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~~SUPERSEDING~~  
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(See 6.3)

MILITARY SPECIFICATION  
CYLINDER, COMPRESSED GAS, DIVER'S,  
FOR DEMAND, OPEN CIRCUIT SCUBA

1. SCOPE

1.1 This specification covers a compressed gas cylinder for stowage of high pressure air for use in demand type, self-contained underwater breathing apparatus.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

QQ-A-200/8 - Aluminum Alloy Bar, Rod, Shapes, Tube and Wire, Extruded, and Structural, Shapes, 6061.

MILITARY

MIL-E-15090 - Enamel, Equipment, Light-Gray (Formula No. 111).

MIL-P-15328 - Primer (Wash), Pretreatment, Blue (Formula No. 117-B for Metals).

MIL-P-15930 - Primer Coating, Shipboard, Vinyl-Zinc Chromate (Formula No. 120 - for Hot Spray).

MIL-M-19595 - Magnetic Effects Limits for Non-Magnetic Equipment Used in the Proximity of Magnetic Influence Ordnance.

STANDARDS

FEDERAL

FED-STD-151 - Metals; Test Methods.

MILITARY

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

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring 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.

NATIONAL BUREAU OF STANDARDS

Handbook H-28 - Screw-Thread Standards for Federal Services.

(Applications for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Boulevard, Chicago, Illinois 60606.)

## COMPRESSED GAS ASSOCIATION (CGA)

## Pamphlet C-1 - Methods for Hydrostatic Testing of Compressed Gas Cylinders.

(Application for copies should be addressed to the Compressed Gas Association, Suite 2400-6, 500-5th Avenue, New York City, New York 10036.)

(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.)

## 3. REQUIREMENTS

3.1 Description. The cylinder is for use as the compressed air supply in nonmagnetic demand type self-contained underwater breathing apparatus.

# 3.2 Physical parameters. The cylinder shall be in accordance with figure 1. It shall have an internal volume of  $700 \pm 30$  cubic inches. The cylinder wall thickness shall be such as to attain the required buoyancy and trim (see 3.2.10), but shall be not less than 0.540 inch thick.

# 3.2.1 Material. The cylinder shall be spun from aluminum alloy 6061 tubing in the "as extruded" condition. The cylinder shall subsequently be heat-treated so that when finished it shall be in the T-6 condition of QQ-A-200/8.

# 3.2.2 Necked end. In forming, sufficient material shall be provided in the neck of the cylinder to face off a flat of the diameter shown on figure 1.

3.2.3 Threading. The cylinder neck shall be configured with the "O" ring type arrangement of figure 1. The thread shall be 3/4-14 NPSM (modified). After machining, there shall be no evidence of folds, cracks, or other imperfections in the threaded area.

3.2.3.1 Protection of threads. The neck of the finished cylinder shall be provided with a plastic cap to protect the threads, "O" ring groove and finished flat surface.

# 3.2.4 Base end. The base end closure of the cylinder shall be made by means of a 6061-T6 aluminum plug as shown on figure 1. If required to effect a seal, a non-leaded, non-toxic sealing compound may be utilized. The interior end of the installed plug shall be within 1/8-inch of being flush with the surrounding interior surface of the cylinder.

3.2.5 Interior surfaces. There shall be no visible evidence of folds, cracks, pits, or extreme waviness on the internal surfaces (including the ends) of the cylinder.

3.2.6 Pressure. The cylinder is for 3000 pounds per square inch gage (psig) working pressure and shall be hydrostatically tested to withstand 5000 psig.

3.2.7 Expansion characteristics. When hydrostatically tested to 5000 psi, the cylinder shall exhibit a total volumetric expansion of  $65 \pm 7$  cubic centimeters. The permanent expansion (PE) shall not exceed 5 percent of the total volumetric expansion, the remainder to be elastic expansion (EE).

3.2.8 Hardness. The cylinder shall have an average hardness on the Rockwell "E" scale (RE) of  $90 \pm 4$ .

3.2.9 Magnetic effects. The magnetic effect of the finished cylinder shall be no greater than 0.05 millioersteds when measured in accordance with 4.4.2.

3.2.10 Buoyancy and trim. The cylinder shall be neutrally buoyant when charged to 1500 psi. The cylinder's trim shall also be neutral.

3.3 Serial number. The cylinder shall be marked with a serial number (see 3.4). This serial number shall be assigned by the manufacturer so that no two cylinders manufactured by him, either in the same lot or offered for delivery in the same calendar year, shall bear the same serial number.

3.4 Marking. The cylinder shall be marked (indented) with the following information in letters not less than 1/4-inch high, as near to the neck of the cylinder as practicable:

On one side: Serial number  
 "N-MAG"  
 "3000 psig (SPUN)"  
 "RE XX"  
 Government inspector's stamp

On opposite side: "Test 5000 psig"  
 Month, year of test  
 "EE XX.X cc"  
 "PE X.X cc"  
 "Volume XXX cu in"

3.5 Coating. The cylinder shall be coated as follows:

- (a) The cylinder shall be degreased inside and out.
- (b) The exterior surface (except the flat at the cylinder neck) shall be anodized.
- (c) The outside surface (except the flat at the cylinder neck) shall be coated with:
  - (1) One coat of pretreatment primer in accordance with MIL-P-15328, followed by:
  - (2) One coat of vinyl-zinc chromate primer in accordance with MIL-P-15930, followed by:
  - (3) Two coats of enamel in accordance with MIL-P-15090, class 2.

3.6 Cleaning. The finished cylinder shall be clean of any impurities which would be detrimental to use with high pressure gas mixtures containing oxygen. To remove materials that have been baked onto the interior cylinder wall during heat-treatment, the cylinder shall be cleaned by rinsing with chromic acid solution followed by thorough flushing with fresh water and drying. When this procedure is not sufficient to remove the baked on materials, they shall be removed by cleaning with caustic soda followed by a chromic acid rinse, thorough fresh water flushing and drying. Hydrogen fluoride (hydrofluoric acid) shall not be used on the cylinder.

3.7 Workmanship. Only first class workmanship will be acceptable. Except where specified all surfaces shall be smooth and continuous and there shall be no evidence of gross tool marks; neither shall there be evidence of puddling of the coating. All indentations shall be clear and legible.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

#### 4.2 Sampling.

4.2.1 Inspection lot. A lot shall consist of all cylinders made from the same run of tubing, fabricated and treated at the same time.

4.2.2 Sampling for tensile test of cylinder material. One finished cylinder shall be selected at random from each lot for tensile test bar specimens (see 4.4.1).

4.2.3 Sampling for visual and dimensional examination. Cylinders shall be selected in accordance with MIL-STD-105, General Inspection Level II, for the inspection of 4.3. The Acceptable Quality Level (AQL) shall be 1.5 percent.

4.3 Visual and dimensional examination. Cylinders selected in accordance with 4.2.3 shall be examined and measured to verify conformance to all of the requirements of this specification which do not involve tests. Threads shall be checked by means of "GO" and "NO-GO" gages as specified in H-28.

4.4.1 Tensile test. Test bars shall be tested according to FED-STD-151 to comply with the properties of 6061 T-6 aluminum set out in QQ-A-200/8. A lot failing to pass this test shall not be offered for delivery.

4.4.2 Magnetic test. Each cylinder in the lot shall be tested to meet the requirements of 3.2.9. This test shall be in accordance with MIL-M-19595 except that readings of magnetic effects that are taken while the cylinder is in motion shall not be considered. Cylinders that fail to pass this test shall be rejected.

4.4.3 Hydrostatic test. Each cylinder in the lot shall be hydrostatically tested to 5000 psi by the water jacket method of CGA Pamphlet C-1. The total volumetric, elastic and permanent expansions shall be determined in accordance with 3.2.7. Cylinders that leak or fail to meet these requirements shall be rejected.

4.4.4 Wall thickness test. The wall thickness of each cylinder in the lot shall be determined by ultrasonic (with the pulse-echo type) equipment calibrated to an accuracy of 3 percent. Cylinders that fail to meet the wall thickness requirements of 3.2 shall be rejected.

4.4.5 Water volume test. The water volume of each cylinder in the lot shall be determined to the nearest cubic inch. Cylinders that fail to meet the requirements of 3.2 shall be rejected.

4.4.6 Hardness test. The average hardness of each cylinder in the lot shall be determined in accordance with the requirements of 3.2.8 by averaging at least three values taken by impressions around its girth. No impression shall indicate hardness less than 86 Rockwell "E". Cylinders that fail to pass the hardness test shall be rejected.

4.4.7 Inspection of preparation for delivery. The packaging, packing, and marking of the cylinder shall be inspected to determine compliance with the requirements of section 5.

## 5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract or order. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

### 5.1 Domestic shipment and early use.

#### 5.1.1 Basic equipment or item.

5.1.1.1 Preservation and packaging. Preservation and packaging which may be the supplier's commercial practice, shall be sufficient to afford adequate protection against corrosion, deterioration and physical damage during shipment from the supply source to the using activity and until early use.

5.1.1.2 Packing. Packing shall be accomplished in a manner which will insure acceptance by common carrier at the lowest rate and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early use. The shipping containers or method of packing shall conform to the Uniform Freight Classification Ratings, Rules and Regulations or other carrier regulations as applicable to the mode of transportation and may conform to the suppliers commercial practice.

5.1.1.3 Marking. Shipment marking information shall be provided on interior packages and exterior shipping containers in accordance with the contractor's commercial practice. The information shall include nomenclature, Federal stock number or manufacturer's part number, contract or order number, contractor's name and destination.

5.2 Domestic shipment and storage or overseas shipment. The requirements and levels of preservation, packaging, packing and marking for shipment shall be specified by the procuring activity (see 6.2).

5.2.1 The following provides various levels for protection during domestic shipment and storage or overseas shipment, which may be required when procurement is made (see 6.2).

(5.2.1.1 Packaging. Cylinders, cleaned and capped in accordance with 3.2.3.1 and 3.6, shall be packaged in accordance with Level A or C as specified (see 6.2).

5.2.1.1.1 Level A. Cylinders shall be cushioned, blocked or braced in accordance with MIL-STD-1186 and individually packaged in accordance with the requirements of MIL-P-116.

5.2.1.1.2 Level C. Packaging shall be sufficient to afford adequate protection against corrosion, deterioration, contamination (both magnetic and chemical), and physical damage from the supply source to the using activity for immediate use. When it meets these requirements, the supplier's commercial practice may be utilized.

5.2.1.2 Packing. Packing shall be in accordance with Level A, B, or C, as specified (see 6.2).

5.2.1.2.1 Level A. Cylinders, packaged in accordance with 5.2.1.1 shall be individually packed in boxes conforming to any one of the following specifications at the option of the contractor:

<u>Specifications</u>	<u>Class or type</u>
PPP-B-636	Class weather-resistant
PPP-B-640	Class 2

Cushioning, blocking, and bracing in accordance with MIL-STD-1186 shall be required. All center and edge seams and the manufacturer's joint shall be sealed and waterproofed with pressure-sensitive tape in accordance with the applicable box specification or appendix thereto. Shipping containers shall be closed and reinforced in accordance with the applicable box specification or appendix thereto, except that reinforcement shall be accomplished using filament-reinforced, pressure-sensitive tape in accordance with the appendix to the box specification.

5.2.1.2.2 Level B. Cylinders, packaged in accordance with 5.2.1.1 shall be individually packed in boxes conforming to any one of the following specifications at the option of the contractor:

<u>Specifications</u>	<u>Class or type</u>
PPP-B-636	Class domestic
PPP-B-640	Class 1

Cushioning, blocking, and bracing in accordance with MIL-STD-1186 shall be required. Shipping containers shall be closed in accordance with the applicable box specification.

5.2.1.2.3 Level C. Packing shall be accomplished in a manner which will insure acceptance by common carrier, at lowest rate, and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or method of packing shall conform to the Uniform Freight Classification Rules and Regulations or other carrier regulations applicable to the mode of transportation. When it meets these requirements, the manufacturer's commercial practice may be utilized.

#### 5.2.1.3 Use of polystyrene (loose-fill) material.

5.2.1.3.1 For domestic shipment and early equipment installation and level C packaging and packing. Unless otherwise approved by the procuring activity (see 6.2), use of polystyrene (loose-fill) material for domestic shipment and early equipment installation and level C packaging and packing applications such as cushioning, filler and dunnage is prohibited. When approved, unit packages and containers (interior and exterior) shall be marked and labeled as follows:

#### "CAUTION

Contents cushioned etc. with polystyrene (loose-fill) material.  
Not to be taken aboard ship.  
Remove and discard loose-fill material before shipboard storage.  
If required, recushion with cellulosic material bound fiber, fiberboard  
or transparent flexible cellular material."

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5.2.1.3.2 For level A packaging and level A and B packing. Use of polystyrene (loose-fill) material is prohibited for level A packaging and level A and B packing applications such as cushioning, filler and dunnage.

5.2.1.4 Palletization. When specified (see 6.2), shipping containers shall be palletized for shipment in accordance with MIL-STD-147.

5.2.1.5 Marking. In addition to any special marking required by the contract or order (see 6.2), unit packages, intermediate packages, shipping containers and palletized loads shall be marked in accordance with MIL-STD-129.)

## 6. NOTES

6.1 Intended use. The cylinders covered by this specification are intended for use in demand type, self-contained underwater breathing apparatus.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Level of packaging (see 5.2 and 5.2.1.1).
- (c) Level of packing (see 5.2 and 5.2.1.2).
- (d) If use of polystyrene is permitted (see 5.2.1.3).
- (e) Palletization for shipment when required (see 5.2.1.4).
- (f) Special markings, when required (see 5.2.1.5).

6.3 CHANGES FROM PREVIOUS ISSUE. THE OUTSIDE MARGINS OF THIS DOCUMENT HAVE BEEN MARKED "4" TO INDICATE WHERE CHANGES (DELETIONS, ADDITIONS, ETC.) FROM THE PREVIOUS ISSUE HAVE BEEN MADE. THIS HAS BEEN DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT AS WRITTEN IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

Preparing activity:

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(Project 4220-N173)

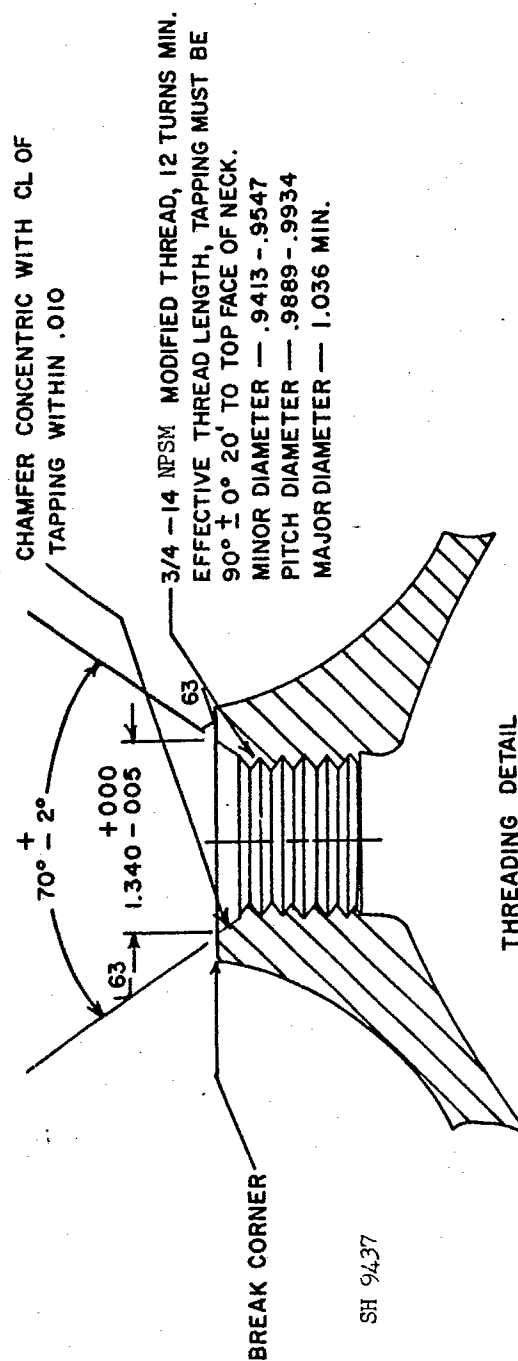
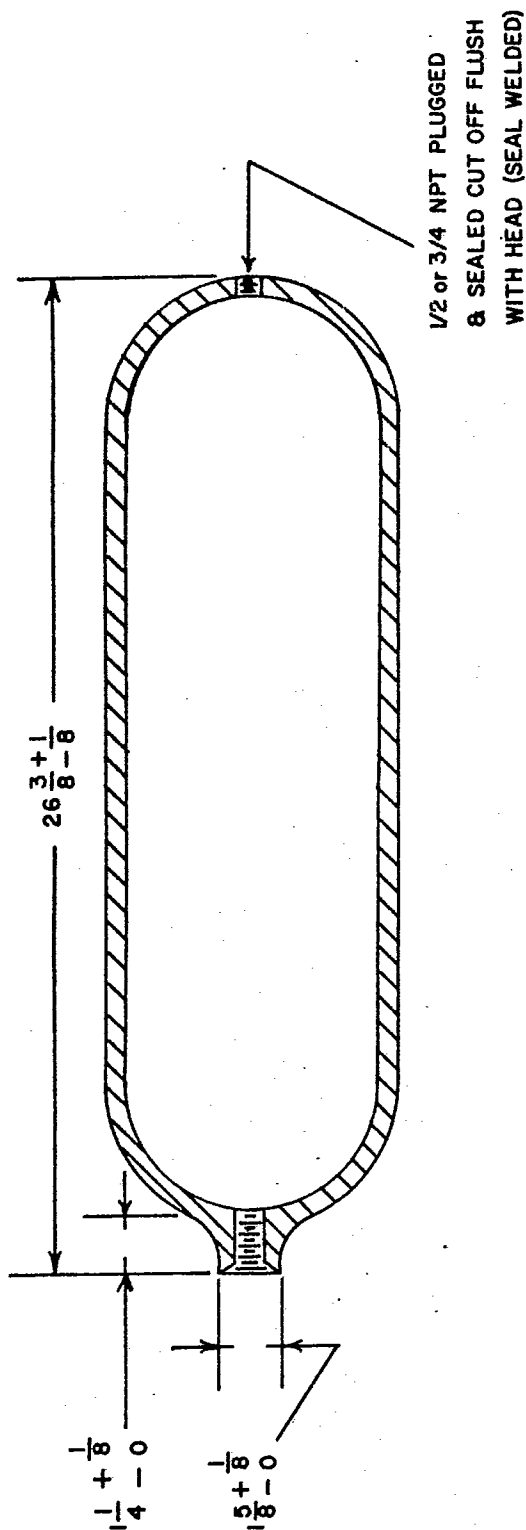


FIGURE 1 - CYLINDER