

OCEAN ENGINEERING DIVISION  
UNITED STATES COAST GUARD  
WASHINGTON, D.C.

FEBRUARY 2002

SPECIFICATION FOR  
ROTATIONAL MOLDED FIFTH CLASS  
UNLIGHTED PLASTIC BUOY  
SPECIFICATION NO. 491A

## 1. SCOPE

1.1 General. This specification defines the requirements for fabrication of fifth class foam-filled, unlighted plastic buoys. These buoys will be used as aids to navigation in the navigable waters of the United States.

1.2 Precedence. In the event of a conflict between the detailed requirements of this specification, the drawings, and the supporting documents, the order of precedence is as follows:

- a. The drawings listed in paragraph 2.5.
- b. This specification less the applicable documents.
- c. The applicable documents listed in paragraphs 2.2 and 2.3.

1.3 Classification. The buoys covered by this specification are classified by size and body style. The nomenclature and description of the buoys covered by this specification are listed in Table I.

Table I

Buoy Nomenclature and Description

<u>Nomenclature</u>	<u>Description</u>
5CPR	Fifth Class Can, Plastic, Radar Reflective, Unlighted Buoy
5NPR	Fifth Class Nun, Plastic, Radar Reflective, Unlighted Buoy

## 2. APPLICABLE DOCUMENTS

2.1 General. The following documents form a part of this specification to the extent referenced herein. Suffixes denoting the specific issue of each document are omitted from future references to the documents in this specification.

2.2 Government documents.

### MILITARY SPECIFICATIONS

MIL-P-21929C(1) - 27 May 94	Plastic Material, Cellular Polyurethane, Foam in Place, Rigid (2 Pounds per Cubic Foot)
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## U.S. COAST GUARD SPECIFICATION

- G-SEC-393A(1) - High Intensity Retroreflective Films for use on Marine Aids to Navigation

## FEDERAL STANDARDS

- FED-STD-595B - Federal Standard Colors  
11 Jan 94

2.2.1 Modification to Government documents. Substitute "United States Coast Guard" for any other Government activities referred to in any of the Government documents that form a part of this specification.

2.3 Industry publications.

## AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

- A276-00a - Standard Specification for Stainless Steel Bars and Shapes
- A312/A312M-01 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
- A666-00 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- B209-01 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- B221-00 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles, and Tubes
- D638-01 - Standard Test Method for Tensile Properties of Plastics
- D2565-99 - Standard Practice for Xenon Arc Exposure of Plastics Intended for Outdoor Applications
- D4020-01 - Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
- D4976-00b - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
- G154-00ae1 - Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

## AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)

ANSI/ISO/ASQC - Quality Systems - Model for Quality Assurance in Production  
Q9002-1994 Inspection, and Servicing

INTERNATIONAL COMMISSION ON ILLUMINATION (CIE)

CIE No. 15.2-86 - Colorimetry, Second Edition

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J-444 - Cast Shot and Grit Size Specification for Peening and  
Cleaning

2.4 Sources of documents. Documents may be obtained from the following sources:

2.4.1 Government documents.

Standardization Documents Order Desk  
Building 4, Section D  
700 Robins Avenue  
Philadelphia, PA 19111-5094

2.4.2 Coast Guard documents.

Commandant (G-ACS-2)  
U.S. Coast Guard  
2100 Second St., SW  
Washington, DC 20593-0001

2.4.3 Industry documents.

American Society for Testing and Materials  
1916 Race Street  
Philadelphia, PA 19103-1187

American Society for Quality Control  
310 West Wisconsin Avenue  
Milwaukee, Wisconsin 53202

(For CIE No 15.2)  
Mr. Thomas M. Lemons  
TLA Lighting Consultants, Inc.  
7 Pond St.  
Salem, MA 01970-4893

Society of Automotive Engineers (SAE)  
400 Commonwealth Dr.  
Warendale, PA 15096

2.5 Drawings. The latest revisions of the following U.S. Coast Guard Civil Engineering drawings form a part of this specification and are referred to hereafter as "the drawings":

<u>Number</u>	<u>Title</u>
121172	1996 Type, 5th Class Can Unlighted Plastic Buoy
121173	1996 Type, 5th Class Nun Unlighted Plastic Buoy

### **3. REQUIREMENTS**

3.1 General. The buoys shall be fabricated from polyethylene plastic. The interior of the buoys shall contain polyurethane foam, a radar reflector, and a counterweight of steel shot. They shall be fabricated in accordance with the drawings and shall meet the requirements of this specification.

3.2 Design, dimensions, weights, and tolerances. All portions of the buoys shall conform to the design, dimensions, and weights indicated on the drawings. The thickness of the molded plastic shall be 1/4" with a tolerance of plus 1/4" and minus 1/16".

3.3 Buoy shell. The buoy shell shall be manufactured from medium density polyethylene using the rotational molding process.

3.3.1 Medium-density polyethylene. All polyethylene used shall be composed of 100 percent virgin material meeting the requirements of ASTM D4976, Group 2, Class 2, Grade 3.

3.3.1.1 Ultraviolet stabilizer. The polyethylene shall contain an ultraviolet stabilizer. The stabilizer shall be certified to enable the polyethylene to retain at least 50% of the original break elongation as determined by ASTM D638 after 8000 hours of exposure in a Xenon Weatherometer operated in accordance with ASTM D2565. A comparably certified UV-8 stabilizer is acceptable.

3.3.1.2 Color pigments. Color pigments shall be added to the medium density polyethylene plastic. The color shall be uniform throughout the thickness of the plastic. The colors shall conform to the following Federal Color Numbers contained in FED-STD-595B: 11350 (red),

14193 (green), and 27875 (white). The Contractor shall use pigments known to industry to be "light stable."

3.3.1.3 Minimum material. Each buoy shall be molded with no less than 36 lbs. of plastic (polyethylene, UV stabilizers, and pigments).

3.4 Inserts and hardware. Inserts and hardware shall be used to strengthen the mooring and lifting eyes.

3.4.1 Inserts.

3.4.1.1 Stainless steel. The stainless steel pipe used in the mooring and lifting eye sleeves shall meet the requirements of ASTM A312, class 316 or 316L.

3.4.1.2 Ultra High Molecular Weight (UHMW) Polyethylene. The UHMW polyethylene used in the eye bearing inserts shall be composed of 100% virgin material meeting the requirements of ASTM D4020, paragraph 3.2.1.

3.4.2 Flat bar. The stainless steel flat bar used for the lifting eye bar and mooring eye bars shall meet the requirements of ASTM A666, type 316 or 316L.

3.4.3 Attachment hardware. The nuts, bolts, and washers used to attach the lifting eye bar and mooring eye bars shall meet the requirements of ASTM A276, type 316 or 316L.

3.5 Counterweight. The counterweight shall be steel shot. The shot shall meet the size requirements of SAE J-444. Shot sizes 110 through 930 are acceptable. Different sizes of shot may be combined together for use in the same counterweight. The Contractor shall ensure that the weight of the shot is correct (plus or minus 5%) prior to insertion into the buoy.

3.5.1 Counterweight Adhesive. The steel shot used as counterweight shall be placed in the buoy simultaneously with a two-component polyurethane casting resin, which shall ensure that shot does not break free upon handling of the buoy.

3.6 Foaming. After the counterweight is added, the interior of the buoys shall be filled with polyurethane foam. There shall be no voids of such quantity or size that could cause the buoy to be susceptible to flooding. Foaming equipment, job site requirements, and specific installation procedures shall be in accordance with the foam manufacturer's recommendations.

3.6.1 Foam material. Foam shall meet the requirements of MIL-P-21929. Fire resistance is not required.

3.6.2 Installation. The buoys shall be positioned upright while the foam is installed. The foam shall be injected into the buoys through fill holes located in the top of the buoy as shown on the drawings. The foam shall be injected in multiple shots, and each shot shall be allowed to expand completely before the next shot is added. After the foam has cured,

there shall be no more than a 1" gap between the top of the foam and the inside of the top of the buoy.

3.7 Radar reflector. The aluminum used in the radar reflector shall meet the requirements of ASTM B209, alloy 5086 T6, 6061 T6, or 5052-H32. Radar reflectors shall be assembled using bead welds, spot welds, rivets, screws, or any other method which will provide sufficient rigidity and strength to maintain the 90 degree (plus or minus one degree) angle between the plates. Brass fasteners shall not be used. Aluminum rods meeting the requirements of ASTM B221 shall be used to hold the radar reflector in place within the mold.

3.7.1 Radar reflector installation. The radar reflector shall be molded inside the buoy. The radar reflector shall be positioned in the buoy as shown in the drawings. The top of the radar reflector shall not be placed more than 8 inches below the top of the plastic buoy shell. The radar reflector shall be installed within 3 degrees from vertical. Any items used to position the radar reflector inside the buoy during molding shall not degrade the watertight integrity of the finished buoy. If any item used to position the radar reflector in the mold protrudes from the buoy after molding, it shall be cut flush with the buoy and covered with an ultraviolet resistant polyethylene spin patch (weld). The spin patch (weld) is not required to be the same color as the plastic described in paragraph 3.3.1.2.

3.8 Fill holes. Upon completion of foaming, the fill holes shall be sealed and made watertight with an ultraviolet resistant polyethylene spin patch (weld). The spin patch (weld) is not required to be the same color as the plastic described in paragraph 3.3.1.2.

3.9 Surface finish. The buoy hull shall be free of ragged edges, cracks, scales, pits, and blisters. The surfaces shall have a natural finish. A protective coating shall not be used. Mold mis-match shall not be greater than 1/16".

3.9.1 Retroreflective material. Each buoy shall have retroreflective material applied, of the size and in the location specified on the drawings. The retroreflective material shall meet the requirements of U.S. Coast Guard specification G-SEC-393A. Red retroreflective material shall be applied to 5NPR buoys and green retroreflective material shall be applied to green 5CPR buoys. White 5CPR buoys shall have retroreflective material applied of the color specified in the delivery order.

3.9.1.1 Flame treatment. Immediately prior to applying the retroreflective material, the surface of the buoy shall be flame treated. The area to be flame treated shall consist of the area directly underneath where the retroreflective material is to be applied and shall extend at least 2 inches beyond all sides of the retroreflective material.

3.10 Identification marking. Each buoy shall be legibly and permanently marked with two lines of alphanumeric characters in the location indicated on the drawings. The letters and numbers shall be block digits 1" tall and raised or recessed by 1/32". The first line of this marking shall be "USCG". The second line shall be the last two digits of the calendar year in which the buoy was manufactured and a two-letter manufacturer's code (e.g., 02-XX). The manufacturer's code will be assigned by the Contracting Officer after the contract

award. The characters shall be molded into the buoy during the rotational molding process. If a plate is mounted on the interior of the mold for the identification markings, it shall not be greater than 1/8" thick.

3.11 Material certifications. The Contractor shall maintain material certifications, from the material manufacturers or a certified independent testing laboratory, indicating that the materials described in the following paragraphs have been tested and found to meet the requirements of this specification:

3.3.1	Medium-density polyethylene
3.3.1.1	UV Stabilizers
3.3.1.2	Color Pigments
3.4	Steel inserts
3.4.1.2	Ultra High Molecular Weight (UHMW) Polyethylene
3.6.1	Foam material
3.7	Radar reflector
3.9.1	Retroreflective material

#### **4. QUALITY ASSURANCE**

4.1 General. The Contractor's quality assurance program shall meet the requirements of ANSI/ASQC Q9002. The Contractor does not have to be Q9002 certified.

4.1.1 Quality assurance and control plan. A quality assurance and control plan shall be provided to the Contracting Officer prior to commencing production of the first articles. The plan shall describe the Contractor's quality assurance program in terms of meeting the requirements of ANSI/ASQC Q9002.

4.1.2 Test plan and procedures. The Contractor shall develop and provide a test plan for first article and production buoys. The plan shall describe how the tests and inspections in paragraphs 4.2.4 through 4.3.3 will be performed and documented.

4.2 First article buoys. The Contractor shall provide first article buoys for inspection prior to the commencement of production buoys. The first articles shall consist of 4 can buoys (3 green and 1 white), and 4 nun buoys (4 red), for a total of 8 buoys. Production on any buoy type shall not begin until all first articles have passed the first article tests and inspections. First article tests and inspections shall be conducted by the Contractor and witnessed by the Contracting Officer's Technical Representative (COTR). The Contracting Officer has the right to waive any or all of the first article requirements.

4.2.1 First article rejection. If any first article buoy fails to meet any of the requirements of this specification, it shall constitute failure of the first article. If any first article is rejected, the Contractor shall correct the defects and demonstrate to the COTR that the process that caused the defects has been corrected. The Contractor shall bear the costs incident to correcting deficiencies and conducting re-tests.



4.2.2 Notification of first articles tests and inspections. The Contractor shall notify the Contracting Officer in writing at least 14 working days prior to the scheduled commencement of first article tests and inspections.

4.2.3 First article test report. The Contractor shall submit a test report after the completion of first article tests and inspections. The test report shall include the documentation required by the test plan, material certifications, test and inspection failures (if any), corrective action taken, and independent laboratory reports required by paragraphs 4.2.4.2 and 4.2.4.6.2.

4.2.4 First article tests and inspections. The following tests and inspections are required for the first article buoys. The tests and inspections required are not intended to supplant any controls, examinations, inspections, or tests normally employed by the Contractor to ensure product quality.

4.2.4.1 Visual inspection. The Contractor shall inspect first article buoys to ensure compliance with the following paragraphs:

- 3.2 Design, dimensions, weights, and tolerances.
- 3.3 Buoy shell (and all associated subparagraphs)
- 3.4 Inserts and hardware (and all associated subparagraphs)
- 3.5 Counterweight (and all associated subparagraphs)
- 3.6 Foaming (and all associated subparagraphs)
- 3.7 Radar reflector (and all associated subparagraphs)
- 3.8 Fill holes
- 3.9 Surface finish (and all associated subparagraphs)
- 3.10 Identification marking

4.2.4.1.1 Rejection criteria. Buoys failing the visual inspection shall be rejected.

4.2.4.2 Independent testing of foam. Prior to the start of foaming operations the Contractor shall send a foam sample to an independent laboratory for testing. The laboratory shall test for density, water absorption, and unicellularity of the foam to ensure conformance with MIL-P-21929. The testing shall be at the Contractor's expense. Written results of the tests, certified by the testing laboratory, shall be included in the first article test report.

4.2.4.2.1 Rejection criteria. Buoys built with foam that does not meet the requirements of MIL-P-21929 shall be rejected.

4.2.4.3 Material inspection. The Contractor shall ensure that all materials used in the buoys are in accordance with the requirements of this specification. Material certifications required by paragraphs 3.11 and 4.2.4.2 shall be maintained by the Contractor and made available for review by the COTR.

4.2.4.3.1 Rejection criteria. All buoys built with incorrect materials shall be rejected. If material certifications are missing, all buoys built with the uncertified materials shall be

rejected.

4.2.4.4 Drop test. During first article testing, the COTR will choose one 5CPR and one 5NPR for use in this test. The test shall be conducted by dropping each buoy onto a concrete surface a total of ten times. The first five drops shall be made with the lowest point of the buoy two feet above the surface of the concrete and in the following attitudes: vertically upright; at an angle of 45 degrees from the vertical; at 90 degrees from the vertical; at 135 degrees from the vertical; and at 180 degrees from the vertical. The second five drops on each buoy shall be made with the lowest point of the buoy five feet above the surface of the concrete and in the same attitudes as listed above. Following the drop test, the buoys shall be visually inspected for cracks, dents, and other structural damage.

4.2.4.4.1 Rejection criteria. Structural damage to any one of the first article units, including visible cracks or permanent deformation, shall constitute failure of all the first article buoys. Small dents, no larger than 3" long and 1" wide, if not accompanied by puncturing or cracking of the buoy hull or daymark, shall not be considered structural damage. Scrapes shall not be cause for rejection.

4.2.4.5 Destructive test. The Contractor shall cut open one buoy from each of the two first article buoy types (one 5CPR and one 5NPR) to allow for inspection of the requirements listed in paragraphs 3.2, 3.3, 3.5, 3.6, and 3.7. The COTR will determine which two buoys are to be cut open. The COTR will also decide what portions of the buoy shall be cut open. Salvageable parts of the buoys may be used in future production. The Contractor shall be responsible for the disposal of the buoys destroyed in this test.

4.2.4.5.1 Rejection criteria. Buoys that fail to meet the requirements listed in paragraphs 3.2, 3.3, 3.5, 3.6, and 3.7 shall be rejected. If one or more of the buoys fails to meet the requirements of this test, the COTR may require that additional buoys be cut open to determine the extent of the defect.

4.2.4.6 Accelerated weathering test. An accelerated weathering test to determine color fastness shall be performed in accordance with ASTM G154, using exposure Cycle 1 from Table X2.1. The Contractor shall provide two plastic samples of each color (red, green, and white) to an independent laboratory for testing. The samples shall be made of the same plastic, UV stabilizer, and pigments (per paragraphs 3.3.1 through 3.3.1.2) used in the fabrication of the buoys. The size and preparation of the samples shall be in accordance with the ASTM G154 test procedures. One sample from each color shall be retained as a control. One sample from each color shall be exposed for a minimum of 2,000 hours in an accelerated weathering apparatus. This test shall be conducted at the Contractor's expense.

4.2.4.6.1 Rejection criteria. At the completion of testing, the color of each sample (including the control) shall be plotted to determine if it is within the appropriate chromaticity region specified in Table II. Any sample that fails to meet the requirements of Table II shall be rejected. Colors that have been rejected shall be corrected and retested. The Contractor shall bear the cost of any retesting.

Table II Chromaticity Regions

	1		2		3		4		<u>Y</u>
	<u>x</u>	<u>y</u>	<u>x</u>	<u>y</u>	<u>x</u>	<u>y</u>	<u>x</u>	<u>y</u>	
<u>Red</u>	0.690	0.310	0.595	0.315	0.569	0.341	0.655	0.345	10-15
<u>Green</u>	0.275	0.550	0.275	0.450	0.225	0.450	0.225	0.550	12-24
<u>White</u>	0.350	0.360	0.300	0.310	0.290	0.320	0.340	0.370	80-95

Note: Coordinates are to be plotted on CIE 1931 color space. Colorimetric measurements are made using 45/0 geometry, using a 2 degree observer and CIE standard illuminant D<sub>65</sub>. (CIE No. 15.2)

4.2.4.6.2 Accelerated weathering test report. The Contractor shall submit a test report after the completion of the accelerated weathering test. This report shall describe the test results, test failures (if any), and corrective action taken. It shall also list the type and quantity of pigments and color stabilizers used in the plastic samples. This report shall be certified by the independent laboratory and included in the first article test report.

4.2.4.7 Shell thickness. The Contractor shall use an electronic sensor to measure the shell thickness of all the first article buoys. These measurements shall be taken without drilling holes in the hull or otherwise damaging the buoys.

4.2.4.7.1 Rejection criteria. All buoys with shell thicknesses that fail to meet the requirements of paragraph 3.2 shall be rejected.

4.3 Production tests and inspections. The following tests and inspections are required for production buoys. These tests and inspections are not intended to supplant any controls, examinations, inspections, or tests normally employed by the Contractor to ensure product quality.

4.3.1 Visual inspection. The Contractor shall inspect production buoys to ensure compliance with the following paragraphs:

- 3.2 Design, dimensions, weights, and tolerances.
- 3.3 Buoy shell (and all associated subparagraphs)
- 3.4 Inserts and hardware (and all associated subparagraphs)
- 3.5 Counterweight (and all associated subparagraphs)
- 3.6 Foaming (and all associated subparagraphs)
- 3.7 Radar reflector (and all associated subparagraphs)
- 3.8 Fill holes
- 3.9 Surface finish (and all associated subparagraphs)
- 3.10 Identification marking

4.3.1.1 Rejection criteria. All buoys failing the visual inspection shall be rejected.

4.3.2 Material inspection. The Contractor shall ensure that all materials used in the production buoys are in accordance with the requirements of this specification. Material certifications required by paragraphs 3.11 shall be maintained by the Contractor and made available for review by the COTR.

4.3.2.1 Rejection criteria. All buoys built with incorrect materials shall be rejected. If material certifications are missing, all buoys built with the uncertified materials shall be rejected

4.3.3 Shell thickness. The Contractor shall use an electronic measuring device to measure the thickness of the buoy shell of at least one buoy per daily production run. If the buoy fails to meet the shell thickness requirements, all buoys from that daily run shall be measured.

4.3.3.1 Rejection criteria. All production buoys with shell thicknesses that fail to meet the requirements of paragraph 3.2 shall be rejected.

4.3.4 Independent testing of foam. On a periodic basis the Contractor shall send a foam sample to an independent laboratory for testing. At a minimum, this shall be done at the start of production for each contract year, and whenever the Contractor changes foam suppliers. The laboratory shall test for density, water absorption, and unicellularity of the foam to ensure conformance with MIL-P-21929. The testing shall be at the Contractor's expense. Written results of the tests, certified by the testing laboratory, shall be maintained by the Contractor and made available for review by the COTR.

4.3.4.1 Rejection criteria. All buoys built with foam that does not meet the requirements of paragraph 3.6 shall be rejected.

## 5.0 PACKAGING AND MARKING

5.1 Preservation, packaging, packing. Buoys shall be packaged and packed to prevent damage during shipment.

5.2 Marking. The Contractor shall legibly mark the packaged buoys with the contract number, delivery order number, and complete address of consignee.

5.3 Material Inspection and Receiving Report (DD Form 250). A DD Form 250 shall be used as a certification of product quality assurance, as a packing list, and as a certification of acceptance. A separate DD Form 250 shall be prepared by the Contractor for each shipping lot. One copy of the signed DD Form 250 shall be packed with each shipment. Additional copies shall be sent to the Contracting Officer and COTR. The DD Form 250 shall contain the following information in block 23:

\*RECEIVING ACTIVITY:

1. INSPECT ITEMS FOR CORRECT QUANTITIES AND SHIPPING DAMAGE.
2. SIGN BLOCK 22 - INDICATE DISCREPANCIES BELOW.
3. RETURN ONE COPY TO BLOCK 10 AND ONE TO COMDT (G-SEC-2B).

5.3.1 Proof of delivery. A copy of the DD Form 250 with the consignee's signature in Block 22 shall be submitted with the payment invoice as proof of delivery. If the completed DD Form 250 is not available for submittal with the payment invoice the Contractor shall include another form of proof of delivery (i.e. freight carrier bill of lading) that legibly shows the first and last name of the Coast Guard representative who received the delivery.



SPECIFICATION NO. 491A -- ROTATIONAL MOLDED FIFTH CLASS UNLIGHTED  
PLASTIC BUOY

FEBRUARY 2002

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**Signature on file**

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**12 Feb 02**

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