

MIL-C-17605C(SH)
13 February 1980
SUPERSEDING
MIL-C-17605B(SHIPS)
10 September 1964
(See 6.3)

MILITARY SPECIFICATION

CHARCOAL, ACTIVATED, UNIMPREGNATED

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers one type of unimpregnated, activated charcoal for use in air filters in submarines.

2. APPLICABLE DOCUMENTS

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

SPECIFICATION

FEDERAL

PPP-B-636 - Boxes, Shipping, Fiberboard.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-129 - Marking for Shipment and Storage.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 6810

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DRAWING

NAVAL RESEARCH LABORATORY (NRL)
D-4176 - Sifter Filling Device.

(Copies of specifications, standards, 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 documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
D2854 - Apparent Density of Activated Carbon.
D2867 - Moisture in Activated Carbon.
D3466 - Ignition Temperature of Granular Activated Carbon.
D3802 - Ball Pan Hardness of Activated Charcoal.
E11 - Wire - Cloth Sieves for Testing Purposes.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

DEPARTMENT OF TRANSPORTATION (DOT)
Code of Federal Regulations - Title 49, Transportation.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

UNIFORM CLASSIFICATION COMMITTEE AGENT
Uniform Freight Classification Ratings, Rules, and Regulations.

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

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3. REQUIREMENTS

3.1 Materials. The charcoal specified herein shall be a high grade type suitable for the intended purpose. Only new charcoal shall be furnished. Mercury shall not be used for any purpose.

3.2 Adsorption. The activated charcoal shall have an activity of not less than 50 and a gas life of not less than 12 minutes to breakthrough with an air-carbon tetrachloride mixture, when tested as specified in 4.6.1.

3.3 Retention. The activated charcoal shall have a retention of not less than 50 when tested as specified in 4.6.1.

3.4 Particle size. The particle size shall be as specified in table I when tested as specified in 4.6.2.

TABLE I. Particle size.

| Sieve | Percent |
|---------------------------|----------|
| On No. 4 | 0.0 |
| Through No. 4, on No. 6 | 0 - 5 |
| Through No. 6, on No. 12 | 90 - 100 |
| Through No. 12, on No. 16 | 0 - 5.0 |
| Through No. 16, on No. 50 | 0 - 0.4 |
| Through 50, on pan | 0 - 0.2 |

3.5 Hardness. The hardness shall be greater than 94.0 when tested as specified in 4.6.3.

3.6 Apparent density. The apparent density shall be between 0.42 grams per milliliter (g/mL) and 0.57 g/mL when tested as specified in 4.6.4.

3.7 Moisture content. The moisture content shall be less than 5.0 percent when tested as specified in 4.6.5.

3.8 Ignition. The ignition temperature shall not be less than 350°C when tested as specified in 4.6.6.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for

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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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot. A lot shall consist of not more than 15,600 pounds of activated charcoal produced by one manufacturer without change in materials by one continuous process or in successive increments by the same intermittent process.

4.3 Sampling.

4.3.1 Sampling for tests. From each lot, a representative sample of not less than 25 pounds shall be taken using the sampling thief equipment. The sample shall be thoroughly mixed and placed in a clean dry container. The container shall have an airtight closure and shall be labeled to identify the lot represented. Each container lot shall be subjected to the tests specified in 4.6 and the balance of the sample shall be reserved for possible retest or until the lot has been accepted. Lot acceptance shall be in accordance with MIL-STD-105, general inspection level II, normal inspection.

4.3.2 Sampling for examination of filled bags. A random sample of the filled bags (see 4.7) shall be selected from each lot, with lot acceptance in accordance with MIL-STD-105, general inspection level II, normal inspection.

4.4 Examination of filled bags. Each sample of the filled bags selected in accordance with 4.3.2 shall be examined for defects of the bags, evidence of leakage, and for unsatisfactory markings. Each sample shall be weighed to determine the amount of the contents. Any bag in the sample having one or more defects, or under the required 5.2 pound fill, shall be cause for rejection. If the number of defective bags in any sample exceeds the acceptance number specified in 4.3.2, this shall be cause for rejection of the lot represented by the sample.

4.5 Tests. Each of the samples selected for testing as specified in 4.3.1 shall be subjected to all of the tests specified in 4.6. Samples shall be divided into portions, and all tests shall be conducted twice on each sample.

4.5.1 Retests and rejection. If any sample fails any test, a retest may be made for that test or tests in which a failure occurred. Samples shall be divided into portions, and all retests shall be conducted three times on each sample. If the sample fails on retest, the lot represented shall be rejected. However, the contractor may rework the defective lot and resubmit the lot for acceptance. If any sample from the resubmitted lot fails any test, the lot represented shall be rejected.

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4.5.2 Reports of tests. Quantitative test reports for each lot tested in accordance with 4.6 shall be furnished to the Government inspector (see 6.2.2). The test reports shall be signed by the director (or his authorized representative) of the laboratory in which the tests were conducted.

4.6 Test procedures.

4.6.1 Adsorption carbon tetrachloride activity.

4.6.1.1 Apparatus. The apparatus shall be assembled as shown on figure 1, or equal, and as follows: A 1/4-inch needle valve (A-A¹) shall be used to regulate the quantity of air to the apparatus. The air shall be as oil-free as possible. If the source of air is a compressor which may entrain oil in its delivered air, oil filters shall be placed ahead of the needle valve. Three water filled pressure regulators (A) shall be filled approximately 3/4 full with clean water. These water columns shall be adjusted up or down in accordance with the static resistance of the balance of the apparatus. The size of the pressure regulators shall be 2-inches in diameter by approximately 3-feet long. Two empty bottles (B) shall be used having a capacity of one liter each as entrainment traps. Three concentrated sulfuric acid bubbler bottles (C) having a capacity of one liter each shall be used to remove moisture from the air. These bottles shall be filled about half-full (500 milliliters (mL)). Rubber tubing connections shall be provided at (B-B¹) and (C-C¹) to facilitate removal of flask (D) containing the liquid carbon tetrachloride. The bottle shall be kept from 1/2 to 2/3 full of carbon tetrachloride at all times. The purity of the carbon tetrachloride shall be not less than 98 percent. One 10-inch diameter by 12-inch deep metal tank with drain cock (E) shall be provided. This tank shall be large enough to accommodate the carbon tetrachloride bottle (D) and enough ice to completely surround the bottle. A distribution manifold (F) shall be provided to the flowmeters (H) for the air-carbon tetrachloride mixture. A 2-way stop cock (G) shall be used to regulate the proper flow of air-carbon tetrachloride mixture to the flowmeter (H). The precalibrated flowmeter (H) shall be installed to regulate the proper flow of air-carbon tetrachloride to the carbon sample. These flowmeters shall be calibrated using 25 mL colored water in the bulb. The proper orifice size shall be selected to give the desired differential reading of the flowmeter about half-way up the stem of the flowmeter. The flowmeter shall be calibrated for the required flow by means of a wet meter of about 150 liters per hour capacity. The correct air flow through the carbon tubes (K) and (L) shall be 1000 mL per minute per square centimeter of internal cross-sectional area. For a tube of 1.41 centimeters (cm) internal diameter, the correct air flow shall be 1561 mL per minute. Variations in tube inside diameters shall necessitate revised calculations. Apply any corrections that are available on the wet meter used in the calibration of the flowmeters. A 4-way diverting stopcock or valve (I) shall be

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installed. This stopcock diverts the air-carbon tetrachloride mixture to the vent manifold (J) or to the carbon sample tubes (K and L) or to another 4-way diverting stopcock or valve (M). These valves (I and M) are not regulating valves, and the valves shall be wide open in whichever of the two ways the air-carbon tetrachloride mixture or air is flowing. A vent manifold (J) shall be provided to vent the air-carbon tetrachloride mixture to the outside of the building, away from any nearby personnel. The second valve (M) shall divert air from valve "I" to carbon sample tube "L" or to vent manifold "J" and divert air from carbon sample tube "L" to the vent manifold "J". The carbon sample tubes (K and L) shall be glass tubes having a disc screen mounted in the bottom, a side arm near the top, and a stopper in the top as shown on figure 1. The inside diameter of the tube shall be 1.41 cm. The height of the carbon sample above the top of the disc screen in the tube shall be exactly 10 cm. A line shall be etched on the outside of the tube for this purpose. In addition to the above, an analytical balance to weigh the carbon sample tubes (K and L) to plus or minus 0.5 milligrams (mg), an accurate clock with a sweep second hand for timing the test, and a mechanically actuated feeding device or a sifter filling device conforming to NRL Drawing D-4716 or equivalent shall be required.

4.6.1.2 Special apparatus requirements. An 8 cm pyrex glass tubing shall be used for all connections where possible. Rubber tubing of the pressure resistant, nonporous type shall be used for all interconnecting glassware. Joints of rubber tubing shall be kept as short as possible. Rubber tubing connections shall be replaced every six weeks to two months, during operation of the testing apparatus. Where rubber stoppers are used in this apparatus, it may be necessary to wire or fasten them in place to withstand the pressure built up in the apparatus during the test.

4.6.1.3 Testing apparatus for leaks. The apparatus shall be assembled and all filled components connected as shown on figure 1. The needle valve (A-A¹) shall be shut tight. Stopcock (G) shall be turned to open position. Stopcocks (I) shall be set so that flow of air-carbon tetrachloride mixture will be toward the carbon sample tubes (K). The tubing going to the vent stack shall be plugged off firmly as close to the carbon sample tubes (K and L) as possible. A 10-inch mercury manometer shall be attached in the system by disconnecting the pressure regulators (A) and inserting the former in their place. A pressure of 5-inches of mercury shall be applied through needle valve (A-A¹). Valve (A-A¹) shall be closed and the mercury column observed for 5 minutes. Leakage will be indicated by a drop in pressure. Leakage shall be found using a soap solution or other method. When and if no leakage takes place, the pressure on the system shall be released very slowly by means of stopcock (I), and the apparatus restored to its correct assembly.

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4.6.1.4 Preparation for tests. The ice bath tank shall be filled with chipped ice so that it completely covers the carbon tetrachloride flask. This should be done at least 1 hour before starting the test. Empty carbon sample tubes (K and L) shall be weighed to 0.5 mg and the weight recorded (W1 and W2). The carbon shall be thoroughly dried for 2 hours in a 120°C oven before testing. Filled carbon sample tubes (K and L) shall be weighed to 0.5 mg on an analytical balance, and the weights recorded (W3 and W4). Carbon sample tubes (K and L) shall be attached to the apparatus. Stopcocks (I and M) shall be turned to vent position. Stopcock (G) shall be closed. Needle valve (A-A¹) shall be opened slowly until a steady flow of air is going through the pressure regulators (A). Stopcock (G) shall be opened slowly and the differential reading adjusted on the flowmeters (H) to about 2-inches of mercury more than required for standard flow. When the flowmeters (H) have been thus adjusted, there shall still be a small flow of air through the pressure regulators (A). It is recommended that this adjustment be made on a practice run, prior to actual testing.

4.6.1.5 Testing procedures. The test shall be considered as started when stopcocks (I and M) are turned so that the air-carbon tetrachloride mixture is flowing to both of the carbon sample tubes (K and L). Flowmeters (H) shall be adjusted by means of the stopcock (G) to their standard differential reading of 1000 mL per minute per square cm as calibrated. Initially, the test shall be run for 12 minutes, at which time the stopcocks (I and M) are turned to the vent position. Carbon sample tube (L) shall be weighed (W5) to the nearest 0.5 mg and the weight recorded. The test shall be restarted by turning stopcock (I) to allow the air-carbon tetrachloride to enter the first carbon sample tube (K) only. Stopcock (M) shall be kept in the vent position for the remainder of the test. Following an additional 48 minutes of testing, stopcock (I) shall be turned to the vent position and the carbon sample tube (K) removed and weighed to the nearest 0.5 mg and the weight recorded (W6). (Note: The 1-hour test period has been shown to be more than ample time for saturation of any sample of activated carbon. It may be desirable in the interest of saving time to stop this test before a total of 1 hour has elapsed due to the carbon being fully saturated.) The carbon tetrachloride flask shall now be removed from the system and air only shall be blown through the carbon sample tube (K) for 2 hours. After 2 hours, the carbon sample tube shall be weighed to the nearest 0.5 mg and the weight recorded (W7).

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4.6.1.6 Calculations. Weights shall be recorded as follows:

- W1 = Weight of empty carbon sample tube (K).
- W2 = Weight of empty carbon sample tube (L).
- W3 = Weight of filled carbon sample tube (K) before test.
- W4 = Weight of filled carbon sample tube (L) before test.
- W5 = Weight of carbon sample tube (L) after 12 minutes of air-CCl₄ mixture flow through.
- W6 = Weight of carbon sample tube (K) after 1 hour of air-CCl₄ mixture flow through.
- W7 = Weight of carbon sample tube (K) after 1 hour of air-CCl₄ mixture and 2 hours of air flow through.

The 12 minute breakthrough minimum shall be calculated by subtracting W5 from W4. The result shall be 0.0 mg \pm 0.5 mg. The activity (A) shall be calculated as follows:

$$A = \frac{W6 - W3}{W3 - W1} \times 100$$

The retentivity (R) shall be calculated as follows:

$$R = \frac{W7 - W3}{W6 - W3} \times 100$$

4.6.1.7 Alternate method for calculating the 12 minute breakthrough. The 12 minute breakthrough minimum may be proved by using an infrared analyzer capable of monitoring 2 parts per million (p/m) of carbon tetrachloride to pinpoint the time of breakthrough. This method will eliminate the need for carbon sample tube (L).

4.6.2 Particle size.

4.6.2.1 Apparatus. The sieves to be employed in conducting the particle size test shall be U.S. Standard testing sieves, or equivalent, conforming to ASTM E11 for sieves for testing purposes. The sieves shall be 2-inches in height and 6-inches in diameter. A standard vibrating machine capable of accommodating six sieves plus a bottom pan and top cover shall be required. An electric timing switch is also required.

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4.6.2.2 Procedure. Sieves 4, 6, 12, 16, and 50 plus a bottom pan and top cover with largest sieve at the top, and the smallest at the bottom shall be nested. A sample of 100 ± 5 grams (g) of charcoal which meets the moisture requirements shall be weighed and placed in the top sieve. The nest of sieves, with the cover and pan in place shall be placed in the testing machine and vibrated for exactly 10 minutes. The percent retained on each sieve and the pan shall be calculated as follows:

$$\text{Percent retained} = \frac{\text{Weight of charcoal (in pan or sieves)} \times 100}{\text{Sum of each individually retained weight}}$$

If the sum of all individually retained weights exceeds the original sample of weight by more than 2.0 g, the test should be repeated.

4.6.3 Ball pan hardness. The apparatus and test procedures used to determine compliance with the hardness specified in 3.5 shall be in accordance with ASTM D3802.

4.6.4 Apparent density.

4.6.4.1 Apparatus. A mechanically actuated feeding device or a filling device conforming to NRL Drawing D-4176 and a 100 mL graduated cylinder shall be required.

4.6.4.2 Procedure. By the grinding and sieving method outlined in 4.6.2.2, a minimum of 30 cubic centimeters of a 6-16 mesh sample of a charcoal dried to constant weight shall be obtained to be tested. Using a mechanically actuated feeding device or a sifter filling device, the 100 mL graduated cylinder shall be filled to the 100 mL mark with the 6-16 mesh charcoal. The carbon sample shall be weighed to the nearest 0.1 g before and after filling. The weight difference between the empty cylinder and the filled cylinder divided by 100 shall be the apparent density of the charcoal in g/mL.

4.6.4.3 At the contractor's option, apparatus and test procedures used to determine apparent density may be in accordance with ASTM D2854 in lieu of those specified in 4.6.4.1 and 4.6.4.2.

4.6.5 Moisture content.

4.6.5.1 Apparatus. An analytical balance, a drying oven, and a tared weighing bottle shall be required.

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4.6.5.2 Procedure. Approximately 10 g of charcoal taken from sample (see 4.3.1) shall be placed in a tared weighing bottle and weighed in milligrams. It shall be dried at 120°C for 4 hours with the cover removed. At the conclusion of the drying period, the charcoal shall be cooled and the bottle containing the charcoal shall be weighed again, and the weight of the dried charcoal determined. The moisture content of the original charcoal shall be determined in percent from the difference in weight of the material from before and after drying and shall conform to 3.6.

4.6.5.3 At the contractor's option, apparatus and test procedures used to determine moisture content may be in accordance with ASTM D2867 in lieu of those specified in 4.6.5.1 and 4.6.5.2.

4.6.6 Ignition temperature.

4.6.6.1 Apparatus. A quartz ignition tube and sample holder, thermocouples, flowmeters, heating mantle, variable transformer, quartz beads, sieves, and a potentiometric recorder shall be required.

4.6.6.2 Procedure. The test shall be conducted in accordance with ASTM D3466.

4.7 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions.)

5.1 Packaging. Packaging shall be level A or C, as specified (see 6.2.1). A quantity of 5.2 pounds of charcoal shall be furnished in a cloth bag having dimensions of 12-inches by 6-inches by 5-inches. The bags shall be fabricated of unbleached cotton sheeting with double stitched sewn and square corners. The top of the cotton bag shall be left open for filling. The physical requirements of the cotton sheeting shall be 56 by 56 yarns per inch, 4.00 yards per pound, with a breaking strength (grab method) of not less than 45 pounds (warp) and 40 pounds (filling). After each bag has received 5.2 pounds of charcoal, the bag shall be stitched and the excess part of the bag folded to give minimum dimensions. It shall be further placed in a multilayer paper bag with strength to withstand normal abuse and of a minimum size.

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5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2.1).

5.2.1 Level A. Twelve units of charcoal, packaged as specified in 5.1, shall be packed in a fiberboard box conforming to style RSC, type CF, class weather-resistant, variety SW, grade V3c of PPP-B-636. Box closure, waterproofing, and reinforcing shall be in accordance with method V of the appendix to PPP-B-636, as applicable to class weather-resistant boxes.

5.2.2 Level B. Twelve units of charcoal, packaged as specified in 5.1, shall be packed in a fiberboard box conforming to type RSC, type CF, class domestic, variety SW grade 275. Boxes shall be closed in accordance with the appendix to PPP-B-636.

5.2.3 Level C. Charcoal, packaged as specified (see 5.1), shall be packed for shipment in a manner which will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply to the Uniform Freight Classification Rules or other carrier regulations as applicable to the mode of transportation.

5.3 Marking. In addition to any special marking required (see 6.2.1), interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129, DOT Regulations, Title 49, and as specified in 5.3.1:

5.3.1 Unit packages and exterior shipping containers shall include the following markings:

- (a) "Activated charcoal, unimpregnated."
- (b) "Intended use: Submarine vent and air conditioning."

6. NOTES

6.1 Intended use. The charcoal covered by this specification is for use in filters in submarines for purification of the ambient air and for use in sanitary and water closet filter canisters on submarines.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Levels of packaging and packing required (see 5.1 and 5.2).
- (c) Markings other than specified (see 5.3).

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6.2.2 Data requirements. When this specification is used in a contract which invokes the provision of the "Requirements for Data" of the Defense Acquisition Regulation (DAR), the data identified below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the DAR are not invoked in a contract, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

| <u>Paragraph</u> | <u>Data requirements</u> | <u>Applicable DID</u> | <u>Option</u> |
|------------------|--------------------------|-----------------------|---------------|
| 4.5.2 | Reports, test | UDI-T-23729 | ----- |

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 of the specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Changes from previous issue. Asterisks (*) are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 6810-NB03)

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LEGEND

- A - PRESSURE REGULATORS WATER FILLED
 B - LIQUID TRAPS
 C - SULFURIC ACID(CONC) - MOISTURE REMOVAL
 D - CARBON TETRACHLORIDE FLASK
 E - ICE BATH CANISTER
 F - DISTRIBUTION MANIFOLD TO FLOWMETERS
 G - REGULATING STOPCOCK FOR FLOWMETERS
 H - CALIBRATED FLOWMETER
 I, M - 4-WAY STOPCOCKS
 J - VENT MANIFOLD
 K, L - CARBON SAMPLE TUBE

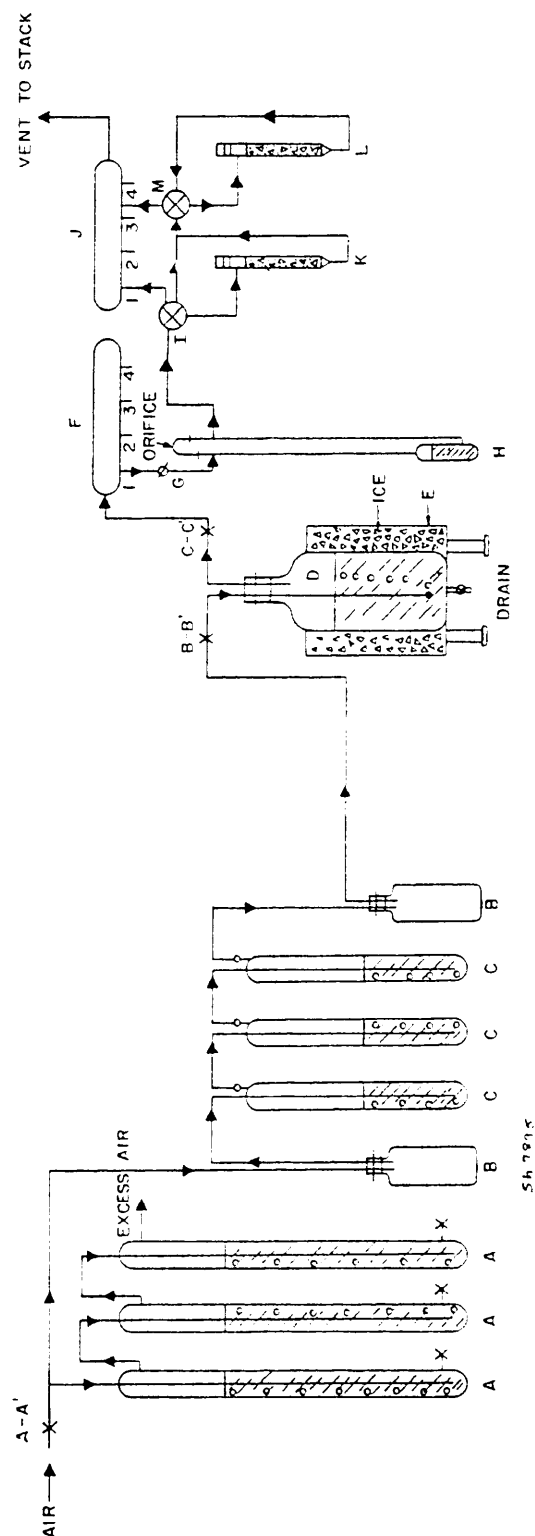


FIGURE 1. Carbon tetrachloride testing apparatus - flow diagram.

| STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL | | OMB Approval No. 22-R255 |
|---|--|-----------------------------|
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DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362

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