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MILITARY SPECIFICATION

PBXN-4 EXPLOSIVE

This specification has been approved by the Bureau of Naval Weapons, Department of the Navy

1. SCOPE

1.1 This specification establishes the requirements for the procurement of the PBXN-4 Explosive, which is used in special applications. The PBXN-4 is of one type and one class.

2. APPLICABLE DOCUMENTS

2.1 Publications. - The following documents of the issue in effect on date of invitation for bids form a part of this specification to the extent specified herein.

AMERICAN SOCIETY FOR TESTING MATERIALS

Method B 311-58	Density of Cemented Carbides

CODE OF FEDERAL REGULATIONS

49 CFR 71-78	Transportation, Interstate Commerce Commission, Explosives and Other Dangerous Articles

FSC 1375

(The Interstate Commerce Commission regulations are now a part of the Code of Federal Regulations available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Application for copies should be addressed to Superintendent of Documents, Government Printing Office, Washington 25, D. C. Orders for the above publications should cite "49 CFR 71-78" with the latest editions and supplements thereto.)

3. REQUIREMENTS

3.1 Description. - The PBXN-4 is a plastic bonded explosive consisting of 94% of 1,3-diamino-2,4,6-trinitrobenzene (DATB) with 6% of polyamide. The polyamide is coated on the DATB particles to act as a binder.

3.2 General requirements.

3.2.1 Conflicting requirements. - Conflicting requirements arising between this specification and any specifications, publications, or drawings listed herein shall be referred in writing to the procuring agency or appointed agent for interpretation, clarification and resolution.

3.3 Performance requirements and product characteristics.

3.3.1 DATB

3.3.1.1 Purity. - The DATB used in the manufacture of PBXN-4 shall have a minimum purity of 99.5%, by weight, as determined in accordance with the provisions of 4.5.1.

3.3.1.2 Melting point. - The melting point shall not be less than 2°C below the comparison sample supplied by NOL. The melting range shall not exceed 2°C from the first appearance of liquid until final liquification. Test procedure shall be in accordance with the provisions of 4.5.2.

3.3.1.3 Vacuum stability. - The maximum rate of gas evolution shall be 0.16 ml per hour per gram average of DATB over a 24 hour period at 200°C as determined in accordance with the provisions of 4.5.3.

3.3.1.4 Bulk density. - The DATB shall have a minimum bulk density of 0.24 grams per milliliter as determined in accordance with the provisions of 4.5.4.

3.3.2 Polyamide (Nylon)

3.3.2.1 Nylon type. - The nylon used in the manufacture of the PBXN-4 shall be Zytel 63, a modified 6,6 nylon, as manufactured by E. I. du Pont de Nemours & Company, Inc., Polychemicals Dept., Wilmington 98, Del.

3.3.3 PBXN-4

3.3.3.1 Composition. - The PBXN-4 shall be composed of 94.0 ± 0.5% DATB and 6.0 ± 0.5% polyamide as determined in accordance with the provisions of 4.5.1.

3.3.3.2 Pressability. - The PBXN-4 when compressed in accordance with the provisions of 4.5.5, shall have a minimum density of 1.70 grams per cubic centimeter.

3.3.3.3 Moisture content. - The moisture content of the PBXN-4 shall not exceed 0.25 percent, by weight, as determined in accordance with the requirements of 4.5.6.

3.3.3.4 Bulk density. - The PBXN-4 shall have a minimum bulk density of 0.30 grams per milliliter, determined in accordance with the provisions of 4.5.4.

3.3.4 Workmanship. - The PBXN-4 incorporating all material entering into its manufacture, shall be formulated and processed in a manner to assure compliance with all requirements of this specification. Particular attention shall be paid to neatness and thoroughness of processing, and prevention of foreign matter from entering the process at all stages of manufacture.

3.3.5 Safety precautions. - Adequate safety precautions (see 6.3) shall be taken during the processing, testing and handling of DATB and PBXN-4. When the contractor is given the prerogative of test method selection, the test method selected shall be compatible with methods generally used by the explosives industry for explosive materials.

4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Sampling plans and procedures.

4.2.1 Inspection lot. - For the purposes of sampling, the term "lot" shall mean "inspection lot" or "manufacturer's batch", i.e., a quantity of product formulated or processed at one time under the same conditions. The maximum and minimum inspection lot sizes are determined by the Government and may differ from the quantity designated in the contract or order as a lot for shipment or other purposes. Unless otherwise specified in the contract or order, the quantity of material contained in an inspection lot of DATB or PBXN-4, as applicable, shall not be less than 100 pounds nor greater than 1000 pounds.

4.2.2 Acceptance sampling. - The sample used in testing for acceptability of product shall be selected in accordance with 4.2.2.1 and 4.2.2.2 below. Unless otherwise specified, acceptance test samples shall be furnished at the expense of the contractor.

4.2.2.1 DATB sampling. - Fifty gram samples of DATB shall be selected at random from each inspection lot on the following basis:

$$N = \sqrt{\frac{W}{50}}$$

where: N = Number of 50 gm samples required per inspection lot. (If a fractional number, to the next highest whole number)

W = Weight of DATB prepared in the last chemical processing step (lbs)

4.2.2.2 PBXN-4 sampling. - Fifty gram samples of PBXN-4 shall be removed from individual shipping containers selected at random prior to closure on the following basis:

$$N = \sqrt{b}$$

Where: N= Number of 50 gm samples required per inspection lot (If a fractional number to the next highest whole number)
b= Number of shipping containers in the inspection lot

4.3 Acceptance test equipment. - The following items of test equipment are required to perform the acceptance tests of this specifications:

Vacuum stability test apparatus (see Figure 1)
Bulk density test apparatus
Hydraulic press and die (20,000-25,000 psi cap.)

4.4 Test and inspection equipment and facilities.- The manufacturer shall furnish and maintain all necessary test equipment, facilities, and personnel for performing all acceptance tests. The test equipment shall be adequate in quantity, and when definite requirements are not specified they shall be of sufficient accuracy and quality to permit performance of the required acceptance tests.

4.5 Test procedure.

4.5.1 Purity test. - A 400 ml volume of 1.0 N sodium hydroxide solution is added to a 0.2 - 0.5 gm specimen of the pulverized explosive in a 500 ml round bottom flask containing boiling chips to prevent bumping.

A condenser fitted with a deflection plate and glass beads, which prevent the spray from the alkaline solution from being carried over into the receiver, is connected to the round bottom flask. An adapter is run from the condenser to a 300 ml Erlenmyer flask containing 40 ml of a 2% solution of boric acid.

Heat is applied to the reaction flask by means of a heating mantle controlled by a Variac which is adjusted to keep the solution at a gentle reflux for about one hour. The heat input is then increased to effect distillation and approximately 150 ml of distillate are collected. Constant supervision is necessary to prevent temperature fluctuations

which might cause the liquid in the receiving flask to be drawn back into the alkaline solution in the reaction flask.

When the distillation is completed, the receiver is lowered and the adapter is removed and rinsed with distilled water. The amount of ammonia liberated is determined by titration with standard 0.1 N hydrochloric acid using 10 to 12 drops of a mixed indicator solution, bromcresol green-methyl red, prepared in accordance with 4.5.1.1 below. The end point is taken as the disappearance of the blue color, or the appearance of a faint pink with a correction of 0.02 ml. The weight of DATB is calculated using the formula.

$$\text{grams of DATB} = \frac{V \times N\ (243.1)}{(2)\ (1000)}$$

where: V = Volume of hydrochloric acid used (ml)
N = Normality of hydrochloric acid used (to four decimal places)
$\frac{243.1}{2}$ = Equivalent weight of DATB

This test shall be performed on one specimen from each of the samples specified in 4.2.2.1 and 4.2.2.2. The weight of DATB in each specimen of DATB and PBXN-4, expressed as a percentage of the original weight shall meet the requirements of 3.3.1.1 and 3.3.3.1, respectively. The weight of nylon in each specimen of PBXN-4, obtained by difference and expressed as a percentage of the original weight, shall meet the requirements of 3.3.3.1.

4.5.1.1 Indicator preparation. - Prepare 0.1 percent bromcresol green and 0.1 percent methyl red (both indicators purchased from Eastman Kodak Co.) solutions in 95 percent alcohol separately. Mix 10 ml of the bromcresol green with 2 ml of the methyl red solution in a bottle provided with a dropper drawn out into a fine capillary. The dropper delivers about 0.05 ml per 4 drops.

4.5.2 Melting point determination, - Any conventional method for the determination of melting points of crystalline materials may be employed with DATB. However, the same test conditions and technique shall be carried through when testing DATB for acceptance as that employed in testing the comparison sample supplied by NOL.

The melting point for this test shall be considered to be the temperature of final liquification. The melting point shall be determined on one specimen from each of the DATB samples specified in 4.2.2.1. The melting point of each specimen shall meet the requirements of 3.3.1.2.

4.5.3 Vacuum stability test.

4.5.3.1 The vacuum stability test is carried out in a sealed glass unit, Figure 1. These tubes are calibrated before use and contain a volume of approximately 10 ml. One mm (nominal) capillary bore Pyrex tubing is used for the manometer. The vacuum stability test chamber is a constant temperature block that accurately maintains a temperature within ± 0.5°C.

4.5.3.2 Calibration. - The volume of the hot zone is found by adding water from a burette to the open end of the sample tube until the water level reaches the height of the upper edge of the horizontal capillary tube (the point where the sample tube is to be sealed) allowing water to flow into the capillary tube to the 102 mm mark.

This volume of water in ml represents the volume of the hot zone for use in the calculations of 4.5.3.4 below. A zero reference mark is made on the capillary tube 820 mm up from the bottom of the 920 mm vertical section. The apparatus shall be thoroughly dry before the test procedure is started.

4.5.3.3 Procedure.

Transfer an accurately weighed sample of 0.2 to 0.3 gram, weighed to the nearest 0.5 milligram, to the calibrated sample tube. The tube is then sealed. As a safety measure, the sample tube is protected by a section of 3" to 4" capped iron pipe while the glass tube is being sealed (see Figure 2). Add 4 ml of mercury to the well of the manometer and evacuate to 1 mm or less. Turn off the vacuum pump and readmit the atmosphere to the mercury well.

Place the sample tube containing the specimen in the stability block after an initial room temperature reading has been recorded along with the barometer reading. After the specimen has been in the block thirty minutes take a reading, then a final reading is taken twenty-four hours later. The thirty minute reading is subtracted from the final reading and the difference in mm shall be corrected for changes in barometric pressure between the beginning and end of the test.

4.5.3.4 Calculation. - All calculations are corrected to STP. The volume of gas evolved per gram of specimen is calculated by the formula:

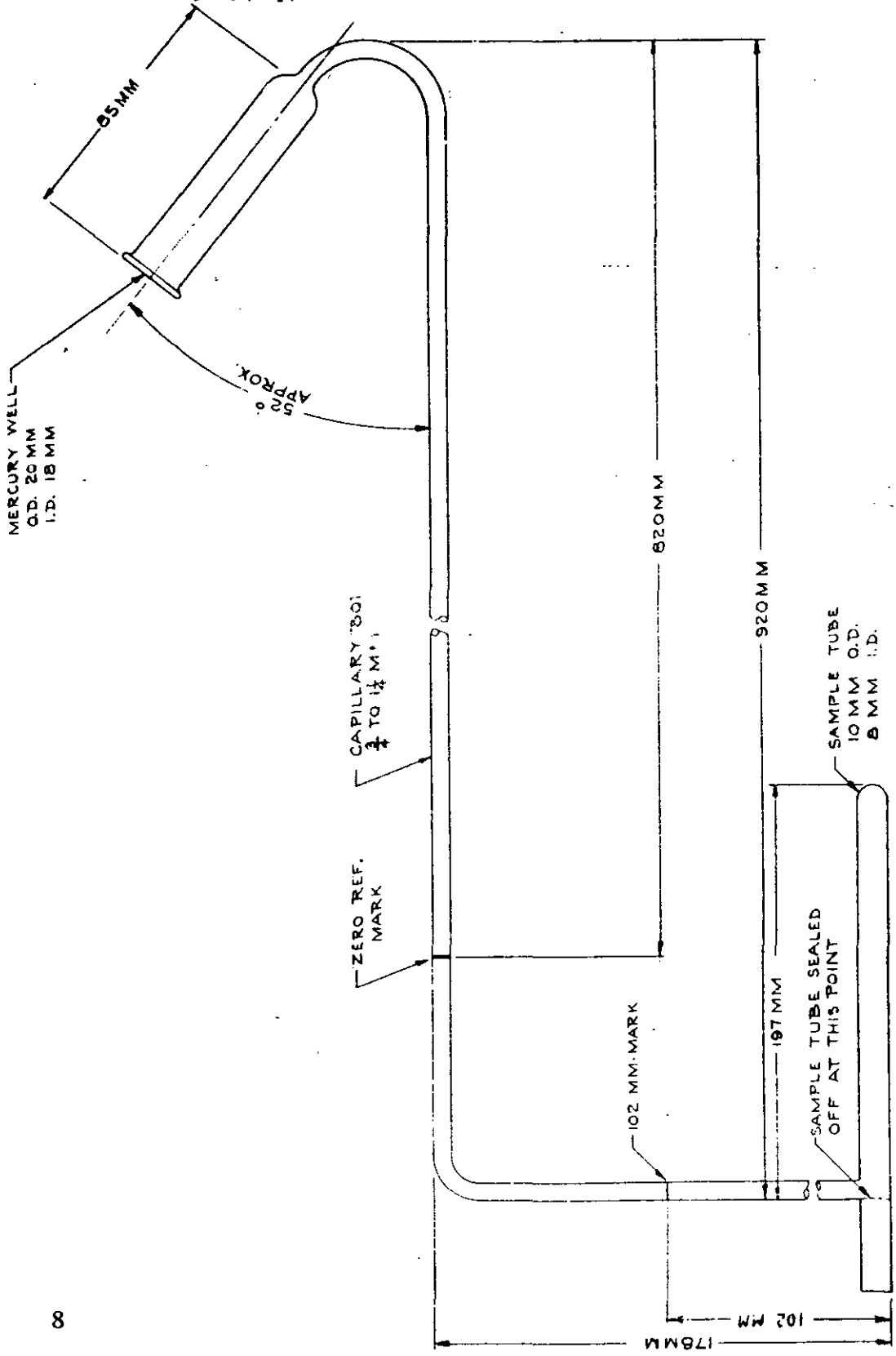


FIGURE 1

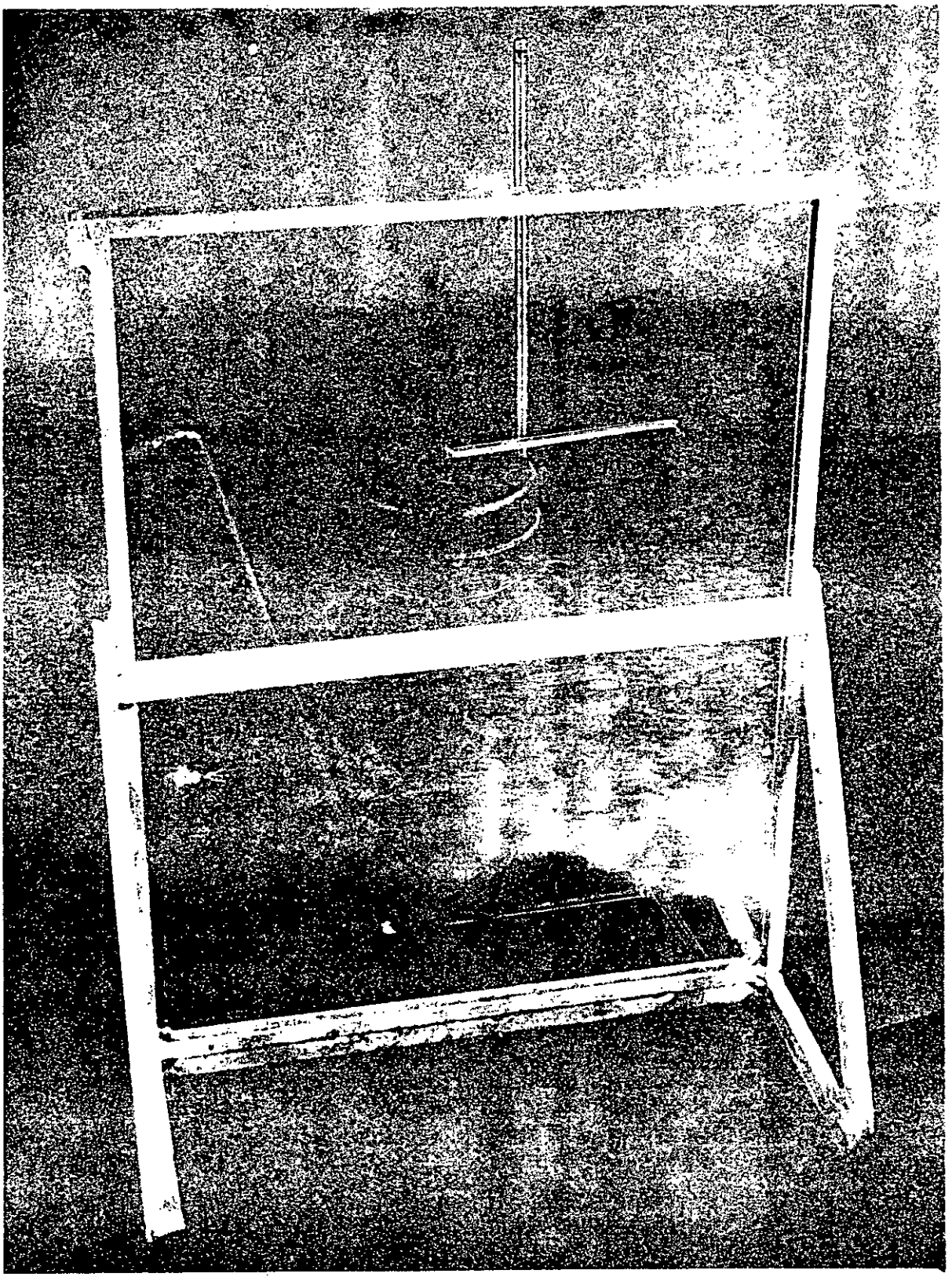


FIGURE 2

$$V = \frac{(x)\ (y)\ (z)}{w}$$

Where: V = ml gas/gram specimen/24 hours @ 200°C
x = Volume of hot zone (ml)
y = Conversion factor = 0.000759, = $\frac{273}{473 \times 760}$
z = Corrected reading in mm as described above in 4.5.3.3
w = Specimen weight in grams

This test shall be performed on one specimen from each of the DATB samples specified in 4.2.2.1. The volume of gas evolved per gram of specimen shall meet the requirements of 3.3.1.3.

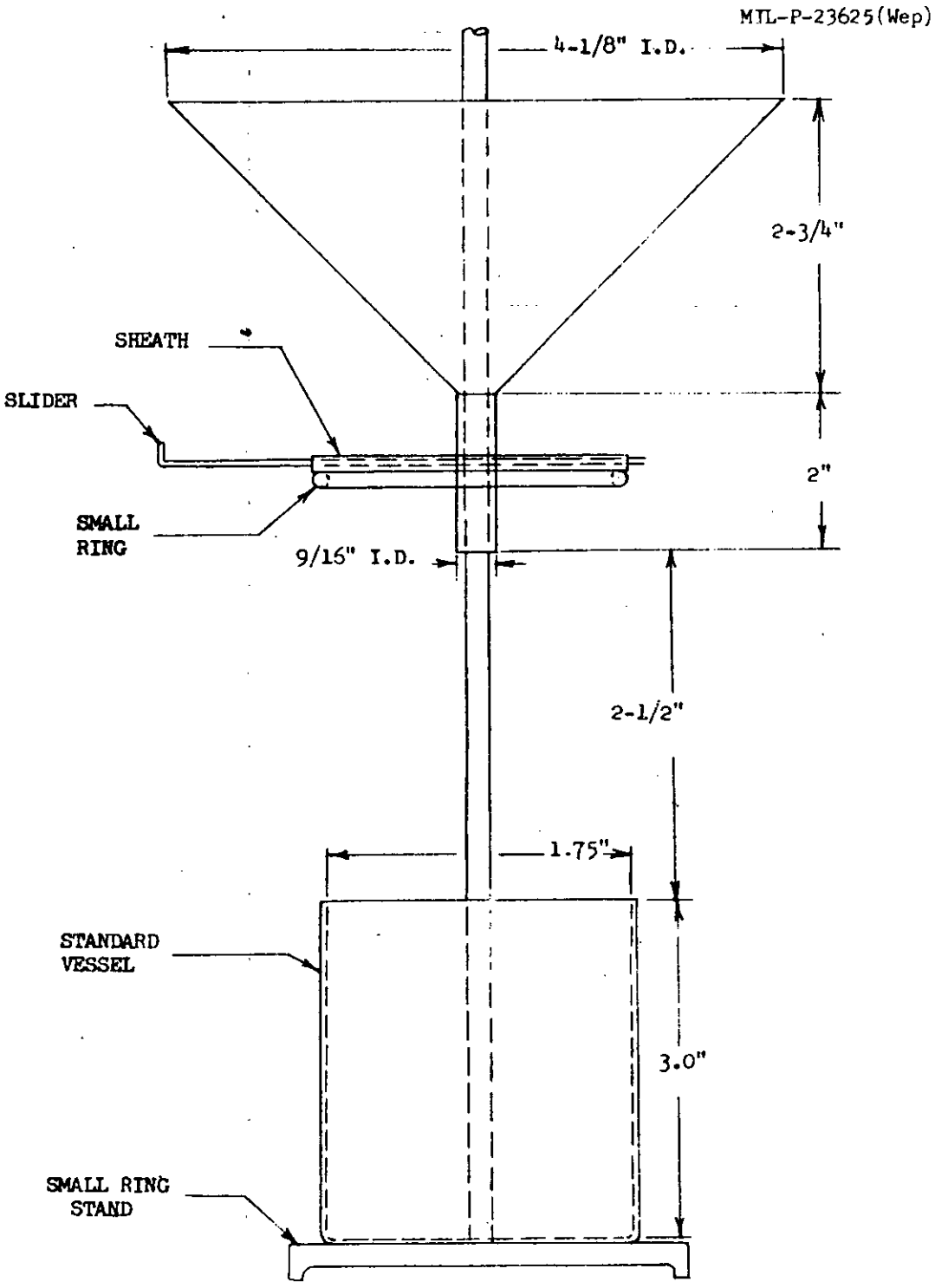
4.5.4 Bulk density. - The bulk density shall be performed on one specimen from each of the samples specified in 4.2.2.1 and 4.2.2.2 in accordance with the following procedure:

4.5.4.1 Apparatus.

(a) Small ring stand with small ring clamp.

(b) Sheet metal funnel 1/32 inch in thickness, the conical portion being 4-1/8 inches inside diameter at the top, and 2-3/4 inches over-all height. The attached stem of the funnel shall be 2 inches high and 9/16 inch inside diameter. Approximately midway along the length of the stem there shall be inserted a sheath for a sliding metal bar, as shown on Figure 3. The sheath and bar serve as a support for the funnel on the ring and act as a trap by means of which the sample shall be released into the standard vessel. The bar shall be 2 by 1-1/8 inches and the sheath shall have holes to fit the stem, and shall be of such size that it holds the bar with sufficient clearance for sliding.

(c) Standard vessel. - A standard vessel similar to that shown in Figure 3 or, instead thereof, a cylindrical vessel of glass or aluminum having a flat rim, straight sides, and a concave inside surface at the bottom to prevent bridging of the sample over sharp corners and a volume of approximately 100 mls; inside diameter approximately 1.75 inches; inside height approximately 3.00 inches; maximum weight approximately 41.0 grams.



APPARATUS FOR DETERMINING BULK DENSITY
OF PBXN-4 EXPLOSIVE

FIGURE 3

(d) Spatula.

(e) Analytical balance.

4.5.4.2 Procedure.

4.5.4.2.1 Standardization of standard vessel. - The standard vessel shall be filled with water at room temperature, until a convex meniscus is formed over the top of the glass. A small flat piece of glass shall then be pressed down over the top, forcing out the excess water. No air bubbles shall be seen beneath the surface of the glass. The exterior parts of the glass and cover shall then be dried carefully and the entire assembly weighed. Weight shall be recorded in grams to 2 decimal places. The dried glass and cover shall be weighed and calculations made as follows:

$$A - B = W$$

where:

A = weight of standard vessel, cover and water
B = weight of standard vessel and cover
W = weight of water

4.5.4.2.2 Density. - The sample shall be dried at approximately 80°C for 1/2 hour and cooled to room temperature in a desiccator. It shall then be spread on a piece of paper and carefully blended to insure a fair distribution of large and small crystals. The funnel shall be so placed on the ring (clamped to the ring stand) that the bottom of the stem shall be 2-1/2 inches above the top of the standard vessel. The standard vessel shall be set on the base of the stand under the center of the funnel. Approximately 130 ml of PBXN-4 measured by allowing the PBXN-4 to fall loosely through the funnel into a graduate cylinder, shall be transferred to the funnel, then the trap released so that there is a free fall of the crystals into the standard vessel. It shall be leveled off with a spatula from the center of the standard vessel to the sides (sides of spatula perpendicular to the surface of the vessel) first to one edge of the rim and then from the center to the other edge of the rim. Weigh on analytical balance. The bulk density shall be calculated as follows:

$$D = \frac{A - B}{W}$$

where:

A = weight of sample plus standard vessel
B = weight of empty standard vessel
W = weight of water
D = density

4.5.5 Pressability. - A hydraulic press is used to compress the specimen in a die having a 0.500 ± .002 inch diameter cylindrical cavity. The die shall be so designed to allow heating and evacuation prior to application of full ram pressure.

4.5.5.1 Procedure. - The mold and sample shall be preheated and allowed to reach equilibrium at 120°C + 5°C - 0°C. The mold plug is lowered to the surface of the sample in the mold, and the mold is evacuated to 10 mm of Hg pressure. Full ram pressure of 20,000-25,000 psi is then applied and allowed to dwell for 15-30 minutes before ejection. The resulting cylindrical pellet shall have a length of 1.000 ± .2 inch. A thin coat of fast drying varnish not exceeding 5 mils shall be applied and allowed to dry. Density determinations shall be made by the submersion method (ASTM Method B 311-58). Pellet density of PBXN-4 obtained by this method shall meet the requirements of 3.3.3.2. The pressability test shall be performed on one specimen from each of the samples specified in 4.2.2.2. The pressability of each specimen of PBXN-4 shall meet the requirements of 3.3.3.2.

4.5.6 Moisture content. - Five gram specimens of PBXN-4 shall be placed in tared porcelain crucibles and placed in an oven at 150°F. The samples shall be heated until constant weight is obtained. The crucible shall be removed, placed in a desiccator until cool, and weighed. The moisture content thus obtained by difference, shall be reported on a percentage basis. The moisture content test shall be performed on one specimen from each of the PBXN-4 samples specified in 4.2.2.2. The moisture content of each specimen shall meet the requirements of 3.3.3.3.

4.5.7 Acceptance criteria. - Failure of any specimen to meet the applicable requirement specified herein shall cause rejection of the lot.

5. PREPARATION FOR DELIVERY

5.1 Packaging, packing and marking.

5.1.1 Level A.

5.1.1.1 The PBXN-4 shall be packaged 50 pounds per fiberboard container. The packaging, packing and marking shall be in accordance with specification 23F65 which is a part of Code of Federal Regulations 49 CFR 71-78.

6. NOTES

6.1 Intended Use. - The PBXN-4 is intended for special explosive applications.

6.2 Ordering data. - Procurement documents should specify the specific title, number and date of this specification and exceptions to this specification, applicable drawings and other documents.

6.3 General safety precautions. - The formulation and processing of the material covered by this specification, and the ingredients entering into the process require suitable explosives safety precautions. Use of this specification shall not be construed as to relieve the contractor or manufacturer of responsibility for the safety of his operations. Listed below are certain minimum provisions which a contractor or manufacturer should observe in order to fulfill his responsibility for safety. At the Bureau of Naval Weapons, Navy Department, and other Government plants, these provisions are mandatory. Such other warnings and precautions, pertinent to the operational effectiveness or safety during processing of the specified material, are included in the detailed technical requirements of the specification.

6.3.1 All formulation and processing shall be performed in a neat and orderly manner.

6.3.2 Safe equipment and methods should be utilized for transporting and handling explosives and the ingredients used therein. Where required, remote control barricaded handling equipment shall be used for explosives operations such as mixing, pouring, weighing, charging, sifting, drying, etc.

6.3.3 The exposure of explosive materials and related parts should be so controlled as to minimize the absorption of moisture from the atmosphere or other sources.

6.3.4 All explosive and completely or partially processed explosive should be stored in suitable storage magazines located in accordance with the American Table of Distances (ATD) or other applicable safety standards; and, while in process, in safety lockers and chests if in loading rooms, or in adequate ready or service magazines located in accordance with intraplant distances when outside of loaded rooms. For Navy managed explosives loading plants, the provisions of the Armed Services Explosive Safety Board covering quantity-distance relations for explosives will apply.

6.3.5 Proper care must be exercised at all times to protect personnel from accidents, fires or explosions, and to limit damage to equipment and processing areas. In this connection, the precautionary measures in the following paragraphs should be observed:

6.3.5.1 Employ properly proportioned and properly located protective ba ricades, screens or shields at all required points.

6.3.5.2 Keep only minimum limited quantities of explosives and partially processed explosives present at each stage of operation.

6.3.5.3 Keep explosive materials in approved covered receptacles with covers in place when material is not being taken out of or put into the receptacles. When necessary, receptacles should be conductive to ground electrostatic charges.

6.3.5.4 Protect operations from electrostatic charges by effectively grounding all machinery, equipment, and fixtures; and, where necessary, employ suitable ground conductive coverings for floors, work benches and tables, and workers' conductive shoes. Workers' clothing of a type to minimize the accumulation of static charges should be employed. Fabrics such as silk and nylon, which promote static generation should be avoided. Where necessary for safety, humidity (see 6.3.3) of work rooms should be increased, as required, to lessen electrostatic effects without excessive moisture absorption.

6.3.5.5 Protect all explosive operations from effects of electric current originating from equipment such as heaters, switches, wiring, motors, lights, test instruments, etc., by suitable insulation, grounding, separation or shielding. Such electric sources may initiate explosives by heat, sparks or arcs.

6.3.5.6 Enforce, where necessary, the wearing of suitable safety footwear, gloves, goggles, respirators, and impregnated garments to protect personnel against burns, poisoning and associated industrial hazards.

6.3.5.7 Allow no fires or exposed electrical or other sparking equipment, and little or no flammable material to be present in loading, handling, and storage spaces. Enforce proper "Match" and "No Smoking" rules where necessary.

6.3.5.8 Enforce good housekeeping and maintain effective policing, inspection, and supervisory methods throughout the processing area. Employ effective cleaning methods periodically to minimize the accumulation of explosives or explosive dust and other contamination upon, and assure its removal from

floors, walls, ceilings, ledges, tables, benches, piping and equipment. Employ an adequate ventilation system to prevent an accumulation of toxic or flammable vapors in manufacturing or storage areas.

6.4 Manufacturing information. - Information obtained during research and development of this material indicates that the pressability requirements of this specification are more readily met if the process is controlled to:

(1) Produce DATB having an average particle diameter of 15 microns.

(2) Produce PBXN-4 having a bulk density approaching 0.6 grams per milliliter.

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 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.