

INCH-POUND

O-O-670C

November 13, 1991

SUPERSEDING

O-O-670B

July 19, 1985

FEDERAL SPECIFICATION

ORTHOPHOSPHORIC (PHOSPHORIC) ACID, TECHNICAL

This specification is approved by the Commissioner of Federal Supply Service, General Services Administration, for use by all Federal agencies.

1. SCOPE

1.1 Scope. This specification covers two classes of technical grade orthophosphoric acid, commonly called phosphoric acid.

1.2 Classification. Orthophosphoric acid shall be of the following classes as specified (see 6.2):

- Class 1 - 85 percent acid
- Class 2 - 75 percent acid

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein:

Federal Specifications:

- L-P-390 - Plastic Molding and Extrusion Material Polyethylene and Copolymers (Low, Medium, and High Density)
- PPP-C-96 - Cans, Metal, 28 Gauge and Lighter

Comments or suggestions pertaining to this specification should be addressed to: Commander, U.S. Army Chemical Research, Development and Engineering Center, ATTN: SMCCR-PET-S, Aberdeen Proving Ground, MD 21010-5423.

AMSC N/A

FSC 6810

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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PPP-C-186 - Containers, Packaging and Packing for Drugs, Chemicals, and
Pharmaceuticals

PPP-T-66 - Tape, Packaging, Vinyl Plastic Film

Federal Standards:

Fed. Std. No. 123 - Marking for Shipment (Civil Agencies)

FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data
for Hazardous Materials Furnished to Government Activities

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification, other Federal specifications, and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Washington, DC; Philadelphia, PA; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Auburn, WA.

(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards and Commercial Item Descriptions from established distribution points in their agencies.)

Military Specifications:

MIL-P-15011 - Pallets, Material Handling, Wood Post Construction, 4-Way
Entry

Military Standards:

MIL-STD-129 - Marking for Shipment and Storage

MIL-STD-147 - Palletized Unit Loads

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

Code of Federal Regulations (CFR):

- 29 CFR 1900.1200 - Hazard Communication
- 49 CFR 171 to 199 - Hazardous Materials Regulations

(The Code of Federal Regulations and Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Chemical Society (ACS)

"Reagent Chemicals, American Chemical Society Specifications"

(Application for copies should be addressed to the American Chemical Society, 1155 Sixteenth Street, N.W., Washington, DC 20036.)

ASTM Standards:

- C 516 - Vermiculite Loose Fill Thermal Insulation
- D 1193 - Reagent Water
- E 29 - Using Significant Digits in Test Data to Determine Conformance with Specifications

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

International Civil Aviation Organization

"Technical Instructions for the Safe Transport of Dangerous Goods by Air"

(Application for copies should be addressed to the International Civil Aviation Organization, 1000 Sherbrooke Street West, Suite 400, Montreal, Quebec, Canada H3A 2R2.)

International Maritime Organization

"International Maritime Dangerous Goods Code"

(Application for copies should be addressed to the International Maritime Organization, 101-104 Piccadilly, London, W1V 0AE, England.)

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(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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Appearance and odor. Orthophosphoric acid shall be a clear, water-white liquid with no foreign odor, shall be free from sediment and suspended matter, and shall not be separated into two or more liquid layers when tested as specified in 4.2.4.1.

3.2 Physical and chemical characteristics. Orthophosphoric acid shall conform to the applicable physical and chemical characteristics of table I when tested as specified therein.

TABLE I. Physical and chemical characteristics

Characteristic*	Class 1		Class 2		Test paragraph
	Minimum	Maximum	Minimum	Maximum	
Total acid content (as H ₃ PO ₄)	85.0	—	75.0	—	4.2.4.2
Sulfates (as SO ₄)	—	0.35	—	—	4.2.4.3
Arsenic (As)	—	0.001	—	0.06	4.2.4.4
Alkali and other phosphates	—	0.25	—	—	4.2.4.5
Heavy metals (Pb)	—	0.005	—	—	4.2.4.6
Volatile acids (as acetic acid)	—	—	—	0.10	4.2.4.7
Specific gravity 20 °/4 ° C	1.690	—	1.580	—	4.2.4.8

*All values are percent by weight except specific gravity.

3.3 Material Safety Data Sheets. Material Safety Data Sheets for orthophosphoric acid shall be prepared and submitted by the contractor in accordance with FED-STD-313 (see 6.3).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection

requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Contractor assurance of compliance. The contractor's quality program or detailed inspection system shall provide assurance of compliance of all characteristics with the applicable specification requirements using, as a minimum, the conformance criteria specified herein.

4.1.3 Alternative inspection provisions. Alternative inspection procedures, methods, or equipment, such as statistical process control, tool control, and other types of sampling procedures may be used by the contractor when they provide, as a minimum, the level of quality assurance required by the inspection provisions specified herein. Prior to applying such alternative procedures, methods, or equipment, the contractor shall describe them in a written proposal submitted to the Government for evaluation and approval. (See 6.4.) When required, the contractor shall demonstrate that the effectiveness of each proposed alternative is equal to or better than the quality assurance provisions specified herein. In cases of dispute as to whether the contractor's proposed alternative provides equal quality assurance, the provisions of this specification shall apply. All approved alternative inspection provisions shall be specifically incorporated into the contractor's quality program or detailed inspection system, as applicable.

4.2 Quality conformance inspection.

4.2.1 Lotting. A lot shall consist of the orthophosphoric acid of one class produced by one manufacturer, at one plant, from the same materials, and under essentially the same manufacturing conditions provided the operation is continuous. In the event the process is a batch operation, each batch shall constitute a lot (see 6.5).

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4.2.2 Sampling.

4.2.2.1 For examination of packaging. Sampling shall be conducted in accordance with table II. The sample unit shall be one filled unit pack or packing container, as applicable, ready for shipment.

TABLE II. Sampling for packaging examination and test

Number of containers in batch or lot	Number of sample containers
1 or 2	all
3 to 25	3
26 to 50	5
51 to 90	6
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1,200	15
1,201 to 3,200	18
3,201 to 10,000	22
over 10,000	29

4.2.2.2 For orthophosphoric acid test. See 6.6 for sampling and testing precautions. Sampling shall be conducted in accordance with table III. A representative specimen of approximately 500 grams (g) shall be removed from each sample container and placed in a suitable clean, dry container labeled to identify the lot and container from which it was taken.

TABLE III. Sampling for orthophosphoric acid test

Number of containers in batch or lot	Number of sample containers
2 to 25	2
26 to 150	3
151 to 1,200	5
1,201 to 7,000	8
7,001 to 20,000	10
Over 20,000	20

4.2.2.3 For container leakage test. Sampling shall be conducted in accordance with table II. The sample unit shall be one filled container.

4.2.3 Inspection procedure.

4.2.3.1 For examination of packaging. Sample containers shall be examined for the characteristics listed below. Failure of any sample container to conform to all characteristics shall be cause for rejection of the lot represented.

- (a) Contents per container
- (b) Container
- (c) Container closure
- (d) Container free of damage and leaks
- (e) Fiberboard liners, partitions, or pads evident and correct (when required)
- (f) Marking evident, correct, and legible
- (g) Unitization

4.2.3.2 For orthophosphoric acid test. See 6.6 for sampling and testing precautions. Each sample specimen taken in 4.2.2.2 shall be tested as specified in 4.2.4. Failure of any test by any specimen shall be cause for rejection of the lot represented.

4.2.3.3 For container leakage test. The sample containers selected in 4.2.2.3 shall be tested as specified in 4.2.5. Failure of the leakage test by any container shall be cause for rejection of the lot represented.

4.2.3.4 Significant places. For the purpose of determining conformance with this specification, and observed or calculated value shall be rounded off "to the nearest unit" in the last right-hand place of figures used in expressing the limiting value, in accordance with ASTM E 29.

4.2.4 Orthophosphoric acid tests. Water in accordance with ASTM D 1193 and reagent grade chemicals shall be used throughout the tests. Where applicable, blank determinations shall be run and corrections applied where significant. Tests shall be conducted as follows:

4.2.4.1 Appearance and odor. Pour approximately 25 milliliters (mL) of the thoroughly mixed specimen into a clean, dry test tube and examine for odor. Allow the specimen to stand for at least 10 minutes, and then examine visually for clearness and color, sediment, suspended matter, and separated liquid layers.

4.2.4.2 Total acid content. Weigh to the nearest 0.01 g approximately 1 mL of the specimen into a 250-mL Erlenmeyer flask and dilute with 120 mL of water. Add 0.5 mL of 0.1-percent thymolphthalein solution as the indicator and titrate with approximately 1N sodium hydroxide solution which has been standardized. Calculate the percent by weight of

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orthophosphoric acid as follows:

$$\text{Percent orthophosphoric acid} = \frac{9.8 AB}{3 W}$$

where A = Milliliters of sodium hydroxide solution used
 B = Normality of sodium hydroxide solution
 W = Weight of specimen in grams.

4.2.4.3 Sulfates. Weigh to the nearest 0.01 g approximately 10 g of the specimen into a 1000-mL beaker. Dilute with 500 mL of water, add 15 mL of concentrated hydrochloric acid, heat to boiling, and add 25 mL of 10-percent barium chloride solution. Boil for an additional 30 minutes, digest on a steam bath for 2 hours, and allow to stand overnight. Filter the precipitate through a tared filter crucible weighed to the nearest 0.1 milligram (mg), wash with hot water, ignite, cool, and weigh to the nearest 0.1 mg. Calculate the percent by weight sulfate as follows:

$$\text{Percent sulfate} = \frac{41.2 (A - B)}{W}$$

where A = Weight of crucible and precipitate in grams
 B = Weight of crucible in grams
 W = Weight of specimen in grams.

4.2.4.4 Arsenic.

4.2.4.4.1 Class 1 orthophosphoric acid. Weigh 3.0 g of the specimen and dilute to 30 mL with water. Test a 3-mL aliquot of the solution for arsenic by the colorimetric comparative procedure for arsenic found in Reagent Chemicals, American Chemical Society Specifications. For the standard use 0.003 mg of arsenic.

4.2.4.4.2 Class 2 orthophosphoric acid. Weigh 1.0 g of the specimen and dilute to 600 mL with water. Test a 3-mL aliquot of the solution for arsenic by the colorimetric comparative procedure for arsenic found in Reagent Chemicals, American Chemical Society Specifications. For the standard use 0.003 mg of arsenic.

4.2.4.5 Alkali and other phosphates. Weigh to the nearest 0.01 g approximately 5 g of the specimen into a 250-mL Erlenmeyer flask. Add 100 mL of 95-percent ethyl alcohol, stopper, and allow to stand for 1 hour at 20° to 30°C. Filter through a tared, clean, dry filter crucible weighed to the nearest 0.1 mg and wash with 95-percent ethyl alcohol until the filtrate no longer shows acid with moistened blue litmus paper. Do not allow the filter to run dry during the filtering and washing operations. Dry the filter crucible and residue to constant weight at 100° to 105°C, cool, and weigh to the nearest 0.1 mg. Calculate the percent by weight of alkali

and other phosphates as follows:

$$\text{Percent alkali and other phosphates} = \frac{100 (A - B)}{W}$$

where A = Weight of filter crucible and residue in grams

B = Weight of filter crucible in grams

W = Weight of specimen in grams.

4.2.4.6 Heavy metals. Dilute 3 mL of the specimen with water and make up to a volume of 150 mL. Neutralize 30 mL of this solution with ammonium hydroxide solution using litmus paper as the indicator. Add 1 mL of concentrated hydrochloric acid and 5 mL of a saturated solution of hydrogen sulfide made by passing hydrogen sulfide gas into cold water, and dilute to 100 mL. Any color produced shall be no darker than that produced when 3 mL of lead nitrate solution (2.6 mg per liter) is tested in the same manner as the 30 mL specimen solution.

4.2.4.7 Volatile acids. Weigh to the nearest 0.1 g approximately 40 g of the specimen and dilute with 75 mL of carbon dioxide free water. Distill off 50 mL of the solution. Titrate the distillate with approximately 0.1N sodium hydroxide solution which has been standardized, using three drops of phenolphthalein indicator solution. Calculate the percent by weight of volatile acids, as acetic acid, as follows:

$$\text{Percent volatile acids} = \frac{6AB}{W}$$

where A = Milliliters of sodium hydroxide solution used

B = Normality of sodium hydroxide solution

W = Weight of specimen in grams.

4.2.4.8 Specific gravity. Determine the specific gravity at 20°/4°C by means of a pycnometer or other suitable method.

4.2.5 Container leakage test. Place the filled container in each of the following positions, and leave it in each for a period of 15 minutes.

- (a) Upright
- (b) Upside down
- (c) On one side (or one quadrant)
- (d) On one end (or second quadrant)
- (e) On other side (or fourth quadrant)

Examine the container after each period for any evidence of leakage.

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5. PACKAGING

Note: The metric equivalents given for inch-pound quantities are nominal values provided for informational purposes and should not be considered as quantity requirements.

5.1 Packaging. Packaging shall be in accordance with the applicable requirements of 49 CFR 171 to 199 and the International Civil Aviation Organization - Technical Instructions for Safe Transport of Dangerous Goods by Air (ICAO-TDGA) or the International Maritime Organization - International Maritime Dangerous Goods Code (IMO-IMDGC), as applicable to the mode of transportation. The packaging shall meet the applicable packaging performance tests specified in ICAO-TDGA or IMO-IMDGC, as applicable.

5.2 Unit packing.

5.2.1 Eight-pound (3.63-kilogram) quantity. A quantity of 8 pounds (+1 or -0 ounces) (3.63 kilograms) of orthophosphoric acid shall be unit packed in a nominal 5-pint (2.5-liter) bottle conforming to an IP.1 or IP.2 container of ICAO-TDGA or IMO-IMDGC, as applicable. The IP.1 container shall conform to group A, class 1, style 1, grade optional of PPP-C-186. The material used for the bottle shall conform to type I, class M or H, grade 1 or 2 of L-P-390. The thickness of the bottle shall be not less than 0.030 inch. The bottle shall be designed with a finish adapted to a screw-cap conforming to closure A or R of PPP-C-186. The closure of the bottle shall conform to closure A with a separate liner or closure R of PPP-C-186. The tightened screw-cap shall be secured to the neck of the bottle by a strip of tape applied circumferentially around, and centered over the juncture between the skirt of the cap and shoulder of the bottle neck. The tape shall have a nominal width of 2 inches and length of not less than one and one-third times the circumference of the screw-cap closure. The tape shall conform to type 1, class optional of PPP-T-66. There shall be no evidence of container leakage when the bottle is tested as specified in 4.2.5. Each bottle shall be placed upright and centered in a can with vermiculite cushioning. The can shall conform to type V, class 2, type VI tin or terneplate of PPP-C-96. The can shall be coated in accordance with plan B, with side seams striped, of PPP-C-96. Sufficient vermiculite conforming to type I, grade 3 of ASTM C 516 shall be used in each can to assure absorption of the entire contents of the bottle in the event of leakage or breakage. The seams of the slip-cover can shall be sealed with the same kind of tape used for the bottle. The IP.2 container shall be the same as specified above except that the bottle shall conform to group A, class 2, style 1, grade 2, closure A, seal A of PPP-C-186.

5.3 Packing. Packing shall be level A or B as specified (see 6.2).

5.3.1 Level A.

5.3.1.1 Two hundred-pound (90.72-kilogram) quantity. A quantity of 200 pounds (+2 or -0 pounds) (90.72-kilograms) of orthophosphoric acid shall be packed in a nominal 15-gallon (60-liter) polyethylene drum conforming to the requirements of a 1H1 container or a

composite container conforming to the requirements of a 6HA1 container of ICAO-TDGA or IMO-IMDGC, as applicable to the mode of transportation.

5.3.2 Level B.

5.3.2.1 Eight-pound (3.63-kilogram) quantity. Four 8-pound (3.63-kilogram) bottles of orthophosphoric acid, unit packed as specified in 5.2, shall be packed upright in a close-fitting, weather-resistant, fiberboard box conforming to the requirements of a 4G container of ICAO-TDGA or IMO-IMDGC, as applicable. Each box shall be closed and reinforced as specified in accordance with the general packing requirements of ICAO-TDGA or IMO-IMDGC, as applicable.

5.4 Overpacking. Overpacking shall be level A or B as specified (see 6.2).

5.4.1 Level A.

5.4.1.1 Eight-pound (3.63-kilogram) quantity. Two packs of 8-pound (3.63-kilogram) bottles shall be overpacked in a close-fitting water-repellent treated wooden or plywood box. The wooden box shall conform to the requirements of a 4C1 container of ICAO-TDGA or IMO-IMDGC, as applicable. The plywood shall conform to the requirements of a 4D container of ICAO-TDGA or IMO-IMDGC, as applicable. In addition, the plywood shall be not less than 3/8 inch thick and the cleats not less than 3/4 inch thick by 1-3/4 inch wide. Each box shall be closed and reinforced as specified in accordance with the general packing requirements of ICAO-TDGA or IMO-IMDGC, as applicable.

5.4.2 Level B.

5.4.2.1 Eight-pound (3.63-kilogram) quantity. Two packs of 8-pound (3.63-kilogram) bottles shall be overpacked in a close-fitting fiberboard box conforming to the requirements of a 4G container of ICAO-TDGA or IMO-IMDGC, as applicable.

5.5 Marking. Shipments for civil agencies shall be marked in accordance with Fed. Std No. 123. Shipments for military activities shall be marked in accordance with MIL-STD-129.

5.5.1 Container compliance markings. Each shipping container shall be marked in accordance with 49 CFR 171 to 179 and either ICAO-TDGA or IMO-IMDGC, as applicable.

5.5.2 Hazard class label. Each shipping container and pallet load shall be labeled in accordance with 49 CFR 171 to 179 and either ICAO-TDGA or IMO-IMDGC, as applicable.

5.5.3 Proper shipping name. Each shipping container and pallet load shall be marked with proper shipping name in accordance with 49 CFR 171 to 179 and either ICAO-TDGA or IMO-IMDGC, as applicable.

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5.5.4 Precautionary markings. Each unit and shipping container shall be marked or labeled, as applicable, in accordance with 29 CFR 1910.1200(f) to show the required precautionary information. Each outer container shall be marked to show the top of the container by use of an arrow and the word "UP".

5.5.5 Overpack markings. Each overpack shall be marked "Inner packages comply with prescribed specification _____." (Enter either 4C1, 4D, or 4G, as applicable.)

5.6 Palletization. All shipments of containers of 5 gallons or less shall conform to load type VI in accordance with MIL-STD-147 and the pallet shall conform to type IV or V of MIL-P-15011. When specified, all other shipments of orthophosphoric acid shall be palletized in accordance with the applicable requirements of MIL-STD-147.

6. NOTES

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

6.1 Intended use. Orthophosphoric acid is intended for use in the manufacture of metals, chemicals, and fertilizers, and in the cleaning of a variety of materials.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification
- (b) Class of orthophosphoric acid required (see 1.2)
- (c) Level of packing required
- (d) Level of overpacking required (see 5.4)
- (e) If palletization is required for shipments of containers over 5 gallons (see 5.6).

6.3 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent mailing addresses for submissions of data are listed in FED-STD-313.

6.4 Submission of alternative inspection provisions. Proposed alternative inspection provisions should be submitted by the contractor to the procuring contracting officer for evaluation and approval by the technical activity responsible for preparation of this specification.

6.5 Batch. A batch is defined as that quantity of material which has been manufactured by some unit chemical process or subjected to some physical mixing operation intended to make the final product substantially uniform.

6.6 Sampling and testing precautions. This specification requires inspection of chemical material which is potentially hazardous to personnel. This specification does not purport to

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address all of the safety problems associated with its use. It is the responsibility of the user of this specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

6.7 Changes from previous issues. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.8 Subject term (key word) listing.

chemical
fertilizer
metal

MILITARY INTERESTS:

Custodians:

Army - EA
Navy - OS
Air Force - 68

Review activities:

Army - MD, ME
DLA - GS

CIVIL AGENCY COORDINATING ACTIVITIES:

GSA-FSS (9FTE-10)

Preparing activity:

Army - EA

Project No. 6810-1238

