

INCH-POUND
MIL-PRF-2912G (SH)
29 September 2004
SUPERSEDING
MIL-PRF-2912F (SH)
26 July 1988

PERFORMANCE SPECIFICATION

SYNTHETIC RUBBER COMPOUND, ACID AND OIL RESISTANT

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 the material for lining the battery compartments of submarines and other compartments aboard ships with a synthetic rubber compound which is resistant to battery acid and hydrocarbon oils (see 6.1).

1.2 Classification. The lining material will be the following type:

Type II - Synthetic rubber which is applied in the vulcanized state by adhering it to the compartment with adhesive.

Note: The Type I material which was included in previous versions of this document is obsolete and has been deleted.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navsea.navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil

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2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-289 - Visual Inspection Guide for Rubber Sheet Material.

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

BUREAU OF MEDICINE AND SURGERY (BUMED)

BUMED INST 6270.8 - Procedures for Obtaining Health Hazard Assessments Pertaining to Operational Use of a Hazardous Material.

(Copies of this document are available online at <https://bumed.med.navy.mil> or from Bureau of Medicine and Surgery, Department of the Navy, 2300 E Street, NW, Washington, DC 20372-5300.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

S9510-AB-ATM-010 Rev 2 of 30 July 1992 - Nuclear Powered Submarine Atmosphere Control Manual.

(Copies of this document are available from the Naval Sea Systems Command, Code SEA 05Z9, 1333 Isaac Hull Avenue, SE, Stop 5133, Washington Navy Yard DC 20376-5133.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension. (DoD adopted)

ASTM D 471 - Standard Test Method for Rubber Property - Effect of Liquids. (DoD adopted)

ASTM D 572 - Standard Test Method for Rubber - Deterioration by Heat and Oxygen. (DoD adopted)

ASTM D 2240 - Standard Test Method for Rubber Property - Durometer Hardness. (DoD adopted)

(Copies of these documents are available from www.astm.org or ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959.)

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2.4 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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.4.

3.2 Material.

3.2.1 Physical properties. The material in the Type II lining shall conform to the physical requirements specified in Table I.

TABLE I. Physical requirements of rubber compounds.

Description	Requirement	Test procedure
Compatibility	No softening or decomposition	4.2.2
Tensile strength, initial, pounds per square inch (lb/in ²), minimum	1400	4.6.2
Ultimate elongation, initial, percent minimum	250	4.6.2
Adhesion to steel and between plies, rate of separation under a 15-pound load, inches per minute, maximum	1	4.6.3
After oxygen pressure aging:		4.6.4
Tensile strength, percent change from initial, maximum	25	4.6.4.1
Ultimate elongation, percent change from initial, maximum	25	4.6.4.1
Adhesion to steel and between plies, rate of separation under a 12-pound load, inches per minute, maximum	1	4.6.4.2
After immersion in acid:		4.6.5
Weight, percent change from initial, maximum	2	4.6.5.1
Tensile strength, percent change from initial, maximum	25	4.6.5.2
Ultimate elongation, percent change from initial, maximum	25	4.6.5.2
After immersion in oil:		4.6.6
Volume, percent change from initial, maximum	15	4.6.6.1
Tensile strength, percent change from initial, maximum	20	4.6.6.2
Ultimate elongation, percent change from initial, maximum	20	4.6.6.2
Adhesion to steel and between plies, rate of separation under a 12-pound load, inches per minute, maximum	1	4.6.6.3
Plastic flow characteristics:		4.6.7
Original deflection, inches, maximum	0.020	
Deflection after 48 hours, inches, maximum	0.028	
Increase of deflection after 48 hours, due to plastic flow, inches, maximum	0.010	
Hardness, Shore A durometer	50 to 70	4.6.8

3.2.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material

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meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Construction. Type II material shall be supplied in rolls 36 inches wide minimum and 1/16-inch thick plus 1/32 minus 0-inch thick. Edges shall be straight.

3.4 Workmanship. Workmanship shall be such as to meet all applicable requirements of this specification. Surfaces shall be free of surface voids, tears, rips, cuts and free from all foreign matter that may affect the use of the product.

3.5 Off-gassing. The material shall meet the requirements in the Nuclear Powered Submarine Atmosphere Control Manual, S9510-AB-ATM-010 Rev 2 of 30 July 1992, for a usage category of Limited (see 4.7 and 6.5).

3.6 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose. The material shall be assessed by the Navy Environmental Health Center (NAVENVIRHLTHCEN) using the administrative Health Hazard Assessment (HHA). A flowchart for this process can be found as enclosure (1) of BUMEDINST 6270.8. The HHA is a review of the material based on information submitted by the manufacturer, to assess health hazards associated with the handling, application, use and removal of the product. The material shall not cause any environmental problems during waste disposal (see 4.8 and 6.6).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- (a) First article inspection (see 4.4).
- (b) Conformance inspection (see 4.5).

4.2 Preparation of samples. First article and conformance inspections of Type II rubber compound shall be performed on a sample prepared as follows: four steel plates shall be prepared for the conformance inspection of the material. Two steel plates shall be prepared for the first article inspection. The mild steel plates, 12 by 12 by 1/8-inches shall be blasted gray white. Immediately after blasting, one side of each plate shall be coated with GACO N-11 primer or equivalent to prevent re-oxidation. The primer shall be allowed to dry for a minimum of one hour and should be thoroughly dry before proceeding with subsequent operations.

4.2.1 For both conformance and first article, a single plate shall be prepared as follows: the plate shall be coated with one coat of accelerated bonding cement, GACO N-29 or equivalent. After the bonding cement has dried, it shall be covered with a 1/16-inch layer of accelerated putty, GACO N-250 or equivalent. The putty shall be allowed to dry for a minimum of 8 hours. A coat of accelerated bonding cement, GACO N-29 or equivalent shall be applied to the puttied surface and the rubber sheet. A 3-inch wide strip of separating material such as aluminum foil shall be located between the putty and the rubber sheet along one edge of the plate to facilitate testing of adhesion between the rubber sheet and the putty. The rubber sheet shall be pressed firmly onto the putty surface such that no raised or soft spots occur on the panel. A steel roller may be used to assure good adhesion.

4.2.2 The three additional plates for conformance and the single additional plate for first article shall be prepared as follows: the plate or plates shall be coated with one coat of accelerated bonding cement, GACO N-29 or equivalent. The rubber sheets for each plate shall be coated on both sides with accelerated bonding cement, GACO N-29 or equivalent. After the bonding cement has dried, the rubber sheet shall be applied to the plate. A 3-inch wide strip of separating material such as aluminum foil shall be located between the plate and the rubber sheet along one edge of the plate to facilitate testing of adhesion between the plate and the rubber sheet. A second rubber sheet shall be coated on one side with accelerated bonding cement, GACO N-29 or equivalent and allowed to dry. A 3-inch wide strip of separating material such as aluminum foil shall be located between the rubber sheets along one edge to facilitate testing for adhesion between the plies. The second rubber sheet shall be pressed firmly onto the prepared plate on top of the first rubber sheet, such that no raised or soft spots occur on the plate.

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A steel roller may be used to assure good adhesion. The completed sample shall be visually observed for evidence of softening or decomposition of the rubber compound at the interfaces with the primer, accelerated bonding cement and accelerated putty.

4.3 Preparation of test specimens. The test specimens shall be prepared in accordance with the requirements of the tests as specified herein.

4.4 First article inspection. First article inspection of the samples shall consist of the tests specified in 4.4.1, 4.7 and 4.8.

4.4.1 First article tests. Samples prepared as specified in 4.2 or 4.3, as applicable, shall be tested for following properties:

- (a) Tensile strength and elongation (see 4.6.2).
- (b) Adhesion (see 4.6.3), both samples.
- (c) Oxygen pressure aging (see 4.6.4).
 - (1) Tensile strength and elongation (see 4.6.4.1).
 - (2) Adhesion (see 4.6.4.2).
- (d) Immersion in acid (see 4.6.5).
 - (1) Weight (see 4.6.5.1).
 - (2) Tensile strength and elongation (see 4.6.5.2).
- (e) Immersion in oil (see 4.6.6).
 - (1) Volume (see 4.6.6.1).
 - (2) Tensile strength and elongation (see 4.6.6.2).
 - (3) Adhesion (see 4.6.6.3).
- (f) Plastic flow (see 4.6.7).
- (g) Hardness (see 4.6.8), double rubber ply sample only.

4.5 Conformance inspection. Conformance inspection shall consist of the examinations and tests pertaining to the material (see 4.5.1)

4.5.1 Conformance inspection of the material. The following examinations and tests shall be performed on test specimens of the material. All tests shall be conducted on the two rubber sheet ply samples. Only the subparagraph (a) adhesion test shall be conducted on the putty and rubber sheet ply sample:

- (a) Adhesion (see 4.6.3).
- (b) Hardness (see 4.6.8).

4.5.2 Rejection. If the material fails to conform to all the requirements for which it is tested, the lot of the material represented by the samples or test specimens shall be rejected.

4.6 Methods of examination and test. No tests shall be made on Type II material until the curing time of 24 hours has elapsed; however, this curing time shall not exceed 14 days.

4.6.1 Visual examination. A visual examination shall be conducted to detect defects in workmanship to ensure conformance to 3.4. MIL-STD-289 shall be used to determine and evaluate defects.

4.6.2 Tensile strength and ultimate elongation. Tensile strength and ultimate elongation shall be determined in accordance with ASTM D 412. Dumb-bell specimens shall be prepared using die C. The material of the specimens shall have a uniform thickness within the range of 0.70 to 0.80 inch and shall have an equivalent cure to the rubber lining material.

4.6.3 Adhesion. The adhesion between plies and between the rubber and steel and between rubber and putty shall be measured at room temperature, 70 to 90 degrees Fahrenheit (°F), on a 12 by 12 inch panel. The

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lining of the 12 by 12 inch panel shall be cut through to the steel with a sharp knife to give three strips, each 1 by 12 inches, as shown on Figure 1. The method for determining adhesion to steel and ply adhesion shall be as shown on Figure 1. The panel shall be supported in a horizontal position with the lining on the underside. A sufficient length of the outer ply of one strip shall be separated from the inner ply to permit attachment of a clamp. A dead-weight load of 15 pounds (clamp plus weight) shall be suspended from the outer ply, and the rate of separation of the ply measured. The test shall be performed on the outer ply of each of the three strips; then it shall be performed on the inner ply of each of the three strips to evaluate the adhesion between the rubber and the steel. Results shall conform to the specification.

4.6.4 Oxygen pressure aging. Oxygen pressure aging shall be performed using the equipment and procedure specified in ASTM D 572.

4.6.4.1 Effect of aging on tensile and elongation properties. Three dumb-bell specimens prepared as specified in 4.6.2 shall be used. After aging they shall be tested by the procedure specified in 4.6.2.

4.6.4.2 Effect of aging on adhesion. A 4 by 9 inch section cut from one of the 12 by 12 inch panels having two 1 by 9 inch adhesion test strips in place shall be used. After aging, the specimen shall be conditioned at room temperature for not less than 20 hours nor more than 24 hours before testing. Adhesion tests shall be performed as specified in 4.6.3 except that dead-weight load of 12 pounds shall be used.

4.6.5 Immersion in acid. The specimens shall be immersed for 46 hours in a 20 percent solution consisting of a concentrated sulfuric acid using water as a dilutant maintained at 158 plus or minus (\pm) 2 °F.

4.6.5.1 Effect of acid immersion on weight. The specimens and procedure shall be as described in ASTM D 471 with the following exceptions. After removal from the sulfuric acid solution, the specimens shall be rinsed briefly in tap water (not longer than 5 seconds immersion), carefully dried and let stand on a galvanized wire screen for 1 hour before weighing.

4.6.5.2 Effect of acid immersion on tensile strength and elongation properties. The specimens shall be as specified in 4.6.2. The procedure shall be as specified in ASTM D 471 with the following exceptions. After removal from the sulfuric acid solution, the specimens shall be rinsed briefly in tap water, carefully dried and let stand on a galvanized wire screen for not less than 20 hours nor more than 24 hours before testing. The tensile strengths after immersion shall be based on the original cross section of the constricted portion of the dumb-bells.

4.6.6 Immersion in oil. The specimens shall be immersed for 46 hours at room temperature in ASTM reference oil number IRM 903 as specified in ASTM D 471.

4.6.6.1 Effect of oil immersion on volume. The specimens and procedure shall be as specified in ASTM D 471. The final weighing shall be completed within 3 minutes after removal from the special testing oil.

4.6.6.2 Effect of oil immersion on tensile strength and elongation properties. The specimens shall be as specified in 4.6.2. The procedure shall be as specified in ASTM D 471. The tensile strengths after immersion shall be based on the final cross section of the constricted portion of the dumb-bells.

4.6.6.3 Effect of oil immersion on adhesion. A 4 by 9 inch section cut from one of the 12 by 12 inch panels and having two 1 by 9 inch adhesion strips in place shall be completely immersed in the oil. At the end of the immersion period the section shall be dipped in acetone, wiped-dry, and tested by the procedure specified in 4.6.3, except that a dead-weight load of 12 pounds shall be used.

4.6.7 Plastic flow. A 4 by 4 inch plate with the rubber lining on one face shall be cut from one of the 12 by 12 inch plates. The small plate shall be laid in a horizontal position on a firm base with the rubber lining facing upward. A cylindrical flat indenter of 1 square inch bearing area shall be centered on the rubber lining. The indenter shall be pressed into the rubber with a total dead-weight load of 100 pounds (including the weight of the indenter). The original depth of penetration shall be measured 30 seconds after application of the load. Depth of

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penetration shall again be measured after the assembly has stood for 48 hours at room temperature. The apparatus for performing this test shall be as shown on Figure 2.

4.6.8 Hardness. The hardness of the rubber lining shall be measured with a Shore A durometer following the procedure specified in ASTM D 2240. The reading shall be taken 3 seconds after pressing the durometer against the lining.

4.7 Off-gassing. The material shall be tested in accordance with the Nuclear Powered Submarine Atmosphere Control Manual, NAVSEA Technical Manual S9510-AB-ATM-010/(U), by a Government approved testing facility. The results shall be submitted to the Government for evaluation and approval for use (see 3.9 and 6.5).

4.8 Toxicity. To determine conformance with the requirements of 3.10, the material shall be evaluated using the HHA process. Sufficient data to permit a HHA of the product shall be provided by the manufacturer/distributor to the NAVENVIRHLTHCEN. To obtain current technical information requirements specified by the NAVENVIRHLTHCEN, see 6.6.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. Type II synthetic rubber compound is intended for use where an acid and oil resistant surface is desired for the battery compartments of submarines or other compartments aboard ship. Type II is a pre-vulcanized material which is lined to the compartment with adhesives.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of the specification.
- (b) When first article is required (see 3.1).
- (c) Is off-gas testing required? (see 3.5 and 6.5).
- (d) Is NEHC toxicity evaluation required? (see 3.6 and 6.6).
- (e) Packaging requirements (see 5.1).
- (f) Is Material Safety Data Sheet required? (see 6.4).

6.3 Additional material required to complete adhesion tests contained in this specification and the actual compartment lining include: priming cement, tie cement, cure accelerator, troweling material and cleaner. These materials may be obtained from GACO Coatings, 2628 Pearl Road, PO Box 724, Medina, OH 44258. Installation instructions can be found in S9086-VG-STM-010/CH-634, Chapter 634, Deck Coverings, under the heading of Acid-Resistant Rubber Sheet.

6.4 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. In order to obtain the MSDS, FAR clause 52.223-3 must be in the contract.

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6.5 Off-gassing. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the atmosphere and results in health hazards to personnel or deleterious effects on machinery. These controls are accomplished through the Submarine Material Control Program, which is described in the Nuclear Powered Submarine Atmosphere Control Manual, NAVSEA Technical Manual S9510-AB-ATM-010/(U). Under the Submarine Material Control Program, all materials considered for use on submarines require certification and assignment of a usage category. Under the certification process, candidate materials are selected by Navy activities or contractors, and a request for certification is submitted to Commander, Naval Sea Systems Command, ATTN: SEA 05Z9, 1333 Isaac Hull Ave., SE, Stop 5122, Washington Navy Yard DC 20376-5122. The certification request is accompanied by detailed information, including descriptions of the material. A chemical analysis is conducted, which is normally accomplished through off-gas testing. The off-gas test is required to be conducted in a Government approved laboratory designated by the preparing activity. Information pertaining to this test requirement may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05Z9, 1333 Isaac Hull Ave., SE, Stop 5160, Washington Navy Yard, DC 20376-5160. Based on the chemical analysis results, a usage category is assigned to the material defining whether, and to what extent, the material may be used on submarines.

6.6 Toxicity evaluation. The NAVENVIRHLTHCEN requires sufficient information to permit a HHA of the product. Any questions concerning toxicity and requests for HHA should be addressed to the Commanding Officer, Navy Environmental Health Center, ATTN: Hazardous Materials Department, Industrial Hygiene Directorate, 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 20378-2103. Upon receipt of the HHA, a copy should be provided to Commander, Naval Sea Systems Command, ATTN: SEA 05Z9, 1333 Isaac Hull Ave., SE, Stop 5133, Washington Navy Yard, DC 20376-5160.

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6.7 Subject term (key word) listing.

Battery compartment
Vulcanized

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

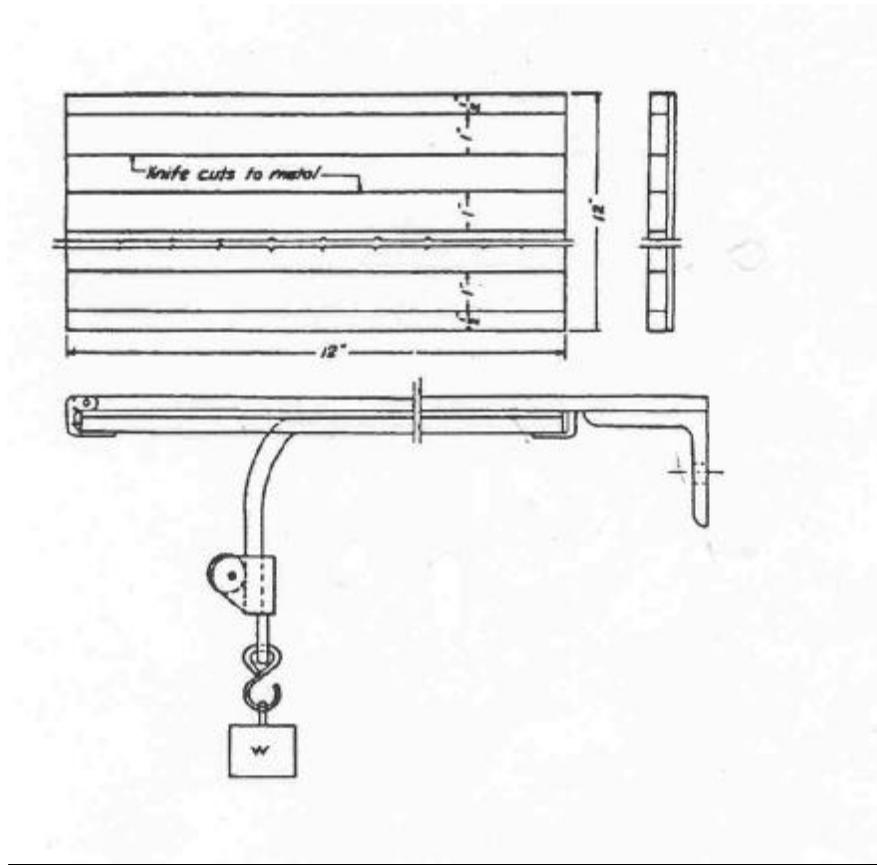


FIGURE 1. Method for determining adhesion to steel.

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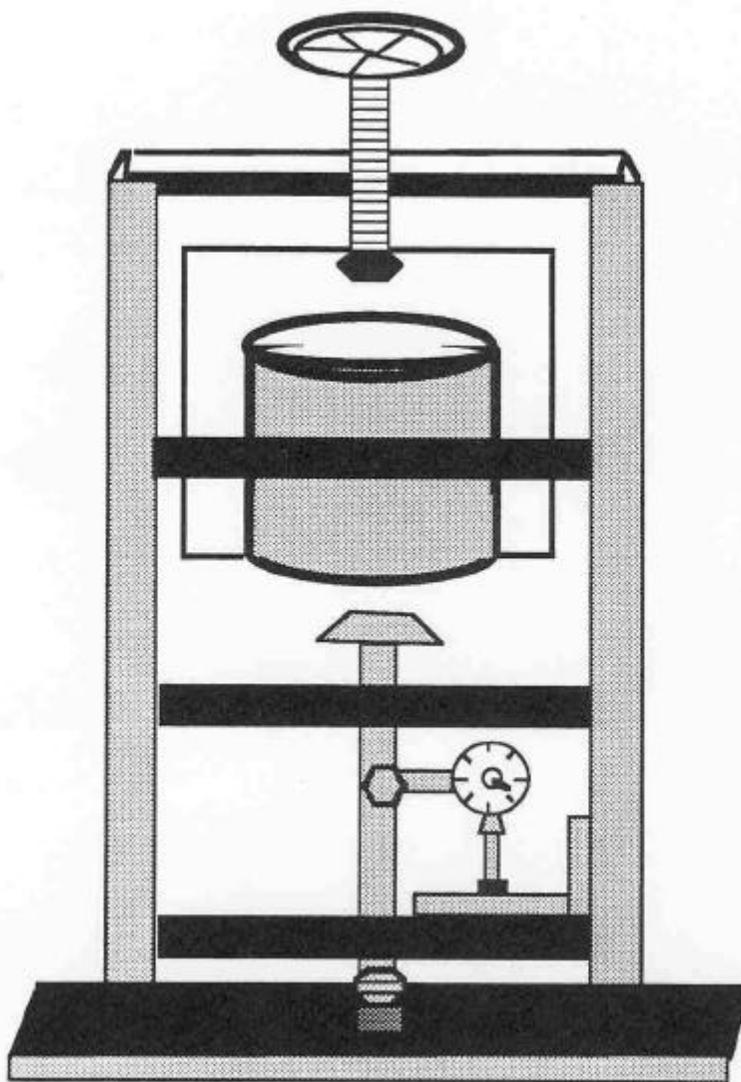


FIGURE 2. Apparatus for measuring plastic flow characteristics of rubber.

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Custodian:
Navy - SH

Preparing activity:
Navy - SH
(Project 9320-0050)

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