 30 inches (760 mm) barometric pressure
	Inches	Inches	Avg. ft <sup>3</sup> /lb., min
Lump	4.24	1.50	4.5
Egg	2.00	0.375	4.5
Nut	1.06	0.250	4.5
1/2 by 1/4 <sup>3/</sup>	<sup>3/</sup>	<sup>4/</sup>	4.5
1/4 by 1/12	<sup>5/</sup>	<sup>5/</sup>	4.5
Rice	0.132	0.0331	4.3
14 ND	0.0661	0.0165	4.3

<sup>1/</sup>For all sizes except the 1/2 by 1/4 size and the 1/4 by 1/12 size, not more than 5 percent, by weight of calcium carbide other than the nominal size shall be present.

<sup>2/</sup>The evolved acetylene gas produced from the carbide shall contain not more than 0.05 percent, by volume, of phosphine (PH<sub>3</sub>).

<sup>3/</sup>The 1/2 by 1/4 size designation is also known as Miner's Lamp, and Miner's Special.

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<sup>4</sup>The 1/2 by 1/4 size carbide shall conform to the following granulation:

<u>Through Sieve With Square Openings:</u>		<u>Min</u>	<u>Max</u>
<u>Millimeter</u>	<u>(Inches)</u>	<u>% By Wt</u>	<u>% By Wt</u>
12.5	(0.500)	100	---
9.5	(0.375)	---	95
6.3	(0.250)	---	50
2.36	(0.0937)	---	5

<sup>5</sup>The 1/4 by 1/12 size carbide shall conform to the following granulation:

<u>Through Sieve With Square Openings:</u>		<u>Min</u>	<u>Max</u>
<u>Millimeter</u>	<u>(Inches)</u>	<u>% By Wt</u>	<u>% By Wt</u>
6.7	(0.265)	100	---
2.36	(0.0937)	---	25
1.70	(0.0661)	---	7
1.40	(0.0555)	---	2

5.3.3 Use. Calcium carbide is used in pyrotechnics. It is also used in the generation of acetylene gas and the manufacture of lampblack and cyanamide.

5.3.4 Safety. Calcium carbide is irritating to the eyes, skin and mucous membranes. Inhalation of dust shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Calcium carbide shall be used with adequate ventilation. There is no TLV or PEL referenced for calcium carbide. (Refer to 4.3.1)

Calcium carbide is nonflammable in the dry state but may generate enough heat on contact with small amounts of water to ignite the acetylene gas formed. Acetylene forms an explosive mixture in air. Acetylene is considered a simple asphyxiant. In the course of decomposition into acetylene, the contaminated impurities may evolve highly toxic phosphine. The TLV for phosphine is 0.3 ppm (0.4 mg/m<sup>3</sup>). The PEL is the same.

5.3.5 Storage. Calcium carbide shall be stored in a cool, dry, well ventilated place in tightly closed containers away from sources of water, ignition, combustible solids, corrosive substances, organic peroxides and strong oxidizing agents. Protect containers against physical damage. (Refer to 4.3.2)

5.3.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

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5.4 Name. Calcium Carbonate, Technical CaCO<sub>3</sub> FW 100.09  
 Natural aragonite  
 Natural calcite

5.4.1 Technical Description. Calcium carbonate (natural aragonite)(pure) exists as colorless, rhombic crystals with refractive indices of 1.530, 1.681 and 1.685 and a density of 2.930 g/cm<sup>3</sup>. Its transition temperature to calcite is 520°C. It decomposes at 825°C. Its solubility in water is 0.00153 g/100 cm<sup>3</sup> at 25°C and 0.00190 g/cm<sup>3</sup> at 75°C. It is soluble in NH<sub>4</sub>Cl.

Calcium carbonate (natural calcite)(pure) exists as colorless, rhombic or hexagonal crystals with refractive indices of 1.6583 and 1.4864 and a density of 2.710 g/cm<sup>3</sup>. Its melting point is 1339°C at 103 atmospheres. It decomposes at 898.6°C. Its solubility in water is 0.0014 g/cm<sup>3</sup> at 25°C and 0.0018 g/cm<sup>3</sup> at 75°C. It is soluble in NH<sub>4</sub>Cl.

5.4.2 Specification. Military, MIL-C-293, Calcium Carbonate, ASTM D-1199, Calcium Carbonate, Pigment.

5.4.2.1 Requirements.

5.4.2.1.1 Material. The material shall be commercial whiting, either ground limestone or precipitated chalk, of light density and fine particles size.

5.4.2.1.2 Apparent Density. The apparent density of the calcium carbonate shall be 0.40 g/cm<sup>3</sup> minimum.

5.4.2.1.3 Granulation. The material shall be free from hard lumps, cakes, or agglomerates, and shall be in such a state of subdivision that no more than 0.3 percent by weight shall be retained on a 325 U.S. standard sieve conforming to RR-S-366 and ASTM E 11.

5.4.2.1.4 Average Particle Size. The average particle size shall not be greater than 3.00 microns. The Military Specification chemical requirements for calcium carbonate, technical are shown in Table IV.

TABLE IV. Calcium carbonate, technical - chemical requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Calcium carbonate	98.0	---
Moisture	---	0.20
Iron oxide plus aluminum oxide	---	0.70

5.4.3 Use. Calcium carbonate is intended to be used in small arms propellants and pyrotechnic mixtures for cartridges not exceeding 20 mm, and for

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impregnation of protective clothing. It is also used in synthesis, as an intermediate, neutralizing agent and the preparation of carbon dioxide.

5.4.4 Safety. Calcium carbonate is nonflammable and nontoxic. Normal laboratory safety precautions are required when handling calcium carbonate. Calcium carbonate is considered a nuisance particulate with a TLV of 10 mg/m<sup>3</sup> of total dust. Calcium carbonate shall be used with adequate ventilation. (Refer to 4.3.1).

Calcium carbonate reacts with acids to evolve carbon dioxide.

5.4.5 Storage. Calcium carbonate shall be stored in a cool, dry place in tightly closed containers away from acids. (Refer to 4.3.2)

5.4.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.5 <u>Name</u> . Calcium Chloride, Technical	CaCl <sub>2</sub>	FW 110.99
	CaCl <sub>2</sub> ·2H <sub>2</sub> O	FW 147.02

NOTE: Calcium chloride, technical exists as the anhydrous form and several hydrated forms.

5.5.1 Technical Description. Calcium chloride, anhydrous (pure) exists as colorless, cubic, deliquescent crystals with a refractive index of 1.52 and a density of 2.15 g/cm<sup>3</sup> at 25/4°C. Its melting point is 782°C and boiling point is >1600°C. Its solubility in water is 74.5 g/100 cm<sup>3</sup> at 20°C and 159 g/100 cm<sup>3</sup> at 100°C. It is soluble in alcohol, acetone and acetic acid.

Calcium chloride, dihydrate (pure) exists as colorless deliquescent crystals. Its density is 0.835 g/cm<sup>3</sup>. Its solubility in water is 97.7 g/100 cm<sup>3</sup> at 0°C and 326 g/100 cm<sup>3</sup> at 60°C. Its solubility in alcohol is 50 g/100 cm<sup>3</sup> at 80°C.

5.5.2 Specification. Military, MIL-C-51511, Calcium Chloride, Technical.

This specification covers one type of technical calcium chloride, dihydrate and one type and three grades of technical calcium chloride, anhydrous. The types and grades shall be as follows:

- Type I - Dihydrate, 77% by weight, flake
- Type II - Anhydrous
  - Grade A - 94% by weight, flake, pellet or other granular
  - Grade B - 90% by weight, lump
  - Grade C - 95% by weight

5.5.2.1 Chemical Characteristics. The Military Specification chemical characteristics for calcium chloride, technical are shown in Table V.

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TABLE V. Calcium chloride, technical - chemical requirements.

Characteristics	Requirements, Maximum			
	Type I	Type II		
		Grade A	Grade B	Grade C
	<u>% By Wt</u>	<u>% By Wt</u>	<u>% By Wt</u>	<u>% By Wt</u>
Alkali chlorides (as NaCl)	8.0	5.0	8.0	---
Magnesium Chloride (MgCl <sub>2</sub> )	0.5	0.5	0.5	---
Other impurities (not including water)	1.0	1.0	1.0	---
Volatile matter	---	---	---	4.0
Acidity (as HCl)	---	---	---	0.005
Alkalinity [as Ca(OH) <sub>2</sub> ]	---	---	---	0.3

5.5.2.1.1 Appearance. Calcium chloride shall not be caked or sticky and shall be free from the presence of dirt and other foreign matter.

5.5.2.1.2 Grit or Insoluble Particles in Type II, Grade C, Calcium Chloride. For Type II, Grade C, calcium chloride, no more than 5 particles shall be retained on a 250  $\mu$ m sieve and no particles shall be retained on a 425  $\mu$ m sieve from a 50 g specimen.

The Military Specification granulation requirements for calcium chloride are shown in Table VI.

TABLE VI. Calcium chloride, technical - granulation requirements.

Sieve Size	Passing			
	Type I	Type II		
		Grade A	Grade B	Grade C
	<u>% By Wt</u>	<u>% By Wt</u>	<u>% By Wt</u>	<u>% By Wt</u>
25.0 mm (1 in)	---	---	100 min	---
9.5 mm (3/8 in)	100 min	100 min	---	---
4.75 mm (No. 4 US standard sieve)	80 min	80 min	5 max	---
1.70 mm (No. 12 US standard sieve)	---	---	---	100 min
850 $\mu$ m (No. 20 US standard sieve)	10 max	10 max	---	---



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5.5.3 Use. Type I and Type II, Grade A calcium chloride are intended for use as a road construction material, admixtures for concrete, refrigerating mediums, and other technical uses. In addition, both types may be used for snow and ice control on sidewalks and driveways of buildings. Type II, Grade B calcium chloride is intended for use as a desiccating agent. Type II, Grade C calcium chloride is intended for use as a dehydrating agent for aluminized high explosives.

5.5.4 Safety. Calcium chloride may be irritating to the eyes and skin. Contact with the eyes is likely to produce injury which may include conjunctive irritation with edema, as well as temporary corneal injury. Single prolonged exposure to solid material to the skin may result in some reddening, while repeated prolonged contacts may cause appreciable irritation and possibly a mild burn. In 5 and 10% solutions, calcium chloride has only a slight effect on intact skin. Prolonged contact may cause some slight irritation. Solutions stronger than 10% may, on prolonged or repeated contact, cause slight to marked irritation, even a burn, depending upon the concentration. Generally calcium compounds should be considered toxic only when they contain a toxic component (such as arsenic) or a calcium oxide or hydroxide. Reasonable care and cleanliness should be exercised in the handling of calcium chloride. There is no TLV or PEL referenced for calcium chloride. (Refer to 4.3.1)

If heated in air to decomposition, calcium chloride evolves calcium oxide which is irritating to the eyes, skin and mucous membranes.

5.5.5 Storage. Calcium chloride shall be stored in a cool, dry place in tightly closed containers. (Refer to 4.3.2)

5.5.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.6 Name. Calcium Chromate, Technical  $\text{CaCrO}_4$  FW 156.07  
Steinbuhl yellow  
Gelbin yellow ultramarine

5.6.1 Technical Description. Commercially available calcium chromate, technical, exists as yellow, monoclinic crystals. Its specific gravity is 2.89 g/cm<sup>3</sup>. It is soluble in dilute acids and alcohols and slightly soluble in water.

5.6.2 Specification. Military, MIL-C-48038, Calcium Chromate, Technical.

5.6.2.1 Requirements.

5.6.2.1.1 Apparent (Bulk) Density. The technical calcium chromate shall have an apparent (bulk) density of 0.35 g/cm<sup>3</sup>, minimum.

5.6.2.1.2 Particle Size. The particle size of the technical calcium chromate shall be 2.0±0.5 microns.

5.6.2.1.3 Granulation. The technical calcium chromate shall be able to pass, 100 percent, through a 45 micron (No. 325 US Standard Sieve).



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The Military Specification chemical requirements for calcium chromate, technical is shown in Table VII.

TABLE VII. Calcium chromate, technical - chemical requirements.

Constituents	Requirements	
	Min	Max
Calcium chromate	96.0	---
Maximum Limits of Impurities		
Calcium carbonate	---	1.5
Chloride (Cl)	---	0.01
Sulfate (SO <sub>4</sub> )	---	0.01
Volatile matter	---	0.10
Aluminum (as Al <sub>2</sub> O <sub>3</sub> )	---	0.20
Sodium (as Na <sub>2</sub> O)	---	0.15
Silicon (as Si)	---	0.05

5.6.3 Use. Calcium chromate, technical is used in pyrotechnic ammunition. It is also used as a pigment, corrosion inhibitor, oxidizing agent and a coating for light metal alloys.

5.6.4 Safety. Calcium chromate is highly toxic and irritating to eyes, skin and mucous membranes. Inhalation of dust or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Calcium chromate shall be used with adequate ventilation. Calcium chromate is a human carcinogen. The TLV for chromium compounds as Cr(II) and Cr(III) is 0.5 mg/m<sup>3</sup>. The TLV for chromium compounds as Cr(VI) is 0.05 mg/m<sup>3</sup>. (Refer to 4.3.1)

If heated to decomposition, calcium chromate may emit toxic or irritating fumes.

5.6.5 Storage. Calcium chromate shall be stored in a cool, dry, well ventilated place in tightly closed containers. (Refer to 4.3.2)

5.6.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4) If in solution reduce chromium(VI) to chromium(III) and add alkali to precipitate chromium(II) sludge. Where permitted by governing laws and regulations, the sludge can be encased in concrete for disposal in permitted landfill.

Calcium chromate has an EPA Hazardous Waste Classification - EP Toxic, Waste Number D007; Toxic, Waste Number U032.

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- 5.7 Name. Calcium Fluoride, Technical CaF<sub>2</sub>    FW    78.08  
 Natural fluorite  
 Fluorspar  
 Calcium difluoride

5.7.1 Technical Description. Calcium fluoride (pure) exists as colorless, cubic crystals with a refractive index of 1.434 and a density of 3.180 g/cm<sup>3</sup>. Its melting point is 1423°C and boiling point is about 2500°C. Its solubility in water is 0.0016 g/100 cm<sup>3</sup> at 18°C and 0.0017 g/100 cm<sup>3</sup> at 26°C. It is soluble in ammonium salts and insoluble in acetone.

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

5.7.2.1 Requirements. Calcium fluoride, technical is available commercially with specification requirements and physical properties as shown in Table VIII and Table IX.

TABLE VIII. Calcium fluoride, technical - manufacturer's specification requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Calcium fluoride (CaF <sub>2</sub> )	97.0	---
Silica (SiO <sub>2</sub> )	---	1.5
Calcium carbonate (CaCO <sub>3</sub> )	---	2.0
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	---	0.15

TABLE IX. Calcium fluoride, technical - manufacturer's specification for minimum physical requirements.

Characteristics	Requirements	
	<u>Lbs/Cu Ft</u>	<u>% By Wt</u>
Bulk density	100	---
Particle size (Tyler)		
Through 30 mesh (550 μm) <sup>∇</sup> min	---	100
Through 325 mesh (45 μm) max	----	85

<sup>∇</sup> Interpolated value

The typical requirement for material retained on 200 mesh (75 μm) is 15% by wt.

5.7.3 Use. Calcium fluoride, technical is used as a source of fluorine and in the preparation of fluorine compounds.

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5.7.4 Safety. Calcium fluoride is irritating to the eyes, skin and mucous membranes. Short term inhalation may cause difficult breathing, burning of respiratory tract, nausea, vomiting, profuse sweating and thirst. On skin it may cause rash, itching and burning. A 1% solution may cause sores. Contact with eyes may cause severe irritation. Long Term exposure to fluoride may increase bone density, stimulate new bone growth or cause calcium deposits in ligaments. Inhalation of dust or mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Calcium fluoride shall be used with adequate ventilation. The TLV for fluoride (as F) is 2.5 mg/m<sup>3</sup>. The PEL is the same. (Refer to 4.3.1)

If heated to decomposition, calcium fluorides will evolve toxic fluorides. If in contact with acids, it may produce toxic HF gas.

5.7.5 Storage. Calcium fluoride shall be stored in a cool, dry, well ventilated place in tightly closed containers away from acids. Protect container against damage. (Refer to 4.3.2)

5.7.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.8 Name. Calcium Hydroxide, Technical Ca(OH)<sub>2</sub>      FW 74.10

5.8.1 Technical Description. Calcium hydroxide exists as a crystal or soft, odorless granules or powder. In the form of crystals, calcium hydroxide are rhombhedral in shape with specific gravity of 2.34 g/cm<sup>3</sup> and a melting point of 580°C. It is slightly soluble in hot or cold water and dissolves in ammonium chloride.

5.8.2 Specification. Federal, O-C-110, Calcium Hydroxide, Technical.

5.8.2.1 Requirements. Calcium hydroxide, technical shall have the particle size distribution specified in Table X.

TABLE X. Calcium hydroxide, technical - minimum granulation requirements.

U.S. Sieves	Requirements
	<u>% By Wt</u>
No. 30, (600 μm) passing	99.5
No. 200, (75 μm) passing	98.0

5.8.2.2 Appearance. Calcium hydroxide, technical shall be white, dry, finely powdered, and free from lumps or any foreign material that might interfere with the operation of dry-feed equipment.

5.8.2.3 Calcium hydroxide content. Calcium hydroxide shall contain no less than 90.0 percent by weight calcium hydroxide.

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5.8.3 Use. Calcium hydroxide is used for potable water, industrial water and sewage treatment as well as for general use. It is not intended for structural use as in the manufacture of mortar, plaster, cement and other building materials and paving materials. Other uses include lubricants, drilling fluids, pesticides, fireproofing coatings, water paints, as egg preservatives, manufacture of paper pulp, SBR rubber vulcanization, and dehairing hydres.

5.8.4 Safety. Calcium hydroxide is nontoxic and noncombustible. Calcium hydroxide is a mild alkaline irritant of the eyes and mucous membranes. Breathing dust shall be avoided. Contact with the eyes should be avoided. Calcium hydroxide shall be used with adequate ventilation. Calcium hydroxide is considered to be a nuisance particulate. Its TLV is 5 mg/m<sup>3</sup> for calcium hydroxide dust. (Refer to 4.3.1)

5.8.5 Storage. Calcium hydroxide shall be stored in a cool, dry, well ventilated place in tightly closed containers away from sources of moisture and air. Calcium hydroxide picks up carbon dioxide from air to become calcium carbonate. Protect containers against physical damage. (Refer to 4.3.2)

5.8.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.9 Name. Calcium Hypochlorite, Technical      Ca(ClO)<sub>2</sub>      FW 142.98  
Bleaching powder  
Chlorinated lime  
Calcium chloride hypochlorite

5.9.1 Technical Description. Calcium hypochlorite (pure) exists as white powder or flat plates with refractive indices of 1.545 and 1.69. Its density is 2.35 g/cm<sup>3</sup>. It decomposes at 100°C. It is soluble in cold water and insoluble in alcohol.

5.9.2 Specification. Federal, O-C-114, Calcium Hypochlorite, Technical.

5.9.2.1 Requirements. The Federal Specification requirements for calcium hypochlorite, technical are shown in Table X and Table XI.

TABLE XI. Calcium hypochlorite, technical - requirements.

Characteristics	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Available chlorine	65.0	---
Loss of available chlorine on heating	---	10.0
Moisture	---	10.0

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TABLE XI. Calcium hypochlorite, technical - requirements (continued).

Characteristics	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Bulk density, g per ml	0.8	---
Maximum Limits of Impurities		
Total mixed oxides of heavy metals plus aluminum oxide	---	0.50
Iron (Fe)	---	0.25

TABLE XII. Calcium hypochlorite, technical - granulation requirements.

U.S. Sieves	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
No. 14 (1.40 mm) passing	75.0	---
No. 100 (150 $\mu$ m) passing	---	10.0

5.9.3 Use. Calcium hypochlorite, technical is used for disinfecting drinking water, for bleaching, as a general disinfectant and for chemical-biological decontamination.

5.9.4 Safety. Calcium hypochlorite is an oxidizer. It is irritating to the eyes, skin and mucous membranes. Inhalation of dust or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Calcium hypochlorite shall be used with adequate ventilation. There is no TLV or PEL referenced for calcium hypochlorite. (Refer to 4.3.1)

If heated to decomposition or on contact with acid or acid fumes, calcium hypochlorite emits highly toxic chlorine. It can react vigorously with reducing materials.

5.9.5 Storage. Calcium hypochlorite shall be stored in a cool, well ventilated place in tightly closed containers away from acids and acid fumes and reducing materials. Protect containers against damage. (Refer to 4.3.2)

5.9.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Calcium hypochlorite has an EPA Hazardous Waste Classification - Ignitable; Waste Number D001.

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5.10 Name. Calcium Magnesium Carbonate, Technical  
 $\text{CaMg}(\text{CO}_3)_2$  FW 184.41

5.10.1 Technical Description. Calcium magnesium carbonate (pure) exists as colorless, trigonal crystals with refractive indices of 1.6817 and 1.5026 and a density of 2.872 g/cm<sup>3</sup>. It decomposes at 730-760°C. Its solubility in water is 0.032 g/100 cm<sup>3</sup> at 18°C.

5.10.2 Specification. Military, MIL-C-51067, Calcium Magnesium Carbonate, Technical (Metric).

5.10.2.1 Requirements. The Military Specification requirements for calcium magnesium carbonate, technical (metric) are shown in Table XIII and Table XIV.

TABLE XIII. Calcium magnesium carbonate, technical - requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Calcium and magnesium carbonate, moisture free	97.0	---
Calcium carbonate, moisture free	53.0	58.0
Moisture	---	0.5

TABLE XIV. Calcium magnesium carbonate, technical - granulation requirements.

Particle Size	Requirements
	<u>% By Wt</u>
Material passing a 75 $\mu\text{m}$ (No. 200 US Sieve)	5.0
Material retained on a 180 $\mu\text{m}$ (No. 80 US Sieve)	1.0

5.10.3 Use. Calcium magnesium carbonate is used as a retarder in grenade mixtures. It is also used in the manufacture of magnesium compounds and the removal of sulfur dioxide from stack gases.

5.10.4 Safety. Calcium magnesium carbonate is nontoxic and noncombustible. Calcium magnesium carbonate is a mild irritant of the eyes and mucous membranes. Breathing of dust shall be avoided. Contact with the eyes shall be avoided. Calcium magnesium carbonate shall be used with adequate ventilation. Calcium magnesium carbonate is considered to be a nuisance particulate. Its TLV is 10 mg/m<sup>3</sup> of total dust. (Refer to 4.3.1)

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5.10.5 Storage. Calcium magnesium carbonate shall be stored in a cool, dry, well ventilated place in tightly closed containers away from sources of moisture. Protect containers against physical damage. (Refer to 4.3.2)

5.10.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.11 Name. Calcium Nitrate, Tetrahydrate, Technical  
 $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  FW 236.15  
 Lime nitrate  
 Nitrocalcite  
 Lime saltpeter

5.11.1 Technical Description. Calcium nitrate tetrahydrate is available in the  $\alpha$  and  $\beta$  forms. Calcium nitrate, tetrahydrate (pure) exists as colorless, monoclinic, deliquescent crystals with refractive indices of 1.465, 1.498 and 1.504.  $\alpha$ -Calcium nitrate, tetrahydrate, has a density of 1.896 g/cm<sup>3</sup> and a melting point of 42.7°C. It decomposes at 132°C. Its solubility in water is 266.0 g/100 cm<sup>3</sup> at 0°C and 660.0 g/100 cm<sup>3</sup> at 30°C. It is soluble in alcohol and acetone.  $\beta$ -Calcium nitrate, tetrahydrate, has a density of 1.82 g/cm<sup>3</sup> and a melting point of 39.7°C.

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

5.11.2.1 Requirements. Calcium nitrate, tetrahydrate, technical is available commercially with manufacturer's specification requirements and typical analysis of trace metals as shown in Table XV and XVI.

TABLE XV. Calcium nitrate, tetrahydrate, technical - manufacturer's specification requirements.

Characteristics	Requirements		
	Min	Max	Max
	<u>% By Wt</u>	<u>% By Wt</u>	<u>PPM</u>
Calcium nitrate (as $\text{Ca}(\text{NO}_3)_2$ )	68	71	---
Calcium (as CaO)	23.1	24.1	---
Nitrogen (N)	11.5	12.1	---
Water of hydration/moisture	29	32	---
Ammonium compounds	---	None	---
Iron (Fe)	---	---	5
Heavy metals (as Pb)	---	---	10
Chloride (Cl)	---	---	50
Sulfate ( $\text{SO}_4$ )	---	---	50

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TABLE XVI. Calcium nitrate, tetrahydrate, technical - typical analysis of trace metals.

Constituents	Requirements
	<u>PPM</u>
Chloride (Cl)	15
Sulfate (SO <sub>4</sub> )	15
Barium (Ba)	15
Copper (Cu)	1
Magnesium (Mg)	30
Sodium (Na)	7
Potassium (K)	12
Strontium (Sr)	100
Iron (Fe)	1

5.11.3 Use. Calcium nitrate, tetrahydrate, technical is used in explosives and pyrotechnics.

5.11.4 Safety. Calcium nitrate, tetrahydrate is an oxidizer but is noncombustible. It is slightly irritating to the eyes, skin and respiratory tract. Inhalation of dust or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Calcium nitrate, tetrahydrate shall be used with adequate ventilation. There is no TLV or PEL referenced for calcium nitrate. (Refer to 4.3.1)

If involved in a nearby fire, keep containers cool with copious amounts of water. Calcium nitrate will accelerate burning of combustible materials. If large quantities are involved in fire or associated combustible materials is finely divided, an explosion may result. Avoid prolonged exposure to heat or fire. If heated to decomposition, calcium nitrate, tetrahydrate can evolve toxic oxides of nitrogen.

5.11.5 Storage. Calcium nitrate, tetrahydrate shall be stored in a cool, dry, well ventilated place in tightly closed containers away from sources of heat, open flame, reducing and combustible materials. (Refer to 4.3.2)

5.11.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Calcium nitrate, tetrahydrate has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001.

5.12 Name. Calcium Phosphate, Tribasic, Technical

$\text{Ca}_3(\text{PO}_4)_2$  FW 310.18

Natural whitlockite  
Calcium orthophosphate  
Tricalcium phosphate

5.12.1 Technical Description. Calcium phosphate, tribasic (pure) exists as white amorphous powder with refractive indices of 1.629 and 1.626 and a



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density of 3.14 g/cm<sup>3</sup>. Its melting point is 1670°C. Its solubility in cold water is 0.002 g/100 cm<sup>3</sup>. It decomposes in hot water. It is insoluble in alcohol.

5.12.2 Specification. Military, MIL-C-14264, Calcium Phosphate, Tribasic, Technical.

5.12.2.1 Requirements. The Military Specification requirements for calcium phosphate, tribasic, technical are shown in Table XVII.

TABLE XVII. Calcium phosphate, tribasic, technical - requirements.

Characteristics	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Loss on ignition	---	10.0
Assay, As P <sub>2</sub> O <sub>5</sub>	39.8	41.2
Granulation		
Through No. 80 sieve (180 μm)	99.8	---
Through No. 325 sieve (45 μm)	97.0	---

5.12.3 Use. Calcium phosphate, tribasic, technical is used in colored smoke munitions. It is also used in the preparation of phosphorous and phosphoric acid, as a clarifying agent and anticaking agent.

5.12.4 Safety. Calcium phosphate, tribasic is nontoxic and nonflammable. Calcium phosphate may cause some irritation to the eyes and skin. Generally calcium compounds should be considered toxic only when they contain a toxic component (such as arsenic) or a calcium oxide or hydroxide. Reasonable care and cleanliness should be exercised in the handling of calcium phosphate, tribasic. There is no TLV or PEL referenced for calcium phosphate. (Refer to 4.3.1)

If heated to decomposition, calcium phosphate, tribasic evolves toxic oxides of phosphorous fumes.

5.12.5 Storage. Calcium phosphate, tribasic shall be stored in a cool, dry, well ventilated place in tightly closed containers. (Refer to 4.3.2)

5.12.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.13 Name. Calcium Phosphide, Technical Ca<sub>3</sub>P<sub>2</sub>      FW 182.19  
Photophor

5.13.1 Technical Description. Calcium phosphide (pure) exists as gray lumps. Its density is 2.51 g/cm<sup>3</sup>. Its melting point is about 1600°C. It

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decomposes in water with the evolution of phosphine ( $\text{PH}_3$ ). It is insoluble in alcohol, ether and benzene.

5.13.2 Specification. Military, MIL-C-3539, Calcium Phosphide. Note: This specification covers two types of calcium phosphide:

- (1) Type A - Uncoated
- (2) Type B - Coated

5.13.2.1 Requirements.

5.13.2.1.1 Material. Calcium phosphide shall be of the best quality, shall be stable, and shall not evolve gas when packed in air tight containers kept in a cool place.

5.13.2.1.2 Form. Calcium phosphide shall be furnished in the form of solid sticks or lumps 1/4 to 1 inch in diameter. Not more than 5 percent of the material shall pass through a 1.18mm sieve (No. 16 U S Standard sieve). Sieves shall conform to RR-S-366 and ASTM E-11.

5.13.2.1.3 Reaction With Water.

5.13.2.1.3.1 Type A calcium phosphide when immersed in sea water shall immediately produce a vigorous reaction with a strong bright flame.

5.13.2.1.3.2 Type B calcium phosphide when immersed in sea water shall give a maximum evolution of smoke and flames at approximately 15 minutes after contact with the water. The reaction shall be vigorous with a strong bright flame.

5.13.2.1.4 Gas Evolution. When tested as specified, a 10 g sample shall give not less than the following amounts of gas within 4 hours:

- Type A - 675  $\text{cm}^3$
- Type B - 610  $\text{cm}^3$

5.13.2.1.5 Coating. Each lump of type B calcium phosphide shall be completely and sufficiently coated with potassium bichromate so as to produce the delayed action specified.

5.13.3 Use. Calcium phosphide, technical is used in charging life buoys and in torpedo-torch pots.

5.13.4 Safety. Calcium phosphide is a flammable solid and is dangerous when wet. It is irritating to the eyes, skin and mucous membranes. Inhalation of dust shall be avoided. Contact with the eyes, skin, and clothing shall be avoided. Calcium phosphide shall be used with adequate ventilation. There is no TLV or PEL referenced for calcium phosphide. (Refer to 4.3.1)

When heated, calcium phosphide may emit highly toxic oxide of phosphorous fumes. Reaction of calcium phosphide with water and acids will liberate highly toxic and flammable phosphine. The TLV for phosphine is 0.3 ppm ( $0.4 \text{ mg/m}^3$ ). The PEL is the same.

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5.13.5 Storage. Calcium phosphide shall be stored in a cool, dry, well ventilated place in tightly closed, air tight containers away from sources of moisture. Protect container from physical damage. (Refer to 4.3.2)

5.13.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Calcium phosphide has an EPA Hazardous Waste Classification - Ignitable; Waste Number D001, Reactive; Waste Number D003.

5.14 Name. Calcium Silicate, Technical  $\text{Ca}_3\text{SiO}_5$  or  $3\text{CaO}\cdot\text{SiO}_2$  FW 228.32  
Natural alite

5.14.1 Technical Description. Calcium Silicate (pure) exists as colorless monoclinic crystals. The index of refraction of the  $\alpha$  form is 1.718 and of the B form is 1.724. Its melting point is 1900°C.

5.14.2 Specification. Military, MIL-C-51077, Calcium Silicate, Technical.

5.14.2.1 Requirements. The Military Specification requirements for calcium silicate, technical are shown in Table XVIII and XIX. The absorption ratio of calcium silicate shall be not less than 550g of meta-nitrotoluene per hundred grams of calcium silicate. The hydrogen ion concentration shall be not less than 7.5 nor more than 8.5 pH.

TABLE XVIII. Calcium silicate, technical - chemical requirements.

Characteristics	Requirements	
	Max	Min
	<u>% By Wt</u>	<u>% By Wt</u>
Total volatile matter	9.0	---
Total silicon as silicon dioxide ( $\text{SiO}_2$ ) dry basis	64.0	52.0
Total calcium as calcium oxide ( $\text{CaO}$ ) dry basis	32.0	23.0
Sum of percent $\text{SiO}_2$ , $\text{CaO}$ , and loss of weight on ignition, dry basis	---	93.0

TABLE XIX. Calcium silicate, technical - maximum physical requirements.

Property	Requirements
	<u>% By Wt</u>
Granulation Retained on No. 140 US Standard sieve (106 $\mu\text{m}$ )	1.0

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TABLE XIX. Calcium silicate, technical - maximum physical requirements (continued).

Property	Requirements
	<u>% By Wt</u>
Retained on No. 325 US Standard sieve (45 $\mu$ m)	6.0

5.14.2.1.1 Color. The calcium silicate, absorbent shall be light gray to white.

5.14.2.1.2 Residue. The number of foreign particles retained on a 250  $\mu$ m sieve (U.S. Standard Sieve Number 60) shall be no more than five (maximum).

5.14.3 Use. Calcium silicate, technical is intended for use in explosive compositions containing trinitrotoluene (TNT) (to prevent exudation of TNT).

5.14.4 Safety. Calcium silicate is not considered a hazardous material. It is nonflammable and nontoxic. Normal safety precautions shall be exercised in the handling of calcium silicate. The generation of dust shall be avoided. Calcium silicate is considered a nuisance particulate with a TLV of 10 mg/m<sup>3</sup> of total dust. Calcium silicate shall be used with adequate ventilation. (Refer to 4.3.1)

5.14.5 Storage. Calcium silicate shall be stored in a cool, dry place in tightly closed containers. (Refer to 4.3.2)

5.14.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.15 Name. Calcium Silicide, Technical CaSi<sub>2</sub> FW 96.25

5.15.1 Technical Description. Calcium silicide (pure) exists as a solid with a density of 2.5 g/cm<sup>3</sup>. It is insoluble in cold water and decomposes in hot water. It is soluble in acid and alkali.

5.15.2 Specification. Military, MIL-C-324, Calcium Silicide, Technical.

This specification covers two types of calcium silicide, technical: Type I and Type II.

5.15.2.1 Requirements. The Military Specification requirements for calcium silicide, technical are shown in Table XX and Table XXI.

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TABLE XX. Calcium silicide, technical - chemical requirements.

Characteristics	Requirements	
	Type I	Type II
	<u>% By Wt</u>	<u>% By Wt</u>
Moisture, max	0.1	0.1
Silicon, min	60.0	60.0
Total iron, max	10.0	3.8
Calcium, min	20.0	30.0
Total silicon, calcium and iron, min	92.0	---
Metallic iron, max	0.2	---
Alkalinity (as CaO), max	2.0	---
Free carbon, max	3.0	---
Carbides and phosphates	to pass test	---

5.15.2.1.1 Apparent Density (Type I Only). Type I calcium silicide shall have an apparent density of no less than 1.20 g/cm<sup>3</sup> and no more than 1.50 g/cm<sup>3</sup>.

TABLE XXI. Calcium silicide, technical - granulation requirements.

Particle Size	Requirements		
	Type I	Type II	
	Min	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>	<u>% By Wt</u>
Retained on 150 $\mu\text{m}$ sieve (No. 100 US Standard Sieve)	---	---	1
Passing 150 $\mu\text{m}$ sieve (No. 100 US Standard Sieve)	99.9	---	---
Retained on 106 $\mu\text{m}$ sieve (No. 140 US Standard Sieve)	---	---	1
Retained on 75 $\mu\text{m}$ sieve (No. 200 US Standard Sieve)	---	6	12
Passing 63 $\mu\text{m}$ sieve (No. 230 US Standard Sieve)	65.0	---	---
Retained on 45 $\mu\text{m}$ sieve (No. 325 US Standard Sieve)	---	25	50
Passing 45 $\mu\text{m}$ sieve (No. 325 US Standard Sieve)	---	40	65

5.15.3 Use. Type I Calcium silicide is intended for use in starter pellets. Type II Calcium silicide is intended for use in smoke, primer, and tracer compositions.

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5.15.4 Safety. Calcium silicide is flammable. It may be irritating to the skin and eyes. Contact with the eyes shall be avoided. Contact with the skin and clothing shall be avoided. It may be harmful if inhaled. Calcium silicide shall be used with adequate ventilation. There is no TLV or PEL referenced for calcium silicide. (Refer to 4.3.1)

Calcium silicide may ignite if exposed to air. Contact with water or heat to decomposition may produce irritating or poisonous gases.

5.15.5 Storage. Calcium silicide shall be stored in a cool, dry, well ventilated place in tightly closed containers away from sources of moisture, heat, sparks and open flame. (Refer to 4.3.2)

5.15.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Calcium silicide has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001; Reactive, Waste Number D003.

5.16 <u>Name</u> . Calcium Sulfate, Technical	CaSO <sub>4</sub>	FW 136.14
Insoluble anhydrite		
Gypsum, dead burned		

5.16.1 Technical Description. Calcium sulfate (pure) exists as colorless rhombic or monoclinic crystals with refractive indices of 1.569, 1.575 and 1.613 and a density of 2.960 g/cm<sup>3</sup>. The rhombic crystals form has a transition temperature of 1193°C to the monoclinic form. The monoclinic crystalline form has a melting point of 1450°C. Its water solubility is 0.209 g/100 cm<sup>3</sup> at 30°C and 0.1619 g/100 cm<sup>3</sup> at 100°C. It is soluble in ammonium salts, sodium thiosulfate and glycerine.

The natural form of anhydrous calcium sulfate is known as the mineral anhydrite (karstenite, muriacite, anhydrous sulfate of lime, anhydrous gypsum). Insoluble anhydrite (dead-burned gypsum) which has the same crystal structure as the mineral is obtained upon complete dehydration of gypsum at above 650°C.

5.16.2 Specification. Military, MIL-G-48344, Gypsum, Dead Burned

5.16.2.1 Requirements. The Military Specification requirements for calcium sulfate, technical (gypsum, dead burned) are shown in Table XXII and Table XXIII. Calcium sulfate shall be free from extraneous foreign materials such as metals, wood, minerals and other debris.

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TABLE XXII. Calcium sulfate, technical (gypsum, dead burned) - requirements.

Constituents	Requirements	
	Min	Max
Purity (as CaSO <sub>4</sub> )	98	---
Combined water	---	0.3

TABLE XXIII. Calcium sulfate, technical (gypsum, dead burned) - granulation, minimum requirements.

Characteristic	Requirements
Pass 45 $\mu$ (No. 325 US Standard Sieve)	<u>% By Wt</u> 97.0

5.16.3 Use. Calcium sulfate, technical (gypsum, dead burned) is intended for use as an inert filler component in ammunition items.

5.16.4 Safety. Calcium sulfate (gypsum, dead burned) is nonflammable and nontoxic. Calcium sulfate may cause some irritation to the eyes and skin. Generally, calcium compounds should be considered toxic only when they contain a toxic component such as arsenic or a calcium oxide or hydroxide. Reasonable care and cleanliness should be exercised in the handling of calcium sulfate. Calcium sulfate is considered a nuisance particulate with a TLV of 10 mg/m<sup>3</sup> of total dust. Calcium sulfate shall be used with adequate ventilation. (Refer to 4.3.1)

If heated to decomposition, calcium sulfate may emit highly toxic oxides of sulfur fumes.

5.16.5 Storage. Calcium sulfate (gypsum, dead burned) shall be stored in a dry place in tightly closed containers. (Refer to 4.3.2)

5.16.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

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5.17 Name. Chromium Trioxide, Technical CrO<sub>3</sub>      FW 100.01  
 Chromic Anhydride  
 Chromic Acid  
 (HAZARDOUS)

5.17.1 Technical Description. Chromium trioxide, technical, comes in the form of a dark, red flake or powder and is deliquescent. It has a density of 2.70 g/cm<sup>3</sup> and a melting point of 196°C. At temperatures above the melting point, it decomposes. Chromium trioxide has a solubility in water of 61.7 g/100 ml at 100°C. It is soluble in alcohol, ether, sulfuric acid and nitric acid. It is a strong oxidizing agent and reacts rapidly with most oxidizable material.

5.17.2 Specification. Federal, O-C-303, Chromium Trioxide, Technical

5.17.2.1 Requirements. The Federal specification requirements are shown in Table XXIV.

The chemical specification requirements are shown in Table XXIV.

TABLE XXIV. Chromium trioxide, technical - chemical requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Assay (as CrO <sub>3</sub> )	99.5	---
Sulfate (SO <sub>4</sub> )	---	0.20
Chloride (Cl)	---	0.10
Insoluble matter	---	0.10

5.17.2.2 Appearance. Chromium trioxide shall be free-flowing, reddish-brown flakes or crystals, free from lumps.

5.17.2.3 Particle size. No more than 30 percent by weight of flake form chromium trioxide shall pass through a standard 600-micrometer sieve (No. 30 U.S. Standard sieve) and no more than 25 percent by weight of crystalline form chromium trioxide shall pass through a standard 420-micrometer sieve (No. 40 U.S. Standard sieve).

5.17.3 Use. Chromium trioxide is intended for military use in chromium plating and related metal finishing, cleaning and etching processes performed in chromic acid baths. Commercial uses include "decorative" chrome plating, "hard" chrome plating, "solderless" cans, anodizing baths, chromate conversion coatings on aluminum, cadmium, magnesium and zinc, stripping copper plating from steel parts, magnesium castings in the manufacture of dyes, organic chemicals and drugs, wood preservatives and textile dyeing.

5.17.4 Safety. Chromium trioxide, technical, is not combustible but is such a powerful oxidizing agent that it may ignite oxidizable substances. The TLV for chromium trioxide is 0.05 mg/m<sup>3</sup>. It is an OSHA Category I carcinogen.



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If chromium trioxide comes in contact with the skin, even in small quantities, harmful or fatal results can occur. Contact of small quantities of chromium trioxide dust may result in severe burns of the digestive tract. For personal protective measures, refer to 4.5.

5.17.5 Storage. Chromium trioxide is such a strong oxidizing agent that it may cause fire on contact with combustible material such as paper and wood. Dry chromium trioxide should be stored only in the original shipping containers - away from combustible substances. Chromium trioxide should be stored in a cool, dry place. Under such storage conditions, the shelf life is indefinite.

5.17.6 Disposal. For appropriate procedures, contact the Installation Environmental Coordinator. A frequently used method of disposal is to reduce the hexavalent chromium to trivalent chromium, and then to precipitate the reduced chromium by neutralization with soda ash, caustic soda or lime to a pH of 8 to 9. Where governing laws permit, the precipitated chromium sludge should be encased in a concrete block or other impervious material prior to disposal in a permitted landfill. The effluent can be discharged into the sanitary sewer in accordance with Section 402 of the Clean Water Act (PL95-500), titled National Pollution Discharge Elimination System (NPDES). (Refer to 4.4 and 4.4.1)

Chromium trioxide has an EPA Hazardous Waste Classification - EP Toxic; EPA Hazardous Waste Number - D007.

5.18 Name. Cobalt Nitrate, Hexahydrate, Technical  
 $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  FW 291.04  
 Cobaltous nitrate, hexahydrate  
 Cobalt (II) nitrate, hexahydrate

5.18.1 Technical Description. Cobalt nitrate, hexahydrate (pure) exists as red, monoclinic, deliquescent crystals with a refractive index of 1.52 and a density of 1.87 g/cm<sup>3</sup> at 25°C/4°C. It has a melting point of 55-56°C. It loses 3 molecules of water at 55°C. Its solubility in water is 133.8 g/100 cm<sup>3</sup> at 0°C and 217.0 g/100 cm<sup>3</sup> at 80°C. It is soluble in acetone and slightly soluble in ammonia.

5.18.2 Specification. Manufacturer's requirements (No government specification).

5.18.2.1 Requirements. Cobalt nitrate, hexahydrate, technical is available commercially with specification requirements as shown in Table XXV.

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TABLE XXV. Cobalt nitrate, hexahydrate, technical - specification requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Cobalt (Co)	19.8	---
Iron (Fe)	---	0.002
Copper (Cu)	---	0.005
Lead (Pb)	---	0.005
Zinc (Zn)	---	0.05
Chloride (Cl)	---	0.005
Sulfate (SO <sub>4</sub> )	---	0.01
H <sub>2</sub> O Insolubles	---	0.02

5.18.3 Use. Cobalt nitrate, hexahydrate, technical is used in the manufacture of cobalt pigments, inks and as catalysts.

5.18.4 Safety. Cobalt nitrate, hexahydrate is an oxidizer. It is irritating to the eyes and skin. It may cause upper respiratory tract irritation. Overexposure to cobalt compounds may cause nose and throat irritation and an allergic skin rash. Excessive inhalation of cobalt salts may affect the kidneys, lungs and thyroid. Inhalation of dust and mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Cobalt nitrate, hexahydrate shall be used with adequate ventilation. There is no TLV or PEL for cobalt nitrate, hexahydrate. (Refer to 4.4)

If heated to decomposition, cobalt nitrate hexahydrate may emit toxic fumes. The TLV for cobalt, metal fume as Co is 0.05 mg/m<sup>3</sup>. The PEL for cobalt, metal fume is 0.1 mg/m<sup>3</sup>. It is a fire risk when in contact with combustible material.

5.18.5 Storage. Cobalt nitrate, hexahydrate shall be stored in a cool, dry place in tightly closed containers away from combustible materials. (Refer to 4.3.2)

5.18.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Cobalt nitrate, hexahydrate has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001.

5.19 Name. Cupric Carbonate, Basic, Technical

$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$  FW 221.11

Natural malachite  
Copper (II) Carbonate  
Copper subcarbonate

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5.19.1 Technical Description. Cupric carbonate, basic (pure) exists as dark green, monoclinic crystals with refractive indices of 1.655, 1.875 and 1.909 and a density of 4.0 g/cm<sup>3</sup>. It decomposes at 200°C. It is insoluble in cold water and decomposes in hot water. It has a solubility of 0.026 g/100 cm<sup>3</sup> in aqueous CO<sub>2</sub>.

5.19.2 Specification. Manufacturer's requirements (No government specification).

5.19.2.1 Requirements. Cupric carbonate, basic, technical is available commercially in a light and dense grade with typical chemical and granulation analysis as shown in Tables XXVI, XXVII, XXVIII and XXIX.

5.19.2.1.1 Bulk density. (a) Light copper carbonate - 32.9 lbs/cu ft  
(b) Dense copper carbonate - 75.5 lbs/cu ft

TABLE XXVI. Cupric carbonate, basic, technical (light) - typical chemical analysis.

Constituents	Requirements
	<u>% By Wt</u>
Copper (Cu)	55.2
Total sulfur (S)	0.30
Iron (Fe)	0.11
Zinc (Zn)	0.03
Nickel (Ni)	0.012
Lead (Pb)	0.012
Manganese (Mn)	0.001
Chloride (Cl)	0.005
Insoluble in HCl	0.08
Insoluble in acetic acid	0.10
Moisture	1.01
Water soluble salts	0.7

TABLE XXVII. Cupric carbonate, basic, technical (light) - granulation analysis.<sup>1/</sup>

Granulation	Requirements
	<u>% By Wt</u>
Through 1300 mesh	74.0
Through 2600 mesh	59.3

<sup>1/</sup>Granulation analysis calculated from settling rate and based on stokes formula.

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TABLE XXVIII. Cupric carbonate, basic, technical (dense) - typical chemical analysis.

Constituents	Requirements
	<u>% By Wt</u>
Copper (Cu)	55.1
Total sulfur (S)	0.42
Iron (Fe)	0.15
Zinc (Zn)	0.03
Nickel (Ni)	0.015
Lead (Pb)	0.014
Manganese (Mn)	0.001
Chloride (Cl)	0.005

TABLE XXIX. Cupric carbonate, basic, technical (dense) - granulation analysis.

Granulation	Requirements
	<u>% By Wt</u>
On No. 100 US sieve (150 $\mu\text{m}$ )	0.7
Through No. 100 US sieve (150 $\mu\text{m}$ ) on No. 200 US sieve (75 $\mu\text{m}$ )	2.3
Through No. 200 US sieve (75 $\mu\text{m}$ ) on No. 270 US sieve (53 $\mu\text{m}$ )	3.9
Through No. 270 US sieve (58 $\mu\text{m}$ ) on No. 325 US sieve (45 $\mu\text{m}$ )	2.8
Through No. 325 US sieve (45 $\mu\text{m}$ )	90.3

5.19.3 Use. Cupric carbonate, basic, technical is used in pyrotechnics; pigments in paints and producing black color on brass.

5.19.4 Safety. Cupric carbonate, basic is irritating to the eyes, skin and mucous membranes. Inhalation of dust or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Cupric carbonate, basic shall be used with adequate ventilation. The TLV for copper dusts and mists as Cu is 1 mg/m<sup>3</sup>. The PEL is the same. (Refer to 4.3.1)

5.19.5 Storage. Cupric carbonate, basic shall be stored in a cool, dry place in tightly closed containers. (Refer to 4.3.2)

5.19.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

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5.20 Name. Cupric Sulfate, Pentahydrate, Technical  
 $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  FW 249.68  
 Copper (II) sulfate, pentahydrate  
 Blue stone  
 Blue vitriol  
 Roman vitriol

5.20.1 Technical Description. Cupric sulfate, pentahydrate (pure) exists as blue triclinic crystals with refractive indices of 1.514, 1.537 and 1.543 and a density of 2.284 g/cm<sup>3</sup>. It loses 4 molecules of water at 110°C and 5 molecules of water at 150°C. Its solubility in water is 31.6 g/100 cm<sup>3</sup> at 0°C and 203.3 g/100 cm<sup>3</sup> at 100°C. It has a solubility of 15.6 g/100 cm<sup>3</sup> in methyl alcohol at 18°C and is insoluble in ethyl alcohol. It is slowly efflorescent in dry air. Its aqueous solution is acid to litmus.

5.20.2 Specification. Federal, O-C-828, Cupric Sulfate, Pentahydrate, Technical.

5.20.2.1 Requirements. The Federal Specification chemical and physical requirements for cupric sulfate, pentahydrate, technical are shown in Tables XXX and XXXI.

TABLE XXX. Cupric sulfate, pentahydrate, technical - chemical requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Assay (as $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ )	98.0	105.0
Insoluble matter	---	0.1
Iron (Fe)	---	0.2

TABLE XXXI. Cupric sulfate, pentahydrate, technical - minimum granulation requirements.

Granulation	Requirements
	<u>% By Wt</u>
Material passing 3/4-inch (19 mm sieve)	100
Material retained on a 2.38 mm (No. 8 US sieve)	95

5.20.3 Use. Cupric sulfate, pentahydrate, technical is intended for use in electroplating, in batteries, in manufacturing germicides or disinfectants, and in compounding insecticides.

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5.20.4 Safety. Cupric sulfate is not burnable, nor will it support combustion. It is relatively nontoxic by inhalation but toxic by ingestion. It is corrosive to the eyes. Inhalation of dust and mists shall be avoided. Contact with the eyes shall be avoided. Cupric sulfate shall be used with adequate ventilation. The TLV for copper dust and mists as Cu is 1 mg/m<sup>3</sup>. The PEL is the same. (Refer to 4.3.1)

5.20.5 Storage. Cupric sulfate, pentahydrate shall be stored in a dry place in tightly closed containers. (Refer to 4.3.2)

5.20.6 Disposal. For appropriate procedure, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.21 Name. Cuprous Cyanide, Technical CuCN      FW 89.59

5.21.1 Technical Description. Cuprous Cyanide exists as a white monoclinic crystal with a density of 2.92 g/cm<sup>3</sup>. Its melting point is 474.5°C. It is insoluble in hot and cold water, but readily dissolves in hydrochloric acid to produce hydrogen cyanide and decomposes in nitric acid. It also dissolves in ammonium hydroxide and solutions of sodium or potassium cyanide.

5.21.2 Specification. Military, MIL-C-51264, Cuprous Cyanide, Technical.

5.21.2.1 Requirements. The Military Specification requirements for cuprous cyanide are shown in Table XXXII.

TABLE XXXII. Cuprous cyanide, technical - chemical requirements.

Constituents	Requirements	
	Min	Max
	<u>% By Wt</u>	<u>% By Wt</u>
Copper (Cu)	70	---
Cyanide (CN)	28.5	---
Insoluble matter in NaCN solution	---	0.20

5.21.3 Use. Cuprous cyanide is intended for use in preparing copper and brass cyanide electroplating solutions.

5.21.4 Safety. Cuprous cyanide is highly toxic and irritating to eyes, skin and mucous membranes. Inhalation of dust or mists shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Cuprous cyanide is listed as an acute hazardous material. (Refer to 4.3.4.2)

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Cuprous cyanide shall be used with adequate ventilation. Cuprous cyanide shall be kept away from acids. The TLV for cuprous cyanide is one mg/m<sup>3</sup>. The PEL for copper dusts and mists as Cu is one mg/m<sup>3</sup>. (Refer to 4.3.1)

5.21.5 Storage. Cuprous cyanide shall be stored in a cool, dry, well ventilated place in tightly closed containers away from acids and acidic materials. When exposed to air over long periods, cuprous cyanide decomposes to copper oxide, carbon dioxide and nitrogen. Acids reduce copper cyanide to copper salts and hydrogen cyanide an acutely hazardous gas smelling like almonds. Protect containers against physical damage. (Refer to 4.3.2)

5.21.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Cuprous cyanide has an EPA Hazardous Waste Classification. EP Toxic, Waste Number D007, Toxic Number U032.

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## 6. NOTES

6.1 Intended Use. This standard is intended to cite nomenclature, 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 (Cadmium Carbonate through Cupric Sulfate) preferred for application by the Department of Defense.

6.2 Subject Term (Key Word) Listing.

Cadmium carbonate  
Cadmium nitrate, tetrahydrate  
Calcium carbide  
Calcium carbonate  
Calcium chloride  
Calcium chromate  
Calcium fluoride  
Calcium hydroxide  
Calcium hypochlorite  
Calcium magnesium carbonate  
Calcium nitrate, tetrahydrate  
Calcium phosphate, tribasic  
Calcium phosphide  
Calcium silicate  
Calcium silicide  
Calcium sulfate  
Chromium trioxide  
Cobalt nitrate, hexahydrate  
Cupric carbonate, basic  
Cupric sulfate, pentahydrate  
Cuprous cyanide  
Exposure limits, hazardous chemicals  
Hazardous wastes, disposal and storage of  
Information, hazardous chemicals  
Safety, hazardous chemicals

6.3 Changes from Previous Issue. The changes from the previous issue include the addition of calcium hydroxide and cuprous cyanide and the addition of safety data for these compounds.

6.4 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.



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**CONCLUDING MATERIAL**

**Lead Standardization Activity:**

Defense Logistics Agency - GS

**Custodians:**

Army - EA  
Navy - None  
Air Force - 68

**Preparing Activity:**

Army - EA  
Project Number 6810-1191

**Review Activities:**

Army - GL, MD, ME, SM  
Air Force - None  
DOD/NASA - DS

**User Activities:**

Army - CE, CR  
Air Force - None

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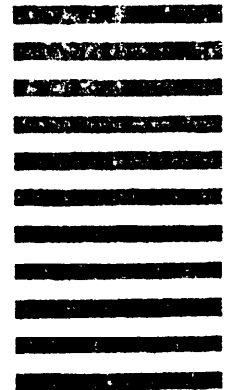
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*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER <b>MIL-STD-1204C</b>		2. DOCUMENT TITLE <b>INORGANIC SALTS AND COMPOUNDS, TECHNICAL GRADE (CADMIUM CARBONATE THROUGH CUPRIC SULFATE)</b>	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION <i>(Mark one)</i>	
b. ADDRESS <i>(Street, City, State, ZIP Code)</i>		<input type="checkbox"/> VENDOR	
		<input type="checkbox"/> USER	
		<input type="checkbox"/> MANUFACTURER	
		<input type="checkbox"/> OTHER <i>(Specify):</i> _____	
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