

MIL-P-20306  
21 November 1951

MILITARY SPECIFICATION

POWDER, IGNITION CARTRIDGE, (M9), 60MM AND 81MM MORTAR

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments, and supersedes the following specification:

Army 50-12-14B  
23 September 1947

This specification consists of this cover sheet and Specification 50-12-14B, dated 23 September 1947, attached hereto, without modification.

When a request for this specification is received by a supplying activity it will be necessary to attach this cover sheet to the pertinent specification before issue.

Copies of specifications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer .

Custodian:  
Army-O

U. S. ARMY  
SPECIFICATION

No. 50-12-14B  
23 September 1947  
Superseding  
No. 50-12-14A  
23 January 1945

POWDER, IGNITION CARTRIDGE, (M9), 60MM AND 81MM MORTAR

A. APPLICABLE SPECIFICATIONS, OTHER PUBLICATION, AND DRAWINGS.

A-1. Specifications. The following specifications, of the issue in effect on the date of invitation for bids, form a part of this specification:

Federal Specification

RR-S-366 Sieves; Standard, Testing

Joint Army-Navy Specifications

JAN-D-98 Diphenylamine

JAN-G-155 Graphite (For Use in Ammunition)

JAN-P-156 Potassium Nitrate

JAN-N-244 Nitrocellulose (For Use in Explosives)

JAN-N-246 Nitroglycerin

JAN-A-489 Acetone (For Use in Ammunition)

U. S. Army Specifications

50-0-1 General Specification for Ammunition, except Small Arms Ammunition

100-2 Standard Specification for Marking Shipments by Contractors.

A-2. Other publication. The following publication, of the issue in effect on the date of invitation for bids, forms a part of this specification.

Interstate Commerce Commission Regulations

Regulations for Transportation of Explosives and Other Dangerous Articles, etc.

A-3. Drawings. The following drawings of the issue in effect on the date of invitation for bids, form a part of this specification:

Ordnance Department Drawings

CP-24114 Bath, Heat Test

76-4-43 Container, Black Powder, Storage, and Shipping, Assembly.

76-4-44 Container, Black Powder, Storage, and Shipping, Details.

C. MATERIAL AND WORKMANSHIP.

C-1. Materials. The raw materials used in the manufacture of powder purchased under this specification shall conform to the requirements of specifications listed in paragraph A-1. In addition, the following materials shall be of the type, grade, or class specified as follows:

Nitrocellulose - Joint Army-Navy Specification JAN-N-244, grade C, type If.

Potassium nitrate - Joint Army-Navy Specification JAN-P-156, class c.

Graphite - Joint Army-Navy Specification JAN-G-155, grades III or IV.

C-2. Workmanship.

C-2a. Process. The process of manufacture and the equipment used by the contractor shall be approved by the Government inspector in writing before the

contractor proceeds with the manufacture and packing of the powder or continues with the manufacturing or packing in case, at any time, the product proves unsatisfactory. In case any process of manufacture shall appear to be questionable, the inspector shall bring the matter to the attention of the Chief of Ordnance, notifying the contractor of his action, in writing within 24 hours.

C-2b. With every lot of powder submitted for acceptance the contractor shall furnish, on official blanks, eight copies of a description sheet giving a complete history of its manufacture and results of chemical and physical analyses.

#### D. GENERAL REQUIREMENTS.

D-1. See section E.

#### E. DETAIL REQUIREMENTS.

##### E-1. Composition

Nitrocellulose	57.75 $\pm$ 1.50
Nitroglycerin	40.00 $\pm$ 1.50
Potassium Nitrate	1.50 $\pm$ 0.50
Diphenylamine	0.75 $\pm$ 0.10

The above percentages are on a volatile-free basis.

E-2. Total volatiles. Maximum, 0.50 percent.

E-3. Graphite coating. Maximum, 0.20 percent.

E-4. Ash. Maximum, 0.40 percent.

E-5. Form and dimensions.

E-5a. Form. Solid disks.

E-5b. Dimensions.

	<u>60mm Mortar</u>	<u>81mm Mortar</u>
Diameter, inches	0.035 $\pm$ 0.003	0.059 $\pm$ 0.003
Thickness, inches	0.00325 $\pm$ 0.001	0.0100 $\pm$ 0.0020

E-6. Heat test requirement (120°C.). When tested as described in paragraph F-4c, complete fading of the methyl violet test paper to a salmon pink color shall not occur in less than 40 minutes. Fumes shall not be visible in 60 minutes test time.

E-7. Ballistic requirements. When the powder is tested as specified in paragraph F-4d, it shall meet the following ballistic requirements:

	<u>60 MM MORTAR</u>	<u>81 MM MORTAR</u>
Weight of charge, grains	14.5 $\pm$ 1.0	24.0 $\pm$ 1.0
Mean velocity, f/s	1665 $\pm$ 10	2255 $\pm$ 10
Maximum velocity variation, f/s	70	70.0
Maximum velocity variation from the mean velocity, f/s	16.0	16.0
Maximum mean pressure, psi	50,000	48,000

#### F. METHODS OF SAMPLING, INSPECTION, AND TESTS.

F-1. Size of lots.-Maximum, 10,000 pounds.

F-2. Sampling.-Each sample taken as specified in paragraphs F-2a and F-2b shall be packed in clean, dry airtight containers labeled to identify

as to chemical, stability, physical or ballistic sample and to show the name of the material, lot number, date of sampling, name of manufacturer, contract number, plant and number of pounds in the lot. In the case of ballistic samples, each label shall show the number of the container from which the sample was taken. Chemical and ballistic samples shall be sent to the facility designated by the Chief of Ordnance. Stability samples shall be sent to the Commanding Officer, Picatinny Arsenal, Dover, N.J.

F-2a. Ballistic sample. Select six containers so as to be representative of the lot. Take approximately 8 ounces of powder from each container and pack these samples in individual airtight containers.

F-2b. Chemical, physical, and stability samples. Take equal portions of powder from each container selected above so as to obtain two representative samples of about five pounds each.

F-3. Inspection. Inspection shall be made in accordance with U. S. Army Specification No. 50-0-1.

F-4. Tests.-

F-4a. Composition.

F-4a(1). Ether extractive matter. Take sufficient of the sample to make up two accurately weighed samples of approximately 5 gm. each. Transfer the samples to Soxhlet or equivalent extraction thimbles, and extract with alcohol-free anhydrous ether. Continue the extraction until completion is indicated by the absence of residue when a portion of the ether is evaporated to dryness. When completion is established, evaporate the extracts by heating on a steam bath at low temperature until approximately 25 ml. of ether remains. Complete the evaporation to dryness in a slow current of dry air for one of the extracts to be used for the determination of nitroglycerin. The extract to be used for the diphenylamine determination need not be evaporated to dryness.

F-4a(1)a. Diphenylamine.- Transfer the unevaporated extract, reserved for the diphenylamine determination in accordance with paragraph F-4a(1), to a 250 ml. beaker by means of ether, making the volume up to 100 ml. Carefully, with swirling, add 0.6 ml. of bromine, place the beaker on a steam bath maintained at approximately 75°C., and evaporate the ether with a current of dry air. Add 40 ml. of 95 percent (by volume) ethyl alcohol and heat the liquid to boiling. Add 40 ml. of hot water, with stirring, and allow the beaker to remain on the steam bath for 10 minutes. Filter the hot solution through a tared filtering crucible which has been warmed by the passage of some hot 47.5 percent (by volume) alcohol wash solution, and wash the retained precipitate of tetrabromdiphenylamine with 80 ml. of boiling 47.5 percent ethyl alcohol and finally with hot water. Dry the crucible and contents for 1 hour at 100°C., cool in a desiccator and weigh. Calculate the weight of the precipitate to percent diphenylamine on a volatile-free basis as follows:

$$\text{Percent diphenylamine} = \frac{34.87A}{W}$$

where A = gm. of tetrabromdiphenylamine

W = gm. of volatiles-free sample.

F-4a(1)b. Nitroglycerin.

F-4a(1)b(1). Preparation of solutions. Prepare the volumetric solutions that are necessary for this determination with freshly distilled water which

is free from atmospheric oxygen. Connect the siphon tubes and burets in such a way that only carbon dioxide gas, supplied from a Kipp generator, will be drawn into the stock bottles as the solutions are used. Replace the rubber tubing used for connections whenever longitudinal cracks appear. When no titrations are being made, turn off the stopcock in the tube connecting the Kipp generator with the stock bottle of titanous chloride solution and the buret. (See fig. 1.)

F-4a(1)b(2). Titanous chloride solution. Prepare a 0.2 normal solution of titanous chloride by mixing 150 ml. of 20 percent titanium trichloride solution with 100 ml. of 38 percent hydrochloric acid solution for each liter of solution. The mixing operation should take place before diluting, and, in these operations keep the solution protected from the air as much as possible by means of carbon dioxide. Mix the solution thoroughly with a current of carbon dioxide and store in a bottle covered with black paint or black paper to exclude light. To standardize the solution transfer an accurately weighed portion of 3.0 to 3.5 gm. of pure hexahydrated ferrous ammonium sulfate of known iron content to a 400 ml. beaker and dissolve in 50 to 75 ml. of water. Add 10 ml. of 38-percent hydrochloric acid solution and 0.5 gm. of potassium chlorate, then evaporate to dryness on a steam bath. Add 50 ml. of water, 5 ml. of 38-percent hydrochloric acid solution and evaporate again to dryness. Pass a current of carbon dioxide through a special type titration flask (see fig. 2) for 5 minutes to displace the air.

Dissolve the resulting ferric salt in a minimum quantity of water and transfer to the flask. Add 25 ml. of 15-percent hydrochloric acid solution and titrate with 0.2 normal titanous chloride solution, keeping a current of carbon dioxide passing through the flask. Near the end point, which can be judged by the gradual disappearance of the reddish-colored ferric salt, add 5 ml. of 20-percent ammonium thiocyanate solution. Continue the titration until the blood-red color of ferric thiocyanate just disappears. Apply temperature and buret corrections to the observed reading.

$$\text{Normality of titanous chloride solution} = \frac{W}{0.3921V}$$

where W = weight of ferrous ammonium sulfate

V = corrected volume of titanous chloride solution.

Check the normality of the titanous chloride solution at least once a week by titration with ferric ammonium sulfate solution.

F-4a(1)b(3). Ferric ammonium sulfate solution (0.15N). Prepare a 0.15 normal ferric ammonium sulfate solution by mixing 75 gm. of hydrated ferric ammonium sulfate ( $\text{Fe}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$ ) with 25 ml. of 95-percent sulfuric acid solution for each liter of solution, and mix thoroughly by means of a current of carbon dioxide. Displace the air in a titration flask with carbon dioxide. Accurately measure 40 to 45 ml. of ferric ammonium sulfate solution into the flask, add 25 ml. of 15-percent hydrochloric acid solution and 50 ml. of water. Titrate with 0.2 normal titanous chloride solution until near the end point, then add 5 ml. of 20-percent ammonium thiocyanate solution. Continue the titration until the red color just disappears. Apply temperature and buret corrections to the observed readings and calculate the normality of the ferric ammonium sulfate solution. It can be assumed that the strength of the solution will remain constant for an indefinite period.



F-4a(1)b(4). Ferrous chloride solution (0.7N). Prepare a 0.7 normal ferrous chloride solution by mixing 140 gm. of ferrous chloride tetrahydrate with 50 ml. of 38-percent hydrochloric acid solution for each liter of solution, and mix thoroughly by means of a current of carbon dioxide. This solution invariably contains a small amount of ferric iron, which must be determined by running a blank under the same conditions as in the analysis for nitroglycerin. Displace the air from a titration flask with a current of carbon dioxide. Add an accurately measured portion of 15 ml. of 0.7 normal ferrous chloride solution, 25 ml. of 15-percent hydrochloric acid solution, 25 ml. of glacial acetic acid, and boil for 5 minutes under a reflux condenser on a hot plate. Cool to room temperature by means of a large beaker of cold water, increasing the current of carbon dioxide so that no air will be sucked down into the flask. It is convenient to hold the index finger over the top of the condenser until equilibrium is established. Disconnect the condenser and add 5 ml. of 20-percent ammonium thiocyanate solution, then titrate with 0.2 normal titanous chloride solution. This volume of titanous chloride solution, usually 0.5 to 1.0 ml., must be subtracted from subsequent titrations involved in the determination of nitroglycerin. Run a blank at frequent intervals to determine whether the ferrous chloride solution has changed. Whenever any new bottles of reagents are used, run a new blank to detect any interfering impurities in these reagents.

F-4a(1)b(5). Procedure. Dissolve the dried residue in the flask reserved for the nitroglycerin determination (see par. F-4a(1)) with glacial acetic acid, transfer the solution to a 250-ml. volumetric flask, make up to volume with glacial acetic acid and mix thoroughly. Avoid temperature changes on account of the high thermal coefficient of expansion of acetic acid. Displace the air in a titration flask by passing in a current of carbon dioxide for 5 minutes. Rinse a calibrated 25-ml. pipet with the acetic acid solution of the sample, then transfer a 25-ml. portion of the solution to the flask. Add an accurately measured portion of 15 ml. of 0.7 normal ferrous chloride solution and 25 ml. of 15-percent hydrochloric acid solution, connect the flask to a reflux condenser, and boil the solution gently for 5 minutes on a hot plate. Add a few glass beads to prevent possible bumping. The color of the solution will change from yellow to dark green to reddish-brown as the reaction proceeds. Increase the current of carbon dioxide, then cautiously immerse the flask in a large beaker of cold water, keeping the index finger over the top of the condenser until the hot vapors are condensed. After cooling the flask and contents to room temperature, disconnect the condenser, insert a one-hole rubber stopper which contains a short piece of glass tubing. Insert the tip of the buret into the glass tubing, and titrate with 0.2 normal titanous chloride solution until near the end point, as shown by the disappearance of the reddish color of ferric iron. Add 5 ml. of 20-percent ammonium thiocyanate solution and continue the titration until the deep color of ferric thiocyanate just disappears. Apply temperature and buret corrections to the observed reading. Calculate the nitroglycerin content on a total volatiles-free basis.

$$\text{Percent nitroglycerin} = \frac{2.523 (V-B) N}{W}$$

where V = ml. of titanous chloride solution used  
 N = normality of titanous chloride solution  
 B = ml. of titanous chloride solution used for titration of blank made on reagents as directed above in the standardization of ferrous chloride solution.

W = gm. of sample, in the aliquot, corrected for total volatiles. The titrations on duplicate aliquot portions should check within 0.05 ml. In the foregoing calculation, the molecular weight of nitroglycerin is divided by 9 to obtain the equivalent weight.

**F-4a(2). Potassium nitrate.**

**F-4a(2)a. Preparation of reagent.** Dissolve 100 gm. of chemically pure trisodium cobaltinitrite  $\text{Na}_3\text{Co}(\text{NO}_2)_6 \cdot \text{H}_2\text{O}$  in water and dilute the solution to 500 ml. Store the solution in a dark bottle and avoid direct sunlight. This reagent is stable for only one week. Reagents older than one week should be discarded, as they tend to give high results. Standardize each lot of trisodium cobaltinitrite against a known solution of  $\text{KNO}_3$  containing 0.050 gm. per 25 ml. In the standardization, use a 20 percent solution of trisodium cobaltinitrite. The trisodium cobaltinitrite used in the analysis shall be a blend representing each bottle in the lot. The recovery shall be within  $\pm 3$  percent of the theoretical.

**F-4a(2)b. Procedure.** Weigh a 2 gm. sample into a tared 90mm evaporating dish, add 10 ml. of 70 percent  $\text{HNO}_3$  and place on the steam bath until the reaction starts. Turn off the steam until the reaction subsides, then evaporate to a gummy mass. (Do not take to dryness on a hot plate.) Place the dish on a nichrome triangle on a tripod and heat cautiously from the top by means of a burner. Finally, heat from the bottom until the bulk of the carbonaceous matter is removed, then transfer to a muffle furnace at dull red heat for 10 to 15 minutes. A small amount of carbon can be neglected. Allow the dish to cool, rinse the sides with 5 ml. of water, then add 5 ml. of concentrated  $\text{HCl}$ . Cover the dish with a watch glass, place the dish on the steam bath for 5 to 10 minutes, dilute the contents of the dish to approximately 25 ml., filter the solutions through a filter paper into a 150 ml. beaker, and wash the residues thoroughly. Evaporate the filtrate to dryness on the steam bath. Add 25 ml. of 1 N  $\text{HNO}_3$ , and cool to  $20^\circ\text{C}$ . By means of a graduate, add 15 ml. of cooled ( $20^\circ\text{C}$ .) 1 N trisodium cobaltinitrite solution (see par. F-4a(2)a) with stirring, to the cooled solution containing potassium ions. Cover the resulting mixture with a watch glass and allow to stand for 2 hours at  $20^\circ\text{C}$ . Filter the solution through a tared filtering crucible. Use a minimum amount of 0.01 normal nitric acid solution in a wash bottle to transfer the precipitate of dipotassium-sodium cobaltinitrite from the beaker to the crucible. Wash the precipitate with three 10 ml. portions of 0.01 normal nitric acid solution and then with three 5 ml. portions of alcohol. Aspirate the crucible until the contents are fairly dry, place the crucible and contents in an oven at  $100^\circ\text{C}$ . for 1 hour, cool in a desiccator and weigh.

$$\text{Percent potassium nitrate} = \frac{44.5A}{W}$$

where A = gm. of precipitate

W = gm. of the volatiles-free sample.

F-4a(3). Nitrocellulose. Calculate the percent nitrocellulose by subtracting from 100 percent the sum of percentages of all other ingredients.

F-4a(4). Total volatiles. Weigh accurately a 10 gm. portion of the sample in a tared aluminum dish with a glass cone-shaped cover. (See fig. 3.) Heat the apparatus on a closed steam bath (with an internal temperature of  $100^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .) for a period of two hours. Cool the apparatus in a desiccator containing calcium chloride and weigh. Calculate the loss in weight as percent total volatiles.

F-4a(5). Ash. Transfer the filter paper used in making the potassium nitrate determination under F-4a(2)b. to a previously ignited and weighed crucible, dry for 30 minutes at  $100^{\circ}\text{C}$ ., char the paper by means of a burner, ignite in a muffle furnace at dull red heat for 15 to 30 minutes, cool in a desiccator and weigh. Calculate the weight of residue as percent ash.

F-4a(6). Graphite. To 5 gm. of powder in a 250 ml. flask add approximately 30 ml. of 70 percent nitric acid. Place on a closed steam bath from 1 to 2 hours or until there is no evidence of undecomposed powder. Cool, filter through a tared acid washed filtering crucible, and wash the residue with hot water. After most of the free acid has been removed, wash with acetone until the washings come through colorless. Wash again with water and finally with acetone. Dry for one hour at  $100^{\circ}\text{C}$ ., cool in a desiccator and weigh. Calculate the weight of residue as percent graphite.

F-4b. Dimensions. Measure the diameter of 60 grains by means of a microscope having a magnification of not less than 25 diameters. Measure the thickness of the same grains by means of a micrometer. Calculate the average diameter and thickness.

F-4c. Heat test ( $120^{\circ}\text{C}$ .). Weigh out 5 portions of the sample, each weighing 2.5 gm., and place each in a heavy glass test tube (Pyrex or equal), approximately 15 mm. inside diameter, 18 mm. outside diameter and 290 mm. long. Place a piece of standard normal methyl violet paper, 70 mm. long and 20 mm. wide, vertically in each tube, its lower edge 25 mm. above the powder. Stopper the tubes with corks through which holes 4 mm. in diameter have been bored. Place the tubes in a constant temperature bath of  $120^{\circ} \pm 0.5^{\circ}\text{C}$ . (see Drawing CP-24114) so that no more than 6 or 7 mm. of length projects. Examine each tube by withdrawing one-half of its length and replacing quickly at 5-minute intervals after 35 minutes have elapsed. Record as the time of completion of the test, the time of the observation which reveals the test paper in any tube to be completely changed to a salmon pink color. At the end of 60 minutes of heating, remove the tube from the bath, place in front of a white paper, and note if any fumes are present in the tube.

F-4d. Ballistic tests. The following weapon and components shall be used in all ballistic tests:

Caliber .30 U. S. Rifle, Model 1903  
Cartridge Case, M1  
Bullet, M2, 152 Grains

Set up the velocity rifle or pressure gage in the mechanical stand; wash it with water, and wipe dry before using for test. Fire three warming shots at intervals of one minute, using small charges of the powder to be tested. Begin the firing of the test cartridges not less than 5 minutes after fir-



ing the last warming shot. In each of the required velocity and pressure tests, fire consecutive shots at intervals of not more than 2 minutes. All ballistic tests shall be made with the powder at a temperature of  $70^{\circ} \pm 2^{\circ}\text{F}$ .

F-4d(1). Weight of charge. Determine the powder charge, within prescribed limits, required to give the prescribed mean velocity at 78 feet. Each of the charges fired shall be composed of powder selected from a blended sample consisting of equal portions from each individual ballistic sample.

F-4d(2). Velocity uniformity. Fire 20 rounds assembled with the above designated components with the charge of blended powder established above. Calculate the mean velocity and maximum velocity variation.

F-4d(3). Pressure uniformity. Using components specified above with the established powder charge, fire 10 rounds for pressure measurements. Determine the pressure in the standard F.A. pressure gage, using F.A. coppers of zero initial compression.

F-4g. Retest. Should a lot fail to pass the specified tests (either ballistic, chemical, or stability) it shall be rejected but it may, upon application from the manufacturer and approval of the Chief of Ordnance, be retested once.

#### G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT.

G-1. Packing. The powder shall be packed by the contractor in metal kegs. The type shall be in accordance with Ordnance Drawings 76-4-43 and 76-4-44, or a commercial drum of equal quality so constructed as to insure acceptance by common or other carrier for safe transportation at the lowest rate to the point of delivery. The container capacity shall be as follows:

60 mm mortar powder - 25 pounds per container

81 mm mortar powder - 27 pounds per container.

G-2. Marking. In addition to markings giving place and date of completion of manufacture, name of manufacturer, type of powder, Army lot number, and the designation of the weapon for which the powder is intended, and marking to insure safe handling as required by Interstate Commerce Commission Regulation for Transportation of Explosives and Other Dangerous Articles, etc., shipments shall be marked in accordance with the requirements of U. S. Army Specification No. 100-2.

#### H. NOTES.

H-1. Use. The powder covered by this specification is intended for use in ignition cartridges for 60 mm, and 81 mm. Mortar ammunition.

H-2. The use of this specification, whenever applicable, is mandatory on all procuring agencies of the Army.

Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by the implication or otherwise

as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Note. Copies of this specification may be obtained from the Office, Chief of Ordnance, Department of the Army, Washington, 25, D.C.

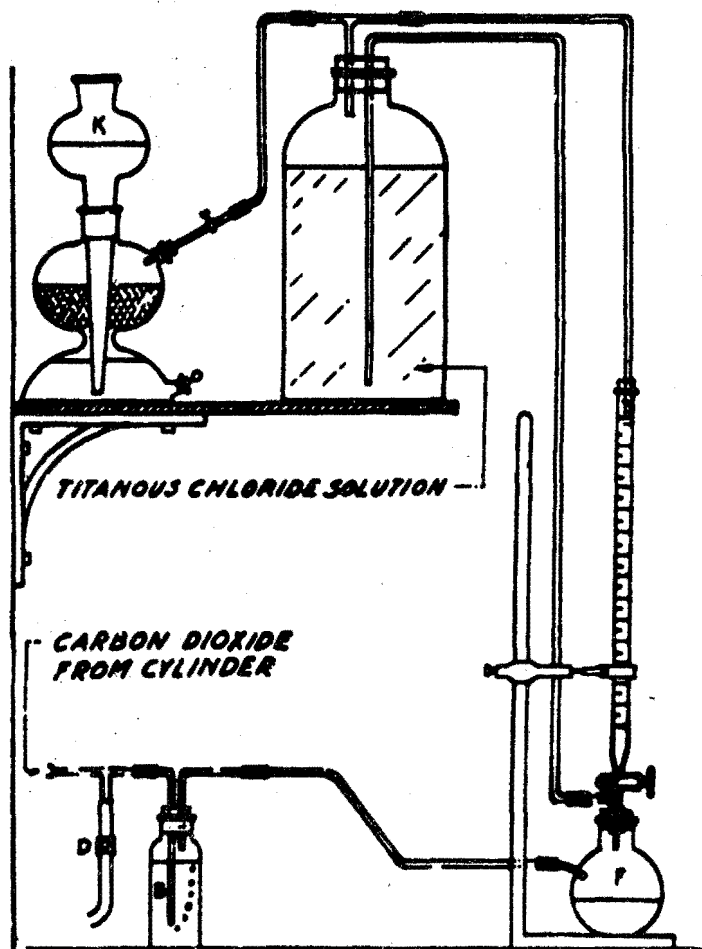
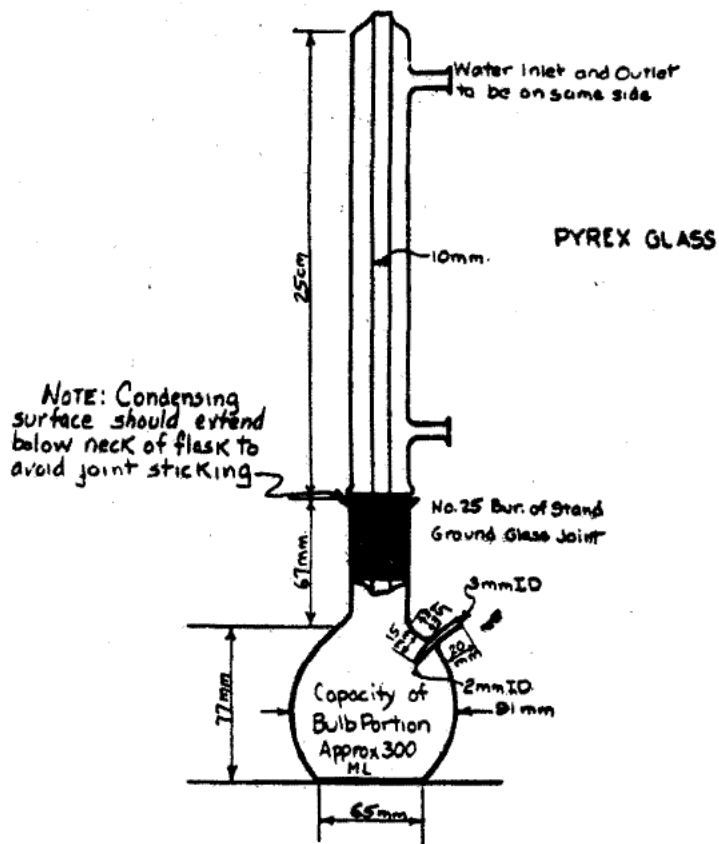


FIGURE 1.—Apparatus for storing and using titanous chloride solution.



All Dimensions Are Approximate

FIGURE 2.—Titration flask.

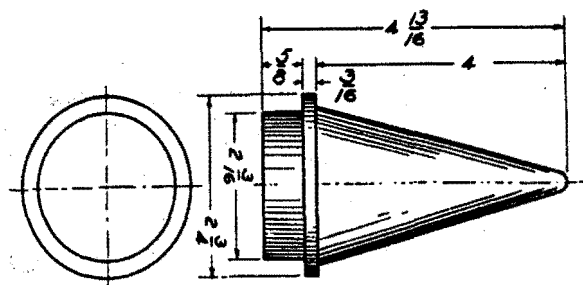


Figure 3 - Aluminum dish with cone-shaped cover.