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COMDTNOTE 16500
APR 06 2010

COMMANDANT NOTICE 16500

CANCELLED: APR 06 2011

Subj: CH-7 TO AIDS TO NAVIGATION MANUAL – TECHNICAL,
COMDTINST M16500.3A

1. PURPOSE. This Notice promulgates changes to the Aids to Navigation Manual, Technical COMDTINST M16500.3A.
2. ACTION. All Coast Guard unit commanders, commanding officers, officers-in-charge, deputy/assistant commandants, and chiefs of headquarters staff elements shall comply with the provisions of this Manual. Internet release is authorized.
3. PROCEDURES.
 - a. The change consists of 64 pages. Remove & insert the following pages:

<u>Remove</u>	<u>Insert</u>
2-11 and 2-12	2-11 and 2-12
2-35 and 2-36	2-35 and 2-36
2-169 and 2-170	2-169 and 2-170
Chapter 6	Chapter 6
9-13 and 9-14	9-13 and 9-14
9-73 thru 9-78	9-73 thru 9-78
9-81 thru 9-84	9-81 thru 9-84
9-89 and 9-90	9-89 and 9-90

- b. Units that have not received COMDTINST M16500.3A, Aids to Navigation Manual – Technical, but have received this change cannot requisition a copy of the manual as it is out of print. The manual is available through the CG directives system on-line and will be reprinted with all changes 1 through 7 included.

DISTRIBUTION – SDL No. 155

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	
A												2	2	2	2		2										
B			3						2					10	1												
C							2				1												2				
D				1																							
E																											
F																											
G																											
H																											

NON-STANDARD DISTRIBUTION: C:i Stations Burlington, St. Ignace and Channel Islands Harbor only (2 copies)

CH-7 TO AIDS TO NAVIGATION MANUAL – TECHNICAL, COMDTINST M16500.3A

- c. Paper copies will be distributed to commands that deal directly with aids to navigation.
- 4. SUMMARY OF CHANGES. Major changes include revised power system data sheets and the selection, preparation and use of approved Light Emitting Diode (LED) lanterns on CG aids to navigation.
- 5. ENVIRONMENTAL ASPECT AND IMPACT CONSIDERATIONS. Environmental considerations were examined in the development of this directive and have been determined to not be applicable.
- 6. FORMS/REPORTS. None

T. P. OSTEBO/s/
Assistant Commandant for Engineering and Logistics

Enclosure: CH-7 to Aids to Navigation Manual – Technical, COMDTINST M16500.3A



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United States Coast Guard

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COMDTNOTE 16500
FEB 11 2005

COMMANDANT NOTICE 16500

Subj: CH-6 TO AIDS TO NAVIGATION MANUAL – TECHNICAL,
COMDTINST M16500.3A

1. PURPOSE. This Notice promulgates change 6 to the Aids to Navigation Manual, Technical COMDTINST M16500.3A.
2. ACTION. Area and district commanders, commanders of maintenance and logistics commands, commanding officers of civil engineering units, commanding officers of headquarters units, assistant commandants for directorates, Chief Counsel, and special staff offices at Headquarters shall ensure that the required changes are made to the manual. Internet release authorized.
3. PROCEDURE. The change consists of 47 pages. Remove & insert the following pages:

Remove
Table of Contents
2-27 and 2-28

Insert
Table of Contents
2-27 and 2-28
2-171 thru 2-174

Chapter 4
5-1 and 5-2
5-19 thru 5-22
6-3 and 6-4
6-7 and 6-8
6-13 thru 6-18
6-29 and 6-30
6-53 and 6-54
6-93 thru 6-127

7-21 and 7-22

5-1 and 5-2
5-19 thru 5-22
6-3 and 6-4
6-7 and 6-8
6-13 thru 6-18
6-29 and 6-30
6-53 and 6-54
6-93 thru 6-127
7-14A
7-21 and 7-22

DISTRIBUTION - SDL No. 142

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A													2	2	2	2	2		2							
B		1	3		1				2					10	1											
C							2		*		1												2			
D				1																						
E																										
F																										
G																										
H																										

NON-STANDARD DISTRIBUTION: *C:1 D1-STA Burlington, D9-STA St. Ignace, and D11-STA Channel Islands Harbor only.

Remove

9-13 and 9-14
9-59 and 9-60
9-93 thru 9-96
9-99 thru 9-104
Index

Insert

9-13 and 9-14
9-59 and 9-60
9-93 thru 9-96
9-99 thru 9-104

- b. Units that have not received the Aids to Navigation Manual – Technical, COMDTINST M16500.3A, but have received this change may requisition a copy of the manual and changes 1 through 5 from the DOT Warehouse in accordance with the Directives, Publications and Report Index, COMDTNOTE 5600.
- c. Paper copies will be distributed to commands that deal directly with aids to navigation. An electronic version of this change is available at <http://isddc.dot.gov/>.

4. SUMMARY OF CHANGES.

- a. Chapter 2, Buoys and Moorings, is amended to clarify the expected service life of foam buoys and a job aid is added to assist units with the decision to retain or remove foam buoys from service.
- b. Chapter 4, Structures, is removed from the manual and is superseded by the Aids to Navigation Manual – Structures, COMDTINST M16500.25, which expands on the construction, inspection and safety aspects of Coast Guard structures.
- c. Chapter 5, Dayboards, is revised to clarify the retro color and dimensions on yellow special mark and ICW range dayboards, and add non-lateral dayboards for western rivers.
- d. Chapter 6, Light Signals, is revised to more closely reflect industry standard ratings for lamp life and incorporates new guidance on aid service intervals. This effectively increases the potential service interval for aids using C-8 marine signal lamps. The data sheet for the self contained LED lanterns is revised to include sizing tables for each model to assist in the proper selection for a given location.
- e. Chapter 7, Sound Signals, is revised to clarify the remote control wiring for FA-232/SA-850 sound signals
- f. Chapter 9, Power Systems, is amended to update the RBDT table for ice buoy batteries to reflect the new LED ice buoy lanterns, and adds updated battery data sheets.

5. ENVIRONMENTAL ASPECT and IMPACT CONSIDERATIONS. Environmental considerations were examined in the development of this directive and have been determined to be not applicable.

6. FORMS/REPORTS. None

P. J. GLAHE /s/
ACTING ASST COMMANDANT FOR SYSTEMS

Enclosure: (1) Change 6 to the Aids to Navigation Manual – Technical

U.S. Department
of Transportation

**United States
Coast Guard**



Commandant
United States Coast Guard

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COMDTNOTE 16500
JAN 22, 2003

COMMANDANT NOTICE 16500

CANCELLED: JAN 22 2004

Subj: CH-5 TO AIDS TO NAVIGATION MANUAL – TECHNICAL,
COMDTINST M16500.3A

1. PURPOSE. This Notice promulgates changes to the Aids to Navigation Manual, Technical COMDTINST M16500.3A.
2. ACTION. Area and district commanders, commanders of maintenance and logistic commands, commanding officers of headquarters units, assistant commandants for directorates, Chief Counsel and special staff offices at Headquarters shall ensure that the required changes are made to the Manual. Internet release authorized.
3. PROCEDURES.
 - a. Remove & insert the following pages:

Remove
Table of Contents
Chapter 2
Chapter 6

9-11 thru 9-18
9-29 and 9-30
9-33 thru 9-36
9-95 thru 9-104
Index

Insert
Table of Contents
Chapter 2
Chapter 6
Page 7-14A
9-11 thru 9-18
9-29 and 9-30
9-33 thru 9-36
9-95 thru 9-104
Index

DISTRIBUTION – SDL No. 140

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	
A												2	2	2	2	2	2										
B		1	3		1				2					10	1												
C							2		*		1												2				
D				1																							
E																											
F																											
G																											
H																											

NON-STANDARD DISTRIBUTION: C:i Stations Burlington, St. Ignace and Channel Islands Harbor only (2 copies)

COMDTNOTE 16500

- b. Units that have not received Aids to Navigation Manual – Technical, COMDTINST M16500.3A, but have received this change may requisition a copy of the Manual and changes 1, 2, 3 and 4 from the Department of Transportation Warehouse in accordance with the Directives, Publications and Report Index, COMDTNOTE 5600.
 - c. Paper copies will be distributed to commands that deal directly with aids to navigation. An electronic version of this change is available at <http://isddc.dot.gov/> and on the next CG Directives CD-ROM
4. SUMMARY OF CHANGES. Major changes include new topmarks, redesigned fast water buoys, the addition of large mooring chain, updated buoy drawings in Chapter 2, the addition of nominal range tables for all omnidirectional lanterns and a data sheet for the self contained LED lantern in Chapter 6.
5. FORMS AVAILABILITY. Form DD-250, Material Inspection and Receiving Report, is available in JetForm Filler on SWIII.

/s/

J. A. KINGHORN

Rear Admiral, U. S. Coast Guard

Assistant Commandant for Systems

Encl: (1) Change 5 to the Aids to Navigation Manual – Technical



COMDTNOTE 16500

COMMANDANT NOTICE 16500

CANCELLED: NOV 2 2000

Subj: CH 4 TO AIDS TO NAVIGATION MANUAL - TECHNICAL, COMDTINST M16500.3A

1. PURPOSE. This Notice promulgates changes to the Aids to Navigation Manual - Technical, COMDTINST M16500.3A.
2. ACTION. Area and district commanders, commanders of maintenance and logistics commands, commanding officers of headquarters units, assistant commandants for directorates, Chief Counsel and special staff offices at Headquarters shall ensure that the required page replacements are made for this change.
3. PROCEDURES.
 - a. The change consists of 312 replacement pages. Remove and insert the following pages.

Remove

i thru xv
Chapter 1
2-3/4
2-15 thru 2-26
2-37 thru 2-40
2-165
4-9 thru 4-14
4-17/18
4-25/26
4-67/68

Insert

i thru xiv CH-4
Chapter 1 CH-4
2-3/4 CH-4
2-15 thru 2-26 CH-4
2-37 thru 2-40 CH-4
2-165 CH-4
4-9 thru 4-14 CH-4
4-17/18 CH-4
4-25/26 CH-4
4-67-68 CH-4
4-75 thru 80

COMDTNOTE 16500

NOV 3 1999

Remove
Chapter 6
Chapter 8
Chapters 9 & 10
Index

Insert (cont.)
Chapter 6 CH-4
Chapter 8 CH-4
Chapter 9 CH-4
Index CH-4

- b. Units that have not received Aids to Navigation Manual-Technical, COMDTINST M16500.3A, but have received this Change may requisition a copy of Aids to Navigation-Technical, COMDTINST M16500.3A and Changes 1, 2 and 3 from Department of Transportation Warehouse in accordance with Directives, Publications and Report Index, COMDTNOTE 5600.
4. SUMMARY OF CHANGES. Major changes include a complete rewrite of Chapters 6 and 9 with significant changes in new equipment and servicing policies; the requirement that all rivet hull buoys be surveyed; the requirement to gas test buoy hulls prior to any hot work being performed; new information on the battery tethering system and descriptions of the new VM-100 fog detector and Low Energy Aid Control-Monitor System (LEACMS).

R. F. Silva
Assistant Commandant for Systems

Encl: (1) Replacement Pages for Change 4

U.S. Department
of Transportation

United States
Coast Guard



Commandant
United States Coast Guard

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COMDTNOTE 16500
19 MAR 1991

COMMANDANT NOTICE 16500

CANCELLED: 19 SEP 1991

Subj: Change 1 to Commandant Instruction M16500.3A,
Aids to Navigation Manual - Technical

1. PURPOSE. This notice promulgates changes to the Aids to Navigation Manual.
2. SUMMARY OF CHANGES. Chapter 3 is reprinted to more clearly portray the true colors of buoys. Other changes include editorial corrections and updates to national stock numbers (NSN's).
3. ACTION: Area and district commanders, commanders of maintenance and logistics commands, unit commanding officers and Commander, CG Activities Europe shall ensure that the required page replacements and changes are made for this change. The change consists of 28 replacement pages and 28 pen and ink corrections.
 - a. Make the following pen and ink corrections:
 - (1) Page 2-1, paragraph A.5. change "Information and Regualtory Marks" to read "Information and Regulatory Marks".
 - (2) Page 2-9, under Power Units, line 1, change "siza" to read "size".
 - (3) Page 2-27, under Inspection and Maintenance, line 3, change "12" to read "24".
 - (4) Page 2-28, under Inspection and Maintenance, line 3, change "eexceed" to read "exceed".
 - (5) Page 2-28, para (7), line 1, change "fadeed" to read "faded".
 - (6) Page 2-80, under Reference Documents, line 3, change "ACN 2050-01-F89-0122" to read "ACN 2050-01-F89-0117".
 - (7) Page 2-98, under FCPR, line 4, change "re" to read "are".
 - (8) Page 2-99, under FNPR, line 2, change "re" to read "are".

3. a. (9) Page 2-99, under FNPR, change sentence three to read "The hollow daymark is fitted with an internal radar reflector."
- (10) Page 2-103, Data Sheet 2-F(3), Wiring, change the NSN for 12-2 COND CABLE TYPE SO from "NSN 6145-00-548-1225" to read "NSN 6145-01-291-2940" (both figures).
- (11) Page 2-106, Data Sheet 2-F(4), Whistle, drawing is out of date. Under Reference Documents, change "G-ECV Drawing No. BU-47-08" to read "G-ECV Drawing No. 120777". A revised data sheet will be promulgated with Change 2.
- (12) Page 2-107, Data Sheet 2-F(5), Four-ball Whistle valve, drawing is out of date. Under Reference Documents change "G-ECV Drawing No. BU-47-09" to read "G-ECV Drawing No. 120777". A revised data sheet will be promulgated with Change 2.
- (13) Page 3-24, under Markings, line 1, change "shall" to read "shall".
- (14) Page 4-22, under Sound Signals, line 1, change "lanterns" to read "sound signals".
- (15) Page 5-7, under Films and Characters, line 7, insert "and" between "3M Company" and "Avery Corporation".
- (16) Page 5-14, Figure 5-8 title, change "4MB" to read "4MR".
- (17) Page 5-15, Figure 5-8 (cont) title, change "4MB" to read "4MR".
- (18) Page 5-20, Figure 5-13 title, change "4MB-I" to read "4MR-I".
- (19) Page 6-5, switch the timing (seconds) of the F1(2)5 and F1(2)6 characteristics.
- (20) Page 6-70, under CG-181 Flasher ACTION OR POLICY, line 7, change "6 percent" to read "5 percent."
- (21) Page 6-85, under Electrical and Mechanical Characteristics, Ambient Temperature Range, change "0 to +125 degrees F" to read "0 to +140 degrees F".
- (22) Page 6-85, under Electrical and Mechanical Characteristics, Note to Output Voltage specification, change "12 Vdc" to read "11.7 to 12.2 Vdc".
- (23) Page 6-92, under Additional Data, 155-mm lantern Clear lens, change "6210-01-043-0753" to read "6210-01-029-4172."
- (24) Page 6-154, Table 6-29 title, third line, add a degree symbol (°) after the numeral "8".
- (25) Page 7-3, Table 7-1, in bottom left corner, change "LBN" to read "LNB".
- (26) Page 7-11, Table 7-4, under Type of Signal, change "SA-860" to read "SA-850".
- (27) Page 9-22, second paragraph, line 9, change "(See Data Sheet 9-E(26))" to read "(See Data Sheet 9-E(27))".

COMDTNOTE 16500
19 MAR 1991

3. a. (28) Page 10-43, under Additional Data, change the NSN's for solar panels to read:

"10-WATT CG 6117-01-145-7152
20-WATT CG 6117-01-145-7153
35-WATT CG 6117-01-148-7879".

- b. Remove and insert the following printed pages:

<u>Remove</u>	<u>Insert</u>
3-4 thru 3-24	3-5 thru 3-24
6-49 thru 6-52	6-49 thru 6-52

4. Units that have not received COMDTINST M16500.3A, but have received CH-1 may requisition a copy of COMDTINST M16500.3A from the DOT Warehouse in accordance with COMDTNOTE 5600; Directives, Publications and Reports Index.

/s/ J. H. DONAHUE
Captain, U. S. Coast Guard
Acting Chief, Office of Engineering,
Logistics and Development

Encl: (1) Replacement Pages for Change 1

U.S. Department
of Transportation

United States
Coast Guard



Commandant
United States Coast Guard

2100 Second Street, S.W.
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COMDTINST M16500.3A
14 AUG 1990

COMMANDANT INSTRUCTION M16500.3A

Subj: Aids to Navigation - Technical

1. PURPOSE. This manual contains the instructions and policies governing the selection, installation and maintenance of equipment for the Short Range Aids to Navigation Program.
2. DIRECTIVES AFFECTED. COMDTINST M16500.3 is cancelled.
3. ACTION. Area and district commanders, commanders of maintenance and logistics commands, unit commanding officers and Commander, CG Activities Europe shall ensure that the provisions of this Instruction are followed.
4. CHANGES. Recommendations for improvements to this instruction shall be submitted to Commandant (G-ECV).

/s/ R. L. JOHANSON
Chief, Office of Engineering,
Logistics and Development

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CHAPTER 4. See COMDTINST M16500.25 Aids to Navigation Manual - Structures

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CHAPTER 1. INTRODUCTION

A. Introduction

1. Purpose. The purpose of this volume of the Aids to Navigation Manual is to provide the technical information needed to establish and maintain the Short Range Aids to Navigation System of the United States. This information establishes, in measureable terms, those technical objectives and standards necessary for Aids to Navigation equipment to function to its design capability and reliability. This manual is intended only for the internal guidance of Coast Guard personnel. The high expectations of performance contained in this Manual are intended to encourage public service above and beyond the minimum threshold of due care that might apply in a non-governmental context. Any requirements or obligations created by this Manual flow only from Coast Guard personnel involved in the selection, installation, and maintenance of equipment to the Coast Guard, and the Coast Guard retains the discretion to deviate or authorize deviation from these requirements. This Manual creates no duties or obligations to the public to comply with the procedures described herein, and no member of the public should rely upon these procedures as a representation by the Coast Guard as to the manner of performance of our Aids to Navigation mission.

2. Content. This volume contains the instructions and policies governing the selection, installation and maintenance of equipment for the Short Range Aids to Navigation (ATON) program. This volume describes the required end result and does not contain step-by-step servicing or maintenance procedures, troubleshooting charts, or check lists to be employed by the servicing personnel. It tells what services are to be done - not how these services will be performed. "How to" information is obtained through training, either at the NATON School, by district training teams or equipment manuals. This volume generally covers only that equipment approved by the Commandant for new installations. Very little coverage is devoted to equipment no longer in production but which may still be in use. Technical manuals, manufacturer's literature or publications, and "as built" drawings are generally the only sources of information for this equipment.

- B. Selection Guide. These guides vary between the categories of equipment. Where possible a tabular arrangement of operational requirements or constraints versus available equipment is present. Given the operational requirement, the technical manager will use these guides to select the proper equipment. Since there are separate chapters on buoys and structures, the selection between these aids is based upon the guidance given in COMDTINST M16500.7, Chapter 4, *Aids to Navigation-Administration*. The primary basis of selection is one of economics--preferring the lower life cycle cost. However, the final decision must be based upon the cost-to-benefit ratio. Thus in selecting an aid for any site, a higher benefit (maintenance of a permanent position, use as marker to position floating aids, etc.) may offset a higher cost.
- C. Preparation and Installation. This section is primarily for servicing personnel. Where possible other documents such as installation manuals are referenced but not repeated. Where other documentation is not available, such as for buoys, it is provided here.
- D. Inspection, Maintenance and Repair. This section is for both maintenance and technical personnel. It provides the standards for both the maintenance force doing the work and for the technical force performing inspections. Both required servicing intervals and maintenance standards are provided.
- E. Data Sheets. There are data sheets for each individual item in the AtoN equipment inventory. Each sheet is self-contained and provides for each item a complete summary of the function, salient features technical characteristics, physical dimensions and source of supply.

CHAPTER 2. BUOYS AND MOORINGS

- A. General. This chapter describes the buoys, moorings, and related equipment that are part of the Coast Guard's aids to navigation system.
- B. Buoy Classification. The Coast Guard uses a wide variety of lighted and unlighted steel, foam, and plastic buoys. Lighted buoys and unlighted sound buoys are designated "pillar" buoys by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) due to their cage and tower arrangements.
1. Buoy Identification.
- a. Lighted Buoys and Unlighted Sound Buoys. Lighted buoys and unlighted sound buoys are classified according to diameter and length, and various design attributes.

<u>Lighted Buoy Attributes</u>	
<u>Designation</u>	<u>Attribute</u>
L	Lighted
R	Radar Reflector
B	Bell
G	Gong
W	Whistle
H	Horn
I	Ice
C	Can-Shaped Radar Reflector
N	Nun-Shaped Radar Reflector
F	Foam

EXAMPLES:

-An 8X26LWR is an eight foot diameter by 26 foot long lighted whistle buoy with a radar reflector.

-A 5X11LNR is a five foot diameter by eleven foot long lighted buoy with a nun-shaped radar reflector.

-A 9X20BR is a nine foot diameter by 20 foot long unlighted bell buoy with a radar reflector.

- 2.B.1. b. Unlighted Buoys. Unlighted buoys are identified by their shape (can or nun), class (1st through 6th, with 1st being the largest and 6th the smallest), and various design attributes.

<u>Unlighted Buoy Attributes</u>	
<u>Designation</u>	<u>Attribute</u>
R	Radar Reflector
C	Can-Shaped
N	Nun-Shaped
I	Ice
F	Foam
P	Plastic
S	Special
T	Tall
FW	Fast Water

EXAMPLES:

-A 2NFR is a second class nun made of foam with a radar reflector.

-A 5NI is a fifth class nun ice buoy.

2. Buoy Serial Numbers.

- a. The serial number for lighted buoys and unlighted sound buoys includes the buoy diameter (with an additional letter for Whistle, Ice, Special, or Foam, if applicable), year built, sequential number, and manufacturer's code.

EXAMPLES:

-Buoy 8-93-11-XX is an 8X26LR. Built in 1993, it was the 11th buoy built by contractor XX.

-Buoy 8W-92-31-XX is an 8X26LWR. Built in 1992, it was the 31st buoy built by contractor XX.

-Buoy 8S-94-19-XX is an 8X21LR. Built in 1994, it was the 19th buoy built by contractor XX. An "S" for "special" is used in the serial number for this buoy because of its unique conical hull shape, which differentiates it from a normal 8 foot buoy.

- 2.B.2.a. -Buoy 7I-94-15-XX is an 7X20LI. Built in 1994, it was the 15th buoy built by contractor XX.
- Buoy 5F-95-08-XX is an 5X9LFR. Built in 1995, it was the 8th buoy built by contractor XX.
- b. The serial number for unlighted steel buoys (1st, 2nd, 3rd, and 5th class) and foam buoys (2nd and 3rd class) includes the buoy class, year built, sequential number, and manufacturer's code.

EXAMPLES:

-Buoy 2CR-89-06-XX is a second class can with radar reflector. Built in 1989, it was the 6th buoy built by contractor XX.

- c. Plastic unlighted buoys (5th class) are marked with the year built and manufacturer's code.
- d. Unlighted foam buoys (4th, 5th, and 6th class) and fast water foam buoys are marked with the buoy class, year built, and manufacturer's code.
- e. Steel river buoys (4th and 6th class) are marked with the year built and the manufacturer's code.
- f. Lighted plastic discrepancy buoys are marked with the year built and the manufacturer's code.

3. Buoy Configuration Criteria.

- a. Standard Buoys. Buoys that are currently being manufactured are designated as standard.
- b. Non-Standard Buoys.
- (1) Category I. Buoys that are no longer manufactured but are the operational equivalent of standard buoys, and meet the requirements of paragraph 2.B.3.c and Tables 2-1, 2-2, and 2-3. These are authorized substitutes for standard buoys.
- (2) Category II. Buoys that are no longer manufactured and are not the operational equivalent of standard buoys, and do not meet the requirements of paragraph 2.B.3.c of this section and Tables 2-1, 2-2,

2.B.3.b.(2).

and 2-3. These buoys **are not authorized substitutes** for standard buoys unless they are upgraded to meet the requirements of Category I non-standard buoys.

c. Requirements for a Category I Non-Standard Buoy.

- (1) Buoy Hulls. Buoy hulls shall be of welded construction. **All buoy hulls that are riveted or have components that are riveted (i.e. lift eyes, counterweights, etc.) shall be surveyed and shall not be deployed.**
- (2) Towers. Towers must have radar reflectors. 1952 towers are not authorized for bell or gong buoys. Tower legs or feet which are bolted to the hull shall be welded to prevent the loss of the tower.
- (3) Battery Pocket Closures. The standard pocket closure is the 6 swing bolt configuration (Data Sheets 2.L.11 through 2.L.13). **The V-band pocket closures are unacceptable and shall be converted to the standard prior to their next deployment.** The 12 swing bolt configuration and bolted flange configuration are acceptable. In many cases, solarization and battery boxes have rendered the pockets unnecessary. The District Commander may authorize welding the pockets shut as detailed in paragraph 2.E.4.f.(3).
- (4) Lifting Bails/Mooring Bails.
 - (a) Standard bails are made from plate steel and externally welded to the buoy hull. (Data Sheet 2.L.24.)
 - (b) Other existing bails made from plate steel or cast steel that are internally or externally welded are acceptable.
 - (c) **All 1942 and 1952 type 6X20 buoys without offset lifting bails shall be surveyed and not deployed** due to safety reasons and their age.
- (5) Bell/Gong Mounting Flanges. A standard bell/gong mounting flange shall be installed on all lighted buoys, except the 5X11LR and the 3.5X8LR, to allow for buoy battery box installation.

C. Buoy Selection Criteria. There is a wide variety and age of buoys in the field. Proper buoy selection requires consideration of the environmental conditions, operational characteristics, and physical characteristics of the buoys available.

- 2.C.
1. Environment. Environmental conditions are categorized as exposed, semi-exposed, and protected. These categories are general in nature. Servicing units should consider the wind, wave, and current condition when assessing the buoy's environmental category.
 2. Operational Characteristics of Standard Buoys. Tables 2-1 through 2-6 give the operational characteristics of standard buoys. Definitions are provided below.
 - a. Focal Height of Light. The distance from the waterline to the focal plane of the lantern.
 - b. Nominal Visual Range of Daymark. The distance at which you can expect to see the buoy if the visibility is 10 nm. Table 2-4 shows the change in visual range under different visibility conditions. The nominal values given in the table are based on certain assumptions about the buoy color, the contrast between the buoy and the background, and the observer's height of eye. These assumptions are described below. The conditions on station will determine the actual visual range of the buoy, which could vary considerably from the values shown in the table.
 - (1) Background. The visual range of a buoy depends on the contrast between the buoy and its background. For buoys with daymark areas of less than 10 square feet, it is assumed they are contrasted against a sea background. For buoys with daymark areas of 10 square feet or more, it is assumed they are contrasted against both sea and sky. The amount of the buoy seen against the sky will depend on the height of eye of the observer. As the observer's height of eye increases, less of the buoy will be seen against the sky and its visual range will decrease. The values in the tables are based on a height of eye of 15 feet.
 - (2) Color. The color of the buoy also affects its ability to be seen. For the values provided in the tables, it is assumed the buoys are either IALA red or IALA green.
 - c. Radar Range. Radar ranges are calculated from complex theoretical equations that consider not only the radar reflector configuration of the buoy, but also the characteristics of the radar set. The ranges determined by this theory have been substantiated by field testing. The ranges represent an average range at which a blip/scan ratio of 0.2 is obtained. The stereotyped radar set used in determining these ranges has the following characteristics:

2.C.2.c

- (1) antenna height, 10 ft.
- (2) peak transmitted power, 3 kW.
- (3) wavelength, 3 cm.
- (4) antenna gain, 25 dB.
- (5) receiver noise figure, 12 dB.
- (6) 1F bandwidth, 10 MHz.
- (7) frequency, 9.4 GHz.
- (8) noise factor, 16 dB.

- d. Minimum Mooring Depth. Depth of water required to keep the buoy counterweight clear of the bottom. Tidal and sea conditions will affect the minimum mooring depth.
- e. Maximum Mooring Depth. The maximum mooring depth for a given buoy depends on the size of chain used. In areas with excessive wear rates, a larger diameter chain **is recommended** for use in the chafe section to extend the time between mooring inspections. Guidance is provided in Tables 2-5 and 2-6. **The Computer-Aided Mooring Selection Guide, MOORSEL, may also be used to assist in the selection of the mooring configuration.**
- f. Minimum Freeboard. The minimum freeboard needed to ensure the buoy will function as designed.
- g. Pounds-per-Inch of Immersion. Weight that will submerge the buoy one inch. This value is used to determine the freeboard with different moorings or power units.

3. Physical Characteristics of Standard Buoys. Tables 2-7, 2-8, and 2-9 provide the physical characteristics of standard buoys. The values given in these tables are for buoys without moorings, power units, or sound signal equipment. Definitions are provided below.

- a. Buoy Weight. This is the weight of the buoy in air.
- b. Flooded Weight. This is the weight of the buoy in air with its hull and pockets flooded.
- c. Buoy Draft. Buoy draft is the distance from the waterline of the buoy to its lowest underwater part, not including mooring.
- d. Freeboard. Freeboard is the distance from the waterline to the top of the hull.

Table 2-1
OPERATIONAL CHARACTERISTICS OF STANDARD LIGHTED BUOYS*

	SEMI-EXPOSED											
	EXPOSED					PROTECTED						
Buoy Type	9X35	9X32	9X20	8X26	8X26	8X21	7X20	7X17	6X20	5X11	5X9	3.5X8
Characteristics	LWR	LR	BR/GR	LR	LWR	LR	LI	LR	LR	LR	LFR	LR
FOCAL HEIGHT OF LIGHT (FT-IN) (At minimum freeboard)	20-7	21-2	—	15-11	15-10	13-4	9-10	11-5	10-9	8-0	6-7	5-7
NOMINAL VISUAL RANGE OF DAYMARK (NM)	3.2	3.8	3.0	3.2	3.2	3.0	1.4	2.3	2.1	1.4	1.4	1.4
RADAR RANGE (NM)	4.0	4.5	3.7	3.7	3.7	3.7	0.5	2.7	2.4	1.7	1.3	1.3
MINIMUM MOORING DEPTH (FT)	35	30	15	25	25	18	25	17	20	13	10	11
MAXIMUM MOORING DEPTH (FT)	SEE TABLE 2-5 AND 2-6											
MINIMUM FREEBOARD (IN)	14	22	12	15	15	11	30	14	10	10	5	6
LB PER INCH OF IMMERSION	300	340	340	264	250	264	170	205	150	105	119	50

*NOTE: ALSO INCLUDES 9X20 UNLIGHTED SOUND BUOY

Table 2-2
OPERATIONAL CHARACTERISTICS OF STANDARD UNLIGHTED STEEL BUOYS

	SEMI-EXPOSED																							
	EXPOSED				PROTECTED				ICE				RIVER											
Buoy Type	1	2	2	3	3	3	3	5	5	5	5	5	5	4	4	4	6	6	6	6	6	6	6	6
Characteristics	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CI	NI	CI	NI	CR	NR	CR	NR	CR	NR	CR	NR	CR	NT
NOMINAL VISUAL RANGE OF DAYMARK (NM)	3.8	3.5	2.8	2.6	1.4	1.4	1.4	1.2	1.2	1.2	1.4	1.4	1.2	1.2	1.4	1.4	1	1	1	1	1	1	1	
RADAR RANGE (NM)	3.5	3.5	2.5	3.0	1.6	1.8	1.25	1.25	1.25	0.5	0.5	0.5	0.5	0.5	1.5	1.5	1	1	1	1	1	1	0.5	
MINIMUM MOORING DEPTH (FT)	15	15	15	15	10	10	10	10	10	10	15	15	10	10	10	10	6	6	6	6	6	6	6	
MAXIMUM MOORING DEPTH (FT)	SEE TABLE 2-5 AND 2-6																							
MINIMUM FREEBOARD (FT-IN)	2-2	2-3	1-6	1-7	0-11	0-11	0-11	0-11	0-11	0-11	3-9	4-11	2-2	3-2	1-0	1-0	0-6	0-6	0-6	1-6	1-6	1-6	2-6	
LB PER INCH OF IMMERSION	104	104	67	67	38	38	16	16	16	16	22	22	16	16	21	21	9	9	9	9	9	9	9	

Table 2-3

OPERATIONAL CHARACTERISTICS OF STANDARD FOAM AND PLASTIC UNLIGHTED BUOYS

Buoy Type Characteristics	EXPOSED						SEMI-EXPOSED						PROTECTED							
	2 CFR	2 NFR	3 CFR	3 NFR	4 CFR	4 NFR	4 CFR	4 NFR	5 CFR	5 NFR	6 CFR	6 NFR	6 CFR	6 NFR	FW CFR	FW NFR	5 CFR	5 NFR	5 CFR	5 NFR
NOMINAL VISUAL RANGE OF DAYMARK (NM)	2.6	2.6	2.0	2.0	1.4	1.4	1.4	1.2	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
RADAR RANGE (NM)	1.5	1.5	1.5	1.5	0.75	0.75	0.75	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
MINIMUM MOORING DEPTH (FT)	15	15	10	10	10	10	10	6	6	6	6	6	6	3	3	3	3	7	7	7
MAXIMUM MOORING DEPTH (FT)	SEE TABLE 2-5 AND 2-6																			
MINIMUM FREEBOARD (IN)	10	10	6	6	4	4	4	4	4	4	4	4	4	5	5	5	5	25	25	25
LB PER INCH OF IMMERSION	119	119	72	72	47	47	47	26	26	12	12	12	12	38	38	38	38	15	15	15

2.C.3.d.

Table 2-4
**CHANGE IN VISUAL RANGE OF BUOY TYPES
 VERSUS CHANGE IN VISIBILITY (NM)**

VISIBILITY (nm) BUOY TYPE	Nominal Range						
	2.0	2.5	5.0	7.5	10.0	12.5	15.0
9X35LWR	1.5	1.7	2.3	2.6	3.2	3.5	3.8
9X32LR	1.7	2.0	2.8	3.3	3.8	4.0	4.1
9X20BR/GR	1.5	2.0	2.4	2.8	3.0	3.1	3.3
8X26LR/LWR	1.5	1.7	2.3	2.6	3.2	3.5	3.8
8X21LR	1.5	2.0	2.4	2.8	3.0	3.1	3.3
7X20LI	0.9	1.0	1.2	1.4	1.4	1.4	1.4
7X17LR	1.2	1.5	2.0	2.1	2.3	2.5	2.6
6X20LR	1.0	1.3	1.8	2.0	2.1	2.3	2.3
5X11LR	0.9	1.0	1.2	1.4	1.4	1.4	1.4
5X9LFR	0.9	1.0	1.2	1.4	1.4	1.4	1.4
3 1/2X8LR	0.8	0.9	1.1	1.2	1.4	1.4	1.4
1CR	1.6	1.8	2.7	3.3	3.8	4.0	4.2
1NR	1.5	1.7	2.6	3.1	3.5	3.8	4.0
2CR	1.2	1.3	1.9	2.5	2.8	3.1	3.3
2NR	1.2	1.3	1.8	2.2	2.6	2.8	2.9
3CR/NR	0.8	1.0	1.2	1.3	1.4	1.4	1.4
4CR/NR	0.8	1.0	1.2	1.3	1.4	1.4	1.4
5CR/NR	0.7	0.8	1.0	1.1	1.2	1.2	1.2
6CR/NR, 6CT/NT	0.7	0.8	0.9	0.9	1.0	1.0	1.0
3CI/NI	0.8	0.9	1.1	1.2	1.4	1.4	1.4
5CI/NI	0.7	0.8	1.0	1.1	1.2	1.2	1.2
2CFR/NFR	1.2	1.3	1.8	2.2	2.6	2.8	2.9
3CFR/NFR	1.0	1.2	1.6	1.8	2.0	2.1	2.1
4CFR/NFR	0.8	1.0	1.2	1.3	1.4	1.4	1.4
5CFR/NFR	0.7	0.8	1.0	1.1	1.2	1.2	1.2
6CFR/NFR	0.7	0.8	0.9	0.9	1.0	1.0	1.0

2.C.3.d.

Buoy Type	Chain Size									
	1-7/8"	1-3/4"	1-5/8"	1-1/2"	1-1/4"	1-1/8"	1"	7/8"	3/4"	1/2"
9X35LWR	127	144	165	191						
9X32LR	217	248	285	332						
9X20R		193	224	261						
8X26LR		129		175	250					
8X26LWR		122		166	236					
8X21LR		94		128	182	224				
7X20LI				33	47	60	75			
7X17LR				133	189	233	291			
6X20LR				69	97	120	149			
5X11LR					69	84	105			
5X9LFR							62	81	110	
3.5X8LR							33	41	55	
1CR				121	174	216				
1NR				126	182	226				
2CR					78	97	121			
2NR					81	101	127			
3CR/3NR							43	56	76	
3CI							30	39	53	
3NI							27	35	48	
5CR/5NR										67
5CI/5NI										50
2CFR/2NFR						91	115	149	204	
3CFR/3NFR								60	82	179
4CFR/4NFR									37	80
5CFR/5NFR										40
6CFR/6NFR										21
FWCFR/FWNFR										71
5CPR/5NPR										35

Table 2-5

MAXIMUM MOORING DEPTHS FOR RECOMMENDED CHAIN SIZES

Example: An 8X26LR with 1-1/2" chain can be moored at a depth of 175 feet. The same buoy with 1-1/4" chain can be moored at a depth of 250 feet. An 8X26LR with a combination of 1-1/2" and 1-1/4" chain should be moored at a depth between 175 and 250 feet. This depth can be found by interpolating between the two depths based on the amounts of 1-1/2" and 1-1/4" chain used.

2.C.3.d.

BUOY TYPE	CHAIN SIZE								
	1-7/8"	1-3/4"	1-5/8"	1-1/2"	1-1/4"	1-1/8"	1"	7/8"	3/4"
9X35LWR	-2'	-2.5'	-2.5'	-3'					
9X32LR	-2'	-2.5'	-2.5'	-3'					
9X20R				-3'	-4.5'				
8X26LR				-3'	-4.5'				
8X26LWR				-3'	-4.5'				
8X21LR				-3'	-4.5'	-5.5'			
7X17LR				-3'	-4.5'	-5.5'	-7'		
6X20LR				-3'	-4.5'	-5.5'	-7'		
SX11LR					-4.5'	-5.5'	-7'		
5X9LFR							-7'	-9'	-12'
3.5X8LR							-7'	-9'	-12'

Table 2-6

CORRECTION FACTORS TO ADJUST THE
 MAXIMUM MOORING DEPTH
 PER 100 POUNDS OF ADDITIONAL BUOY WEIGHT
 (e.g. Sound Signals, Lighting Equipment, etc.)

Example: The maximum mooring depth for an 8X26LR with 1-1/4" chain is 250 feet. If 400 pounds of equipment (battery box and lighting equipment) is added, the new maximum mooring depth will be 232 feet. This is found by locating the correction factor for an 8X26LR buoy moored with 1-1/4" chain (-4.5'), and multiplying this factor by how many hundreds of pounds were added (in this example, 4). Add this result to the original maximum mooring depth and you will get the corrected maximum mooring depth:

$$\begin{aligned}
 &8X26LR \text{ with } 1-1/4" \text{ chain} = \text{Correction Factor of } -4.5' \\
 &250' + (4 \times -4.5') = 232 \text{ feet}
 \end{aligned}$$

Table 2-7
PHYSICAL CHARACTERISTICS OF STANDARD LIGHTED BUOYS*

Buoy Type	9X35	9X32	9X20	8X26	8X26	8X26	8X21	7X20	7X17	6X20	5X11	5X9	3.5X8
Characteristics	LWR	LR	B/GR	LR	LWR	LR	LR	LI	LR	LR	LR	LFR	LR
BUOY WEIGHT (LB)	18,500	17,500	8,000	11,800	12,100	13,900	6,500	6,500	7,800	6,500	3,000	1,500	1,500
FLOODED WEIGHT (LB)	52,000	53,000	24,000	34,000	33,000	33,000	19,000	19,000	24,500	17,000	9,000	—	4,000
BUOY DRAFT (FT-IN)	15-10	11-7	5-4	10-4	10-5	7-9	10-7	10-7	5-6	9-0	3-9	2-9	2-9
FREEBOARD (FT-IN)	3-0	4-7	2-6	3-1	3-0	2-3	3-1	3-1	3-0	2-1	2-1	1-1	1-4
BRIDLE SIZE	1-1/2	1-1/2	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1	1	—	7/8
CHAIN DIA X LENGTH (IN X FT)	20	18	15	15	15	15	15	15	15	12	12	—	10
MOORING CHAIN SIZE (IN)	SEE TABLE 2-12												
SINKER SIZE (LB)	12,750	12,750	8,500	8,500	8,500	8,500	**	**	8,500	5,000	4,000	4,000	3,000

* NOTE: ALSO INCLUDES 9X20 UNLIGHTED SOUND BUOY

** NOTE: USE SINKER EQUIPMENT FROM PERMANENT AID

Table 2-8
PHYSICAL CHARACTERISTICS OF STANDARD UNLIGHTED STEEL BUOYS

Bouy Type	1	1	2	2	3	3	3	3	5	5	5	5	4	4	6	6	6	6		
Characteristics	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CR	NR	CT	NT
BUOY WEIGHT (LB)	6,100	6,000	2,800	2,600	1,200	1,175	710	710	1,550	1,550	1,550	4,200	4,200	465	470	160	165	165	165	170
FLOODED WEIGHT (LB)	18,500	18,400	8,400	8,300	3,200	3,200	1,800	1,800	4,200	4,200	4,200	1,900	1,900	-----	-----	-----	-----	-----	-----	-----
BUOY DRAFT (FT-IN)	8-7	8-4	6-3	6-1	4-4	4-4	5-1	5-1	7-7	7-7	7-7	5-0	5-0	5-0	5-0	3-10	3-10	4-0	4-0	4-0
FREEBOARD (FT-IN)	5-5	5-8	3-9	3-11	2-4	2-4	2-3	2-3	5-5	5-5	6-5	3-2	4-2	2-11	2-11	2-5	2-5	2-9	4-2	4-2
MOORING CHAIN SIZE (IN)	SEE TABLE 2-12																			
SINKER SIZE (LB)	8,500	8,500	4,000	4,000	3,000	3,000	2,000	2,000	3,000	3,000	3,000	2,000	2,000	2,000	2,000	500	500	500	500	500

*NOTE: USUALLY MOORED WITH 1/2" (3/8") WIRE ROPE.

Table 2-9
PHYSICAL CHARACTERISTICS OF STANDARD FOAM AND PLASTIC UNLIGHTED BUOYS

Bouy Type Characteristics	2	2	3	3	4	4	4	5	5	6	6	6	5	5
	CFR	NFR	CFR	NFR	CFR	NFR	CFR	NFR	CFR	NFR	CFR	NFR	CFR	NFR
BUOY WEIGHT (LB)	1,100	1,025	525	500	195	180	115	115	65	65	200	195	114	114
BUOY DRAFT (FT-IN)	5-3	5-3	3-1	3-1	2-10	2-10	3-0	3-0	2-4	2-4	1-1	1-1	3-6	3-6
FREEBOARD (FT-IN)	2-0	2-0	1-4	1-4	0-11	0-11	0-10	0-10	1-11	1-11	1-0	1-0	3-0	3-0
MOORING CHAIN SIZE (IN)	SEE TABLE 2-12													
SINKER SIZE (LB)	3,000	3,000	2,000	2,000	1,000	1,000	500	500	500	500	1000+	1000+	500	500

2.D.

New Buoys.

1. New Buoys. New buoys are fabricated by commercial contractors in accordance with Commandant (G-SEC-2) specifications. DD-250 shipping document(s) must accompany buoy shipments. Ensure that the types, colors, and quantities of the buoys shipped agree with the DD-250. Check for damage that may have occurred during shipment. DD-250s shall be mailed or faxed to Commandant (G-SEC-2) as specified on the bottom of the DD-250. Contact Commandant (G-SEC-2) **immediately** if a buoy is damaged.
2. Air Test. New steel ocean buoys shall be air tested in accordance with paragraph 2.E.4.m.(1) before delivery to the servicing unit. Contact Commandant (G-SEC-2) **immediately** if a new buoy hull fails an air test.

E. Steel Buoy Maintenance. Steel buoy maintenance is performed by Coast Guard and commercial industrial facilities. A flowchart describing the decisions made in the steel buoy maintenance process is shown in Figure 2-1.

1. Definitions.
 - a. Overhaul. Overhaul includes repair to the buoy hull and tower, any required upgrades, blast cleaning, and painting.
 - b. Repair. Work required to fix or replace any part of the buoy that has been damaged.
 - c. Upgrade. Work required to improve the buoy from a Category II to a Category I buoy.
 - d. Outfitting. Equipping the buoy hull with the proper hardware and appendages.
 - e. Survey. Decision to identify a buoy as no longer fit for service. The decision is usually based on the cost to overhaul the buoy.
 - f. Scrapping. Disposing of a surveyed buoy in accordance with Federal, state, and local laws and regulations.
 - g. Appendages. Signal equipment that is bolted or pinned to the hull (bells, tappers, lighting equipment, racons, etc).

2.E.

2. Economic Repair and Upgrade of Steel Buoys. Economic feasibility of repairing and upgrading steel buoys is based on labor hours. The maximum labor hour limits for buoy repairs and upgrades are listed in Table 2-10. These limits do not include blast cleaning, painting, and outfitting.

Table 2-10
**LABOR HOUR LIMITS FOR ECONOMICAL REPAIR AND UPGRADE
 OF STEEL BUOYS AND TOWERS**
 (Excluding blast cleaning, painting, and outfitting)

<u>BUOY TYPE</u>	<u>HOURS (TOWER)*</u>	<u>HOURS (TOTAL BUOY)**</u>
9X35	40	90
9X32	30	90
9X20, 8X21	20	70
8X26	20	70
7X20		25
7X17, 6X20	10	45
5X11, 3.5X8		25
1CR/1NR		25
2CR/2NR		25
3CR/3NR		10
3CI/3NI		5
5CR/5NR		5
5CI/5NI		5

* As indicated in paragraph 2.E.4.d.(2) towers may be replaced instead of repaired.

** Includes all hours required for repair and upgrade of the entire buoy including the tower.

3. Survey of Steel Buoys. When a buoy cannot be economically repaired and upgraded within the Labor Hour Limits of Table 2-10, it shall be surveyed. A Category II non-standard buoy that cannot be economically repaired and upgraded to a Category I buoy shall also be surveyed.
 - a. Scrapping Surveyed Buoys. Upon approval of the District Commander, surveyed buoys shall be disposed of in accordance with Federal, state, and local regulations. Cast counterweights and other buoy parts may be salvaged for re-use.

2.E.3.b.

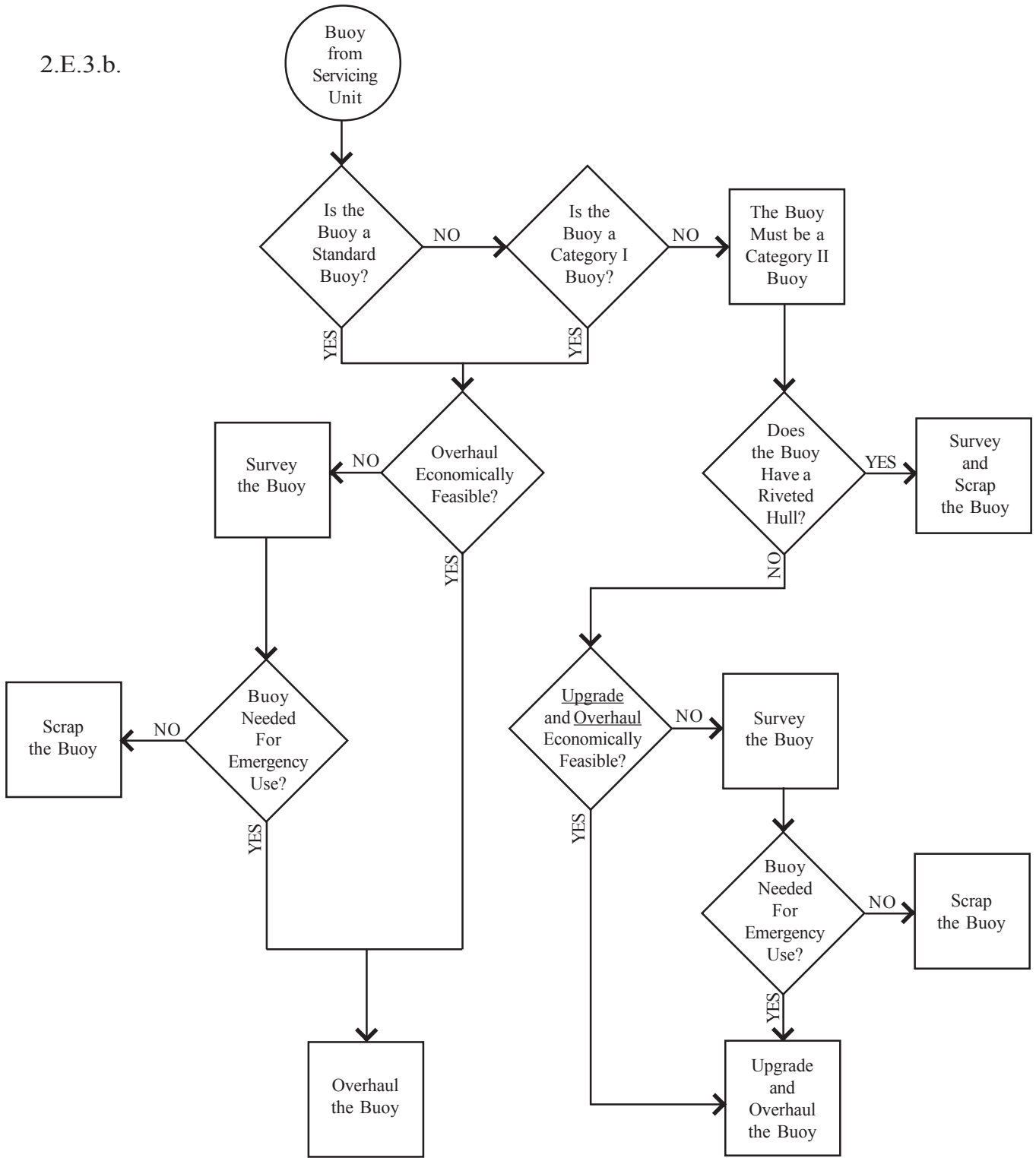


Figure 2-1
STEEL BUOY MAINTENANCE DECISION FLOW CHART

- 2.E.3.b. b. Emergency Use of Surveyed Buoys. The District Commander may authorize overhauling a surveyed buoy to meet an emergency need. If a surveyed buoy is overhauled it shall be deployed only once for a period not to exceed six years. An “S” twice the size of the serial number shall be welded at the end of the serial number to prevent survey duplication and repeated overhauls.

4. Overhaul of Steel Buoys.

- a. Gas-Free Testing. Be aware that combustible gases could be present in the buoy hull. Before beginning any work on the buoy, the hull shall be tested for combustible gases using a combustible gas monitor or explosive meter. Insert the probe from the meter into the buoy body air test fitting.
- (1) If no combustible gases are detected, then work can be performed on the buoy.
 - (2) If combustible gases are detected, the buoy hull shall be purged with compressed air to displace the combustible atmosphere. If the hull is equipped with two air test fittings (see paragraph 2.E.4.m), ensure that both fittings are open to improve the air flow.
- b. Preparation. Prior to blast cleaning, all appendages shall be removed, and all threaded surfaces shall be covered for protection.
- c. Blasting. The buoy shall be blasted in accordance with the *Coatings and Color Manual* COMDTINST M10360.3 (series) prior to any cutting or welding.
- d. Towers.
- (1) Towers shall be welded to the buoy hull. Tower legs bent more than 3 inches from a straight line over a 2 foot length shall be straightened. The tower centerline shall not be more than two degrees from perpendicular to the waterline. Radar reflector panels shall not exceed 3 degrees from a right angle. The lantern mounting surface and lantern ring shall be parallel to the waterline.
 - (2) Towers not meeting the criteria outlined in paragraph 2.B.3.c.(2), and towers that cannot be economically repaired in the time specified in Table 2-10 shall be replaced. New buoy towers are available on commercial contract and can be ordered through Commandant (G-SEC-2).

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- e. Buoy Hull. Any damage that penetrates the hull shall be repaired. Severe dents and creases (12 inches long or 4 inches deep) shall be repaired, returning the buoy body to its approximate original shape. All buoy hulls shall be air tested in accordance with paragraph 2.E.4.m prior to painting.

- f. Battery Pockets.
 - (1) Closures. **All V-band pocket closures shall be replaced** with the standard pocket closure as illustrated in Data Sheets 2.L.11 through 2.L.13. The standard battery pocket conversion kit, shown in Data Sheet 2.L.14, is available through the stock system.
 - (2) Gaskets. Battery pocket cover gaskets shall be replaced. Gasket material included in Data Sheets 2.L.11 through 2.L.13 is available through the stock system. Gaskets for non-standard pocket covers are no longer available through the stock system. Remember that overtightening the swing bolts could crack the gasket, which would compromise the watertight integrity of the battery pockets.
 - (3) Permanently Closing the Battery Pocket. The battery pocket may be welded shut per paragraph 2.B.3.c.(3). The pocket may either be cut flush with the top head or just below the flange. A plate shall then be welded over the pocket opening.
 - (4) Vent Lines. The vent lines shall be inspected for any damage or obstructions that would impair the flow of air or allow flooding of the battery pocket(s). All damage shall be repaired or replaced as appropriate. The stainless steel unions may be removed and stainless steel couplings may be welded in their place. Damaged threads at the end of vent lines shall be repaired. When there are no batteries in either battery pocket, the vent valves may be removed and vent lines capped with a 3/4" stainless steel pipe cap.
 - (5) Crossover Tubes. Crossover tubes shall be inspected for any damage or obstructions that would impair the flow of air. Specifically, ensure the tubes are free of blast grit, paint chips, dirt, or other foreign material.
 - (6) Air Test. Battery pockets shall be tested in accordance with paragraph 2.E.4.m before painting.

2.E.4.g. g. Lifting Bails. Standard lifting bails are machined from plate steel and externally welded to the buoy hull. (Data Sheet 2.L.24).

(1) Non-Standard Bails. Lifting bails made from plate steel or cast steel that are internally or externally welded to the buoy hull are acceptable.

(2) Testing. The following guidelines apply to all lighted buoys and unlighted buoys 3rd class and larger:

(a) The integrity of lifting bails is vital to the safety of buoy handling operations. Failure of a lifting bail could lead to serious injury. Therefore, it is paramount to ensure the quality of the welding on this critical component. Non-destructive testing is extremely important for buoys that have been in service and are undergoing overhaul. Lifting bails are subjected to repeated lifting while in service which can weaken the weld and the surrounding metal. **If any welds which attach the lifting bails to the buoy hulls are of questionable integrity, then non-destructive testing (NDT) shall be performed using the magnetic particle method.**

(b) Magnetic-particle testing procedures and techniques shall be in accordance with ASTM E709. Personnel performing NDT shall be certified to Level II in accordance with the current edition of the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A. The NDT inspector can be either a Coast Guard employee or a commercial contractor.

(c) Repair weld defects in accordance with American Welding Society (AWS) D.1.1.

h. Mooring Attachments.

(1) Mooring Bails. Worn mooring bails shall be repaired or replaced if economically feasible (reference Table 2-10). Repaired mooring bails shall be built up to original size and shape by welding or inserting sleeve bushings. Hardfacing material shall be used when weld build-up is the repair method.

(2) Mooring Arms. Bent mooring arms should be straightened or replaced if they do not function properly. The mooring arm pin and the mooring arm shall be repaired or replaced when the clearance between them

2.E.4.h.

exceeds 5/8 inch. If the hole in the lower end of the mooring arm has worn by more than 1/2 inch in diameter, it shall be repaired or the mooring arm shall be replaced. Hardfacing material shall be used when weld build-up is the repair method. All pre-1991 mooring arms should be replaced with the current shorter arms.

(3) **Testing. If any welds which attach the mooring bails or the mooring arm pins to the buoy hull are of questionable integrity, then non-destructive testing shall be performed using the magnetic particle method** outlined in paragraph 2.E.4.g.(2)(b).

i. Miscellaneous Bails. Miscellaneous bails such as the cage line attachment on 7X20LI buoys, and the lifting bails on 5X11LR radar reflectors shall be inspected, and repaired or replaced as necessary.

j. Buoy Counterweight Tubes.

(1) Bent counterweight tubes shall be replaced.

(2) The welds at the junction of the tube and buoy hull shall be inspected and repaired as required.

(3) Steel doubler plates (6 X 24 X 3/8 inches) shall be installed between the gussets and buoy hull on all 1962-type 8X26LR buoys not previously modified.

k. Counterweights. The space between the counterweight and tube shall be filled with asphalt enamel. 10 inch tall counterweights on 6X20LR buoys and 21 inch tall counterweights on 8X26LR buoys shall be replaced with standard counterweights.

l. Chafing Blocks. Chafing blocks are not required on buoys with 12 inch diameter counterweight tubes. Worn chafing blocks shall be replaced with salt-treated wood or hardwood. Retaining pins shall be replaced with nuts and bolts. The nuts shall be welded in place to prevent their loss. New chafing blocks shall be installed after the finish coat of paint is applied to the buoy.

m. Air Test. **All lighted and unlighted steel ocean buoys shall be retrofitted with a second air test coupling on the buoy hull to facilitate the gas freeing procedure (2.E.4.a.(2) and 2.J.2.f.(4)(b)).** Prior to priming and painting, the buoy hull and buoy battery pockets shall be air tested as outlined below. Do not over-pressurize the buoy body or battery pockets, as it can lead

2.E.4.m.

to catastrophic failure. Differences between the temperature of the incoming air and the buoy can lead to over-pressurization.

- (1) Buoy Hull Air Test. The buoy hull shall hold 3 psi for 10 minutes. Any buoy hull failing the air test shall be repaired and re-tested. Air test procedures and apparatus are described below.
 - (a) Prior to pressurizing the hull, the battery pocket covers must be removed. With the apparatus described below, pressurize the buoy hull to 3 psi and secure the air source. The hull must hold the pressure for 10 minutes. Any drop in pressure is a buoy hull air test failure.
 - (b) The source of the test air shall be the lowest pressure practicable. The air test apparatus shall consist of:
 1. A calibrated pressure gage with a scale no greater than 20 psi and an accuracy of plus or minus 1%.
 2. A pressure regulator installed in the line that reduces the pressure to 3 psi.
 3. A relief valve that automatically relieves pressure greater than 5 psi. The valve shall be non-adjustable and capable of independently reducing the hull air pressure more rapidly than it can be increased by the air source.
 4. A valve shall be provided to vent off the pressure at the end of the test.
- (2) Buoy Battery Pocket Air Test. The buoy battery pocket shall hold between 1 and 2 psi for 5 minutes. Any battery pocket failing the air test shall be repaired and re-tested.
 - (a) With the apparatus depicted in Figure 2-2, pressurize the battery pockets to between 1 and 2 psi and secure the air source. The battery pockets must hold the pressure for 5 minutes. Any drop in pressure is a battery pocket air test failure.

2.E.4.m.(2).

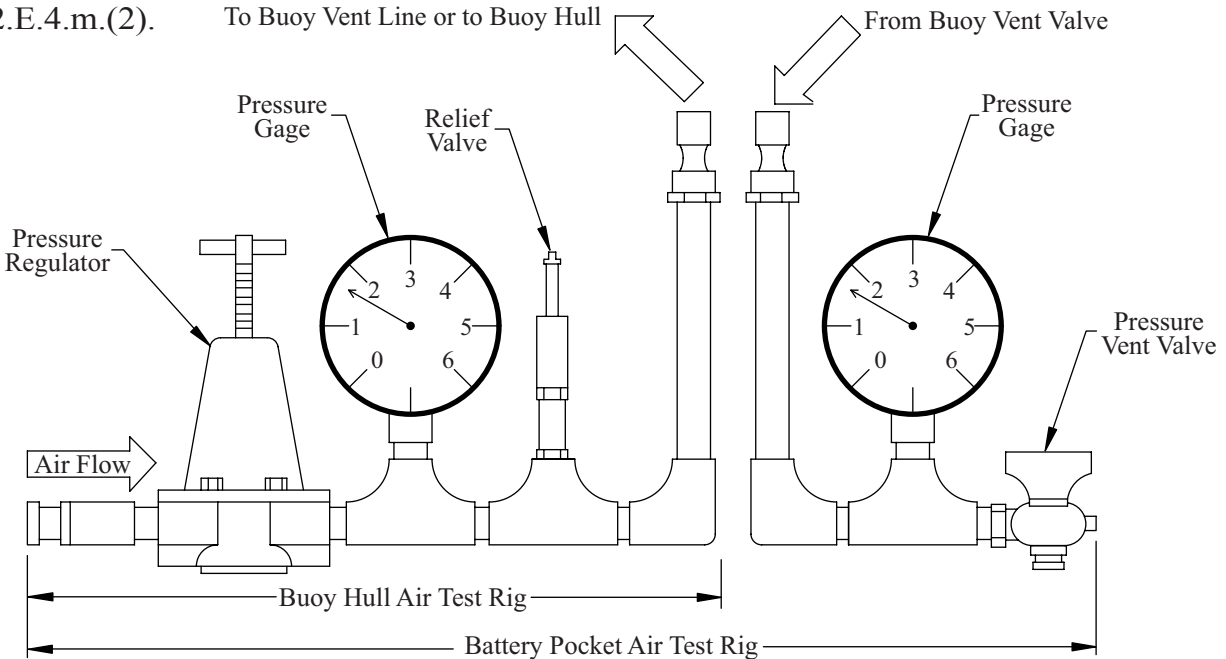


Figure 2-2
AIR TEST RIG

(b) The source of the test air shall be the lowest pressure practicable. The air test apparatus shall consist of:

1. Two calibrated pressure gages with a scale no greater than 20 psi and an accuracy of plus or minus 1%.
2. A pressure regulator installed in the line that reduces the pressure to 2 psi.
3. A relief valve that automatically relieves pressure greater than 5 psi. The valve shall be non-adjustable and capable of independently reducing the pocket air pressure more rapidly than it can be increased by the air source.
4. A valve shall be provided to vent off the pressure at the end of the test. Pressure shall be vented slowly to prevent damage to the batteries.

n. Battery Boxes. Battery boxes shall be repaired or replaced as necessary.

2.E.4.

- o. Sound Signals. Sound signal appendages are stocked, maintained, and installed by industrial facilities.
 - (1) Whistles. **Replace whistle balls each time the buoy is overhauled.** After installation on the buoy, the space between the whistle bell and the whistle body shall be adjusted to $15/16 \pm 1/16$ in. Whistles are depicted on Data Sheets 2.L.4 and 2.L.5.
 - (2) Bells. Bells do not require any special preparation. Bells are depicted on Data Sheet 2.L.6.
 - (3) Gongs. Gongs do not require any special preparation. Gongs are depicted on Data Sheet 2.L.8.
 - (4) Bell and Gong Stands. Bell and gong stands shall be blasted and inspected for cracks. Damaged stands shall be repaired or replaced. Properly prepare and paint the entire stand prior to installation. Ensure new isolation pads are installed between the stand and the bell or gong. Stainless steel nylock nuts and lock washers shall be used. Bell and gong stands are depicted on Data Sheet 2.L.7 and 2.L.9, respectively.
 - (5) Tappers.
 - (a) Standard Tappers. The standard tapper shown on Data Sheet 2.L.10 is available through the stock system. This adjustable tapper replaces all 1952- and 1962-type tappers.
 - (b) Non-Standard Tappers. The 1952-type tapper is no longer approved for use. The 1962-type tapper may still be used.
 - (c) Tapper Ball Adjustment. After the tapper is mounted, the tapper ball shall be adjusted to the correct height and the nuts tightened. The tapper ball shall be adjusted so that its centerline is located 1-1/4 inch above the bell's lower edge or 1/4 inch above the gong's lower edge. Excess tapper bar must then be removed by cutting it below the lower securing nut.
 - (d) Replacement Criteria. In general, tapper balls should be replaced at each overhaul. However, if the tapper ball is in good condition it may be rotated 180 degrees and used for one

2.E.4.o.(5).d.

more deployment. Other taper components shall be replaced if:

1. The taper bar is broken or severely bent.
2. The swing rod is worn to 1 inch or less.
3. The swing rod sleeves are worn to a 1/16 inch thickness.

p. Painting.

- (1) Buoys. Buoys shall be painted in accordance with the *Coatings and Color Manual* COMDTINST M10360.3 (series). When painting buoys, refer to Table 2-11 of this chapter for standard waterlines (the line between the color coat and the antifouling paint). Color and marking shall be in accordance with Chapter 3 of this manual.
- (2) Buoy Appendages. All buoy appendages below the lantern including bell stands, battery boxes, gong stands, tappers, etc. shall be painted with a neutral topcoat color such as gray. Stainless steel and aluminum appendages above the lantern such as topmark stands and solar panel frames shall remain unpainted. Steel appendages above the lantern shall be galvanized or painted with a neutral topcoat color such as gray.

2.E.4.p.(2).

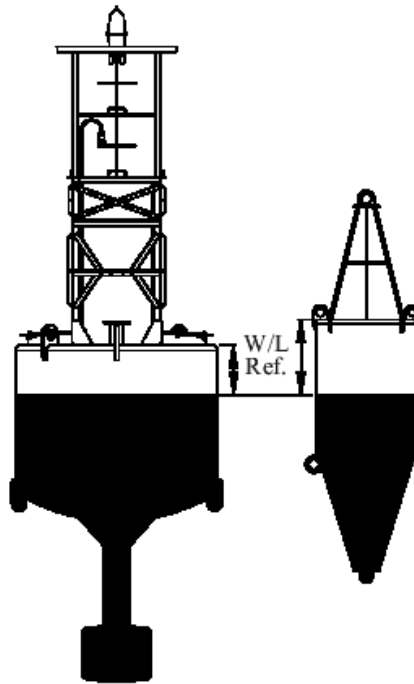


Table 2-11

STANDARD WATERLINES FOR STEEL BUOYS

Noted below are the standard waterlines which will be indicated on new steel buoys (line between color coat and antifouling paint). Used buoys should have the same waterlines except when used in areas where the buoy may ride much lower or higher than normal.

<u>STD Buoy Type</u>	<u>W/L (in.)</u>	<u>STD Buoy Type</u>	<u>W/L (in.)</u>
9X35 LWR	24	2NR/2CR	36
9X32 LR	30	3NR/3CR	24
9X20 R	18	3NI	60**
8X26 LR	24	3CI	54**
8X26 LWR	24	4NR/4CR	24
8X21 LR	24	5NR/5CR	24
7X20 LI	*	5CI	33**
7X17 LR	18	5NI	46**
6X20 LR	18	6NR/6CR	18
5X11 LR	12	6CT	24**
3.5X8 LR	9	6NT	40*
1NR/1CR	60	FOAM BUOYS	***

*Located at Largest Diameter

**Measured from Top Horizontal Surface

***Located half way between the top and bottom of the buoy hull (flotation foam)

2.F. Foam Buoys. The entire "family" of foam buoys was redesigned in 1996. The buoys now have a more robust structural framework, the lifting eyes are larger and stronger, the mooring eyes are similar in size to the equivalent steel buoy, and all assembly hardware is made of corrosion-resistant stainless steel. The color pigments and antioxidant additives in the foam have been increased to reduce fading. The new designs are sized to provide the same visual signal to the mariner as the equivalent class of steel buoy. However, foam buoys have a significantly higher life cycle cost than steel buoys. Foam buoys should only be used when there is a clear operational reason that makes them preferable to steel. An example would be a station where switching from steel to foam will permit changing the servicing platform from a buoy tender to a buoy boat. Also, foam buoys are generally not suitable for rugged environments, and should never be used in ice conditions. Foam buoys are designed to remain on station for eight years with minimal maintenance required. They may be kept on station beyond eight years if they remain serviceable and continue to provide the required signal. Data Sheet 2.N.1 is a job aid which is provided to assist field units in evaluating a foam buoy's condition to determine whether to leave it on station or relieve it.

1. Assembly of New Buoys. Foam buoys are shipped either unassembled or partly assembled, depending on the buoy type. Assembly instructions are included in the data sheets for each buoy type. In general, the following guidelines apply:
 - a. Upon receipt of new buoys, inspect for shipping damage and ensure all parts are accounted for.
 - b. The middle and bottom plates on new buoys are sometimes warped during the manufacturing process. This should not affect assembly of the buoy or its performance on station.
 - c. Assemble the buoys as soon as possible so that the parts are not lost.
 - d. Ensure that all connections are tightly secured. On the smaller buoys, the nuts shall be tightened until the metal plates are compressed at least 1/2 inch into the foam or until the elastic lock nuts ("Nylock") bottom out on the threads.
 - e. Always use new stainless steel elastic lock nuts to assemble the buoys. These nuts shall not be reused if they have been backed off. Once they have been tightened, do not loosen them.
2. Servicing. Foam buoys have been designed to require minimal servicing while on station. The following guidance applies:
 - a. Check for any loose connections and tighten if possible.
 - b. Use a pressure wash or scrub brush to remove growth, guano, etc.

- 2.F.2.
- c. Do not paint the foam hulls or daymarks. Fading of the foam will eventually occur (usually late in the service life), so deploy new buoys as soon as possible rather than letting them sit on the pier.
 - d. Buoys should not be relieved because of minor “cosmetic” damage. They should only be relieved if damaged metal or foam parts affect the operational performance or safe handling of the buoy. Minor repairs to the foam parts and metalwork may be carried out at the unit’s discretion.
 - e. Replacement of major components with new parts may be done at the unit’s discretion. Foam hulls, daymarks, and “metal sets” (the structural framework of the buoy) are available on commercial contract and can be ordered with unit funding through Commandant (G-SEC-2). In addition, salvaged parts from other buoys can be used to replace damaged parts and extend the life of the buoy.
 - f. The extensive metalwork on the 5x9 buoy, particularly the tower, might require maintenance painting during the service life of the buoy to repair significant damage to the coating system or to maintain the daytime signal. Refer to the *Coatings and Color Manual* COMDTINST M10360.3 (series) for guidance on materials, safety, and application instructions. Follow the guidance for “steel ocean buoys” for shoreside maintenance painting. Follow the guidance for “foam buoys” for on-station touch-up painting.

3. Disposal. Buoys shall be disposed of in accordance with Federal, state, and local regulations.

G. Plastic Buoys. A new plastic buoy was designed 1996. This new buoy replaces the old 5th and 6th class plastic “QPL” buoys. The old plastic buoys are still authorized for use but are no longer available for purchase. The new plastic buoys are designed to be kept on station for as long as they remain serviceable and continue to provide the required signal.

1. Servicing. Plastic buoys have been designed to require minimal servicing while on station. The following guidance applies:
- a. Check the lifting eye and mooring eyes for loose connections and tighten if possible.
 - b. Check the watertight integrity of the “spin patches” on the buoy top head. Buoys with “spin patches” that have lost their watertight integrity shall be relieved.

- 2.G.1.
 - c. Use a pressure wash or scrub brush to remove growth, guano, etc.
 - d. Do not paint the buoys. Fading of the plastic will eventually occur (usually late in the design life), so deploy new buoys as soon as possible rather than letting them sit on the pier.
 - e. Buoys should not be relieved because of minor “cosmetic” damage. They should only be relieved if the watertight integrity of the plastic shell is compromised or if there is damage to the lifting or mooring eyes.

2. Disposal. Plastic buoys shall be disposed of in accordance with Federal, state, and local regulations.

H. River Buoys. Steel river buoys are filled with polyurethane foam. This foam emits a toxic gas when burned. Therefore, welding repairs to river buoy bodies are not permitted. High pressure water wash of the entire buoy (above and below the waterline) is recommended to remove guano, “buoy critters”, dirt, salt, etc. Touch-up painting is not recommended for “cosmetic” reasons. Touch-up painting should only be done to repair significant damage to the topcoat. If touch-up painting is performed, follow the guidance in the *Coatings and Color Manual* COMDTINST M10360.3 (series) for materials, safety, and application instructions.

I. Buoy Outfitting. Communication between the maintenance facility and the servicing unit is critical to ensure that the buoy is properly outfitted for its intended station.

- 1. Maintenance Facility. Before delivery to the servicing unit, the maintenance facility shall outfit the buoy with the following equipment (as applicable):
 - a. Wiring as specified by the servicing unit (i.e., for one or both pockets or a solar battery box).
 - b. Solar battery box.
 - c. Sound signals.
 - d. New gaskets for solar battery boxes and battery pockets.
- 2. Floating Units. The servicing unit shall outfit the buoy with the following equipment (as applicable) and **conduct an initial air test on the pockets before the buoy is deployed**:
 - a. Lantern and light equipment.

- 2.I 2. b. Solar panels and frame.
- c. Topmark.
- d. Batteries.
- e. Vent valves.
- f. Racon or other special equipment.
- g. Retroreflective material.
- h. If necessary, a ballast slug should be placed in the opposite pocket to compensate for either primary or secondary batteries.
- i. Mooring.

J. Scheduled Servicing Visits. Routine visits, mooring inspections, battery recharge visits, and buoy reliefs are discussed below and in the *Aids to Navigation Manual Administration* COMDTINST 16500.7 (series). Bringing the buoy on deck **shall be avoided** except as required for inspection of moorings, relocation, relief, recharge, or correction of a discrepancy.

- 1. Routine Visits. The primary purpose of this visit is to position check the buoy and ensure the correct operation of the signal hardware. However, this visit also provides a good opportunity to inspect the condition of the buoy above the waterline. Servicing units shall perform the following inspections during routine visits. Repairs shall be made as required.
 - a. Lighting Equipment. All lighting equipment (lamps, flashers, lamp changers, daylight controls, and lanterns, etc.) shall be inspected using Chapter 6 of this manual and the *Short Range Aids to Navigation Servicing Guide* COMDTINST 16500.19 (series) for guidance.
 - b. Solar Panels. Solar panels shall be inspected using Chapter 10 of this manual and the *Short Range Aids to Navigation Servicing Guide* COMDTINST 16500.19 (series) for guidance.
 - c. Wiring. All accessible wiring shall be visually checked for cracking, deterioration, and corrosion. Wire retaining clips shall be checked to ensure that the wire is secure. Stuffing tubes shall be inspected.

- 2.J.1.
- d. Batteries. Batteries shall be load tested at the lantern using Chapter 10 of this manual and the *Short Range Aids to Navigation Servicing Guide* COMDTINST 16500.19 (series) for guidance.
 - e. Retro. Any retroreflective material which is peeling or faded shall be replaced as outlined in Chapter 3 of this manual.
 - f. Vent Valves. The vent valves shall be inspected to ensure that the balls are free to move. (Data Sheet 2.L.2)
 - g. Topmarks. Repair or replace topmarks and mounting hardware as necessary. (Data Sheets 2.L.18 through 2.L.21)
 - h. Buoy Battery Boxes. Battery boxes shall be inspected for damaged flanges, covers, gaskets, vent valves, and securing hardware. Air testing is not required. (Data Sheet 2.L.15)
 - i. Tappers. Tapper hinges shall be checked for wear and free movement. (Data Sheet 2.L.10)
 - j. Bells and Gongs. Bells, gongs, and mounting equipment shall be inspected for wear, cracks, excessive rust, missing shock pads, and loose hardware. (Data Sheets 2.L.6 through 2.L.9)
 - k. Whistles. The ball valves on whistles shall be checked for free operation and cleaned of salt and dirt. (Data Sheets 2.L.4 and 2.L.5)
 - l. Towers. The tower legs and feet shall be inspected for cracks and broken welds.
 - m. Battery Pockets. Battery pocket closures shall be inspected for damaged flanges, covers, swingbolts, and gaskets, and repaired if possible. (Data Sheets 2.L.11 through 2.L.14) **All repaired battery pocket closures shall be air tested before redeployment in accordance with paragraph 2.E.4.m.(2).** If pockets are not damaged, but need to be opened for any reason, follow the air testing guidance listed below. Care shall be taken when tightening the swing bolts. Overtightening the swing bolts could crack the gasket, which would compromise the watertight integrity of the battery pockets.
 - (1) **When standard 6 swing bolt or non-standard 12 swing bolt battery pockets are opened, air tests on these pockets are not required.** However, air tests may be performed at the Commanding

2.J.1.m.(1).

Officer's discretion if on-station conditions warrant; for example, when buoys are frequently awash.

- (2) **Buoys with V-band or bolted flange pocket closures shall be air tested after being opened**. If a servicing unit is unable to perform the required air test, V-band or bolted flange battery pocket closures shall not be opened. In this case, buoys requiring recharge shall be "hotpacked."

2. Mooring Inspections. As the name implies, the purpose of this inspection is to ensure that the buoy and mooring hardware will last until the next scheduled mooring inspection. Because this inspection requires that the buoy be brought on board, it also provides an opportunity for a thorough examination of the buoy, particularly the underwater portion. If a buoy is damaged or deteriorated beyond the servicing unit's repair capabilities, it shall be relieved immediately or its relief date adjusted as required. In addition to the inspections required for routine visits listed in paragraph 2.J.1 above, servicing units shall perform the following mooring and buoy hull inspections.

- a. Chain. A chain mooring consists of three parts: the riser chain, the chafe section, and the bottom chain (see Figure 2-3). At a minimum, the entire chafe section of the mooring shall be brought on deck and inspected. Depending on the length of time between mooring inspections and the severity of environmental conditions, it may be prudent to bring the entire mooring (including the sinker) on board. When inspecting chain, it is important to know its condition at the time of the last mooring inspection. Annual wear rates for a given buoy station can be estimated by keeping records of the chain measurements at each inspection. The chafe section of the chain is likely to show the greatest wear. (Data Sheet 2.M.1)
 - (1) Inspection. Inspect for wear by measuring the smallest parts of the most worn links, using a caliper. Regardless of the original chain size used on a given buoy, the chain need not be replaced until it has reached the minimum chain wear measurement for that buoy type. Minimum chain wear measurements for each buoy are provided in Table 2-12. The chain shall be replaced if it is worn to the minimum wear measurement, or if it will reach this point before the next scheduled mooring inspection (based on annual wear rates). Any chain that is deformed, stretched, bent, or twisted shall be replaced.
 - (2) Chain Conservation. **All efforts shall be made to conserve chain to the maximum extent possible**. Each mooring has to be evaluated on a case by case basis to determine the best course of action, and

2.J.2.a.(2)

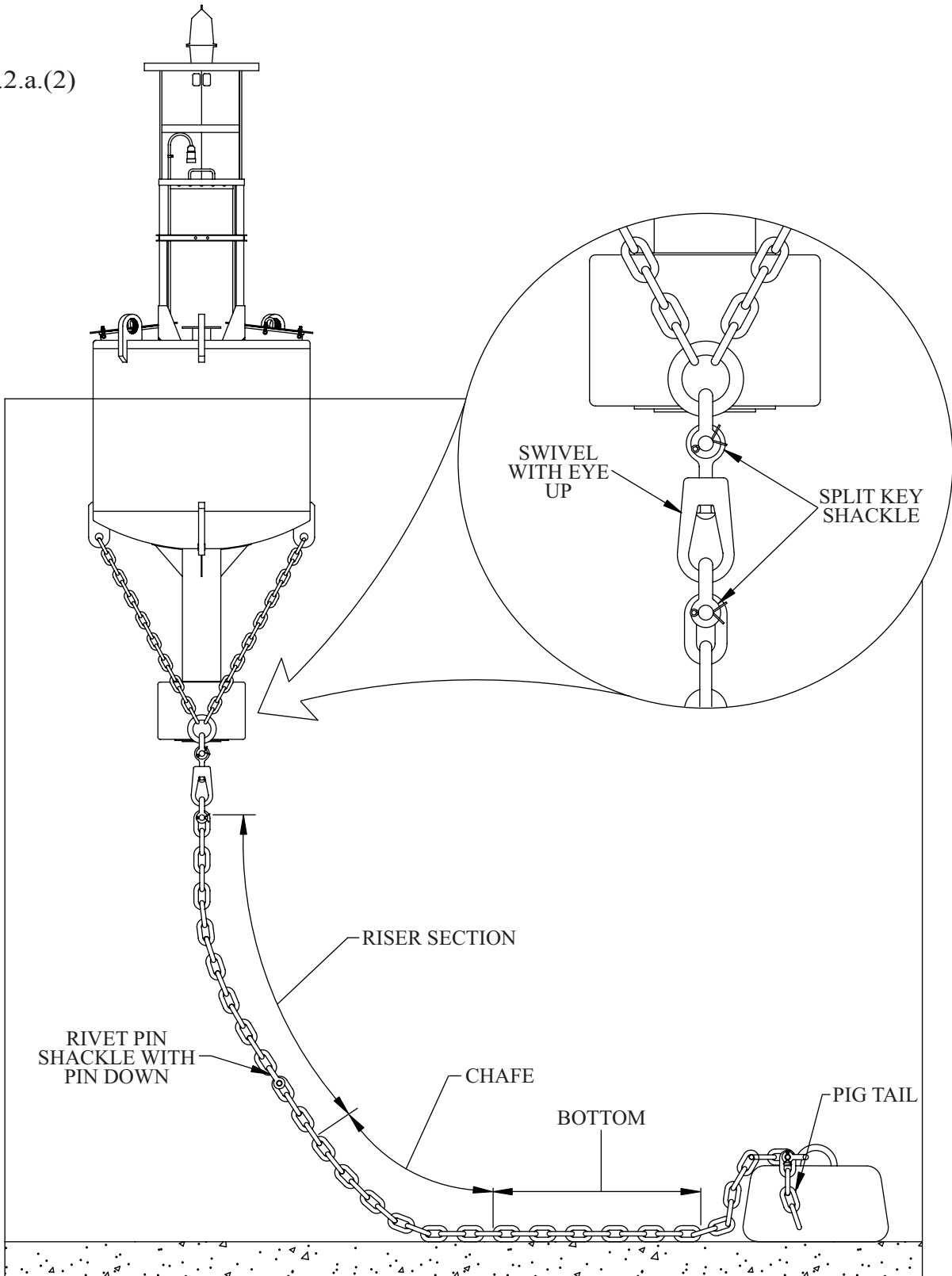


Figure 2-3
MOORING CONFIGURATION

2.J.2.a.(2)

accurate record keeping is vital to assist in this process. At the Commanding Officer's discretion, units may utilize one or more of the following methods for chain conservation:

- (a) Extended mooring inspection intervals. All units should aggressively pursue extending mooring inspection intervals beyond two years. The use of larger chain sizes in the chafe (or in the entire mooring) is highly recommended to increase servicing intervals and reduce chain consumption. Guidelines for extending mooring inspection intervals can be found in the Aids to Navigation Manual-Administration, COMDTINST M16500.7 (series).
 - (b) Cropping chain. When replacing sections of worn chain, care should be taken to minimize the amount of chain that is replaced by following the wear measurement guidance in Table 2-12. However, enough chain should be removed on either side of the worn section to ensure the shackles do not ride in the chafe when the replacement chain is connected to the mooring. If a mooring has sufficient scope and only a short section of chain is worn, it may be possible to remove the worn section and join the riser and bottom section without replacing any chain. In this case, remove enough of the chain above the worn section to ensure the shackle does not ride in the chafe when the sections are connected together (see 2.J.2.c.(2)).
 - (c) End-for-end. If conditions warrant, either the entire mooring or certain sections of chain can be and end-for-ended. This method can be utilized where chain is worn but not to extent that it needs to be replaced. This action will put "good" chain in the chafe section and shift the worn chain to an area of less wear.
 - (d) Chain downgrading. Chain that is worn below the useable diameter for a given buoy type may be "downgraded" and used on a buoy that requires a smaller size chain.
- b. Bridles. Inspect for wear by measuring the smallest parts of the most worn links using a caliper. Any bridles that have links which are deformed, stretched, bent or twisted shall be replaced. When a buoy hull is relieved, the bridle shall be removed and evaluated. If the bridle has not reached the minimum wear measurement for the comparable chain size, the bridle shall be

2.1.2.b.

Buoy Type	Recommended Mooring Chain				Minimum Wear Measurement
9X35LWR	1-7/8"	1-3/4"	1-5/8"	1-1/2"	1-1/16"
9X32LR	1-7/8"	1-3/4"	1-5/8"	1-1/2"	1-1/16"
9X20R	1-3/4"	1-1/2"	1-1/4"		7/8"
8X26LR	1-3/4"	1-1/2"	1-1/4"		7/8"
8X26LWR	1-1/2"	1-1/4"			7/8"
8X21LR	1-3/4"	1-1/2"	1-1/4"	1-1/8"	25/32"
7X20LI	Use existing Mooring from Permanent Buoy				
7X17LR	1-1/2"	1-1/4"	1-1/8"	1"	25/32"
6X20LR	1-1/2"	1-1/4"	1-1/8"	1"	25/32"
5X11LR	1-1/4"	1-1/8"	1"		25/32"
5X9LFR	1"	7/8"	3/4"		1/2"
3.5X8LR	1"	7/8"	3/4"		1/2"
1CR/1NR	1-1/2"	1-1/4"	1-1/8"		25/32"
2CR/2NR	1-1/4"	1-1/8"	1"	7/8"	25/32"
3CR/3NR	1"	7/8"	3/4"		1/2"
3CI/3NI	1"	7/8"	3/4"		1/2"
5CR/5NR	1/2"				11/32"
5CI/5NI	1/2"				11/32"
2CFR/2NFR	1-1/8"	1"	7/8"	3/4"	1/2"
3CFR/3NFR	7/8"	3/4"	1/2"		11/32"
4CFR/4NFR	3/4"	1/2"			11/32"
5CFR/5NFR	1/2"				11/32"
6CFR/6NFR	1/2"				11/32"
FWCFR/FWNFR	1/2"				11/32"
5CPR/5NPR	1/2"				11/32"

Table 2-12

RECOMMENDED MOORING CHAIN SIZES AND MINIMUM CHAIN WEAR MEASUREMENTS FOR VARIOUS BUOY TYPES

Example: The recommended mooring chain sizes for an 8X26LR are 1-3/4", 1-1/2" or 1-1/4" chain. Replace those sections of mooring chain that are worn to 7/8" or those sections that are anticipated to be worn to 7/8" before the next scheduled mooring inspection.

Note: Ensure that the minimum allowable chain measurement retains sufficient proof load (Data Sheet 2.M.1 Buoy Chain) to recover the sinker.

Note: Larger buoy chain may be inserted into the chafe section of the mooring to facilitate extending mooring inspection intervals. The minimum chain wear measurement requirement will remain the same for the specific buoy type. Follow the guidelines in paragraph 2.1.2.a.(2)(b) when cropping chain.

- 2.J.2.b. cleaned and retained on board for further use. In general, a bridle should last through at least two buoy hull deployments. (Data Sheet 2.M.2)
- c. Shackles.
- (1) Split-Key. Split-key shackles shall only be used to connect the bridle to the buoy, the swivel to the bridle, the riser to the swivel, and the mooring chain to the sinker. Split-key shackles **shall not** be used to connect lengths of chain. When connecting the swivel to the bridle, ensure that the head of the shackle pin lies toward the buoy counterweight to reduce wear. See Figure 2-3. (Data Sheet 2.M.3)
 - (2) Rivet-Pin. Rivet-pin shackles (“heat and beat”) are used to connect lengths of chain. Install the shackle with the pin toward the sinker to prevent catching the “horse collar” during mooring retrieval. **Rivet-pin shackles shall not be used in the chafe section of the mooring.** When removing a rivet pin shackle to replace a section of mooring chain, cut the shackle pin instead of the shackle body. This will conserve the shackle body for future use and will only require replacement of the less expensive shackle pin. (Data Sheet 2.M.3)
- d. Swivels. Worn or seized swivels shall be replaced. Swivels are mounted between the bridle and the riser chain with the round eye toward the bridle. If the mooring is prone to knotting an additional swivel can be used further down in the riser section of the mooring. **However, swivels shall not be used in the chafe section of the mooring.** (Data Sheet 2.M.4)
- e. Sinker. The sinker shall be replaced if the bail is worn to less than 1/2 of its original diameter, or the concrete is eroded or broken away. Sinker bails shall be made from steel bar stock. **Sinkers with bails made from buoy chain shall be replaced.** (Data Sheet 2.M.5) “Dor-Mor” cast iron sinkers are authorized for small unlighted buoys. (Data Sheet 2.M.6)
- f. Hull. Buoys shall be checked for flooding, inspected for damage that could affect their watertight integrity, and repaired if possible. Any time structural repairs are performed on the buoy hull, **an air test shall be performed** in accordance with paragraph 2.E.4.m.(1). When performing hot work on the buoy hull, follow the safety guidance listed below:
- (1) **If hot work is required in the vicinity of the battery pockets or near vent lines or vent valves, remove the battery pocket covers and batteries prior to beginning hot work.**

2.J.2.f.

- (2) Cutting. If a buoy hull is completely or partially full of water (i.e., when recovering a sunken buoy or a buoy riding low in the water), exothermic or oxy/acetylene equipment may be used to cut a hole and drain the water. The general procedure would be to cut a hole in the lowest part of the hull that is practical to reach. In this case, there would be water opposite to the hot work, so gas-freeing of the hull is not required.
- (3) Welding. Welding is sometimes required to repair a cracked seam or gusset, etc. on the buoy hull. Before beginning, first remove the buoy body air test cap to allow the release of any pressure that might build up from the heat of the welding process; then follow the guidelines in paragraph (4) below for gas-free testing.
- (4) Gas-Free Testing. Be aware that combustible gases could be present in the buoy hull. Before beginning hot work, the hull shall be tested using a combustible gas monitor or explosive meter. Insert the probe from the meter into the buoy body air test fitting.
 - (a) If no combustible gases are detected, then hot work can be performed on the buoy.
 - (b) If combustible gases are detected, the buoy hull shall be gas-freed before hot work is performed. This is not easily done in the field. If it is critical that the buoy be repaired on station, the buoy hull can be purged with compressed air to displace the combustible atmosphere. If the hull is equipped with two air test fittings (see paragraph 2.E.4.m), ensure that both fittings are open to improve the air flow. If it is not critical that the buoy be repaired on station, return it to the buoy maintenance facility with a warning concerning the detection of combustible gases.
- g. Appendages. Swing arms, mooring pins, and mooring eyes shall be inspected for excessive wear and repaired if possible.
- h. Towers. The tower legs and feet shall be inspected for cracks and broken welds and repaired if possible.
- i. Battery Pockets. Battery pocket closures shall be inspected for damaged flanges, covers, swingbolts, and gaskets, and repaired if possible. (Data sheets 2.L.11 through 2.L.14) **All repaired battery pocket closures shall be air tested before redeployment in accordance with paragraph 2.E.4.m.(2).** If

2.J.2.i.

pockets are not damaged, but need to be opened for any reason, follow the air testing guidance listed below. Care shall be taken when tightening the swing bolts. Overtightening the swing bolts could crack the gasket, which would compromise the watertight integrity of the battery pockets.

- (1) **When standard 6 swing bolt or non-standard 12 swing bolt battery pockets are opened, air tests on these pockets are not required.** However, air tests may be performed at the Commanding Officer's discretion if on-station conditions warrant; for example, when buoys are frequently awash.
- (2) **Buoys with V-band or bolted flange pocket closures shall be air tested after being opened.** If a servicing unit is unable to perform the required air test, V-band or bolted flange battery pocket closures shall not be opened. In this case, buoys requiring recharge shall be "hotpacked."

- j. Buoy Battery Boxes. Battery boxes shall be inspected for damaged flanges, covers, swingbolts, gaskets, and vent valves and repaired if possible. Do not air test the buoy battery box. (Data Sheet 2.L.15)
- k. Vent Valves. The vent valves shall be inspected to ensure that the balls are free to move and the o-rings seat with the PVC reducers. Repair or replace as necessary. (Data Sheet 2.L.2)
- l. Bells and Gongs. Mounting equipment for bells and gongs shall be inspected for cracks, excessive rust, missing shock pads, and loose hardware; repair or replace if possible. Bells and gongs which are excessively worn shall be rotated. (Data Sheets 2.L.6 through 2.L.9)
- m. Tappers. Tapper hinges shall be checked for wear and free movement. Tapper balls that are worn shall be rotated or replaced. (Data Sheet 2.L.10)
- n. Whistles. The ball valves on whistles shall be checked for free operation and cleaned of salt and dirt. The air gap on the whistle bell shall be adjusted to $15/16 \pm 1/16$ inch. (Data Sheets 2.L.4 and 2.L.5)
- o. Wiring. All accessible wiring shall be visually checked for cracking, deterioration, and corrosion and shall be replaced as necessary. Wire retaining clips and stuffing tubes shall be repaired or replaced as necessary

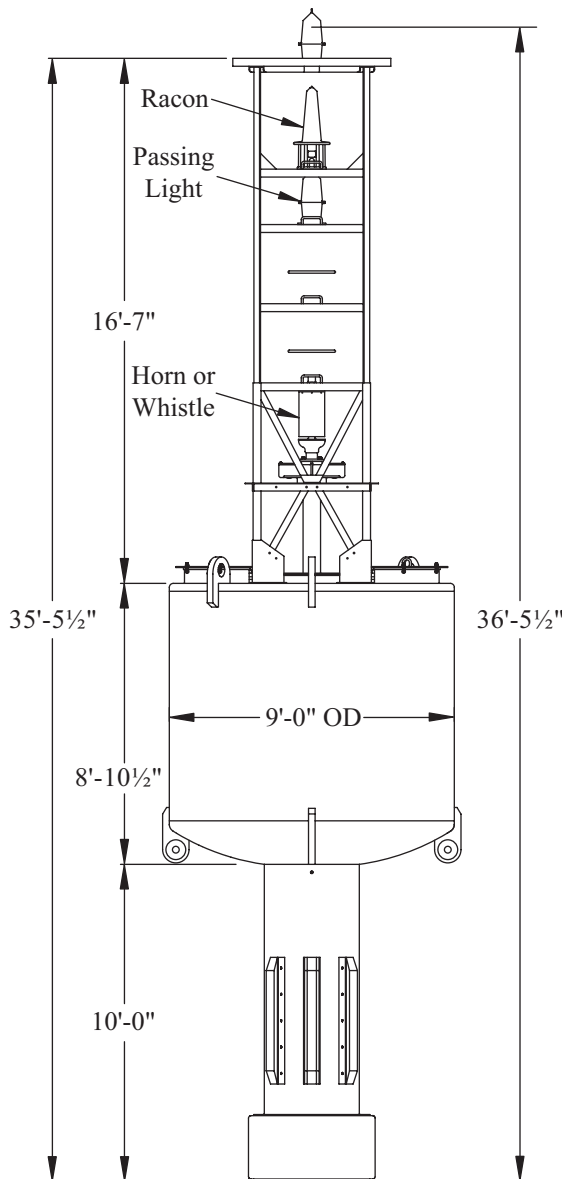
2.J.2.p

- p. Coating. Coating repair on station is described in the *Coatings and Color Manual* COMDTINST M10360.3 (series).
- (1) Cleaning. Heavy marine growth and “buoy critters” should be removed by scraping. Care shall be taken when scraping so as not to damage the buoy’s coating system. In particular, the ablative antifouling paint used below the waterline is relatively “soft” and can be removed by aggressive scraping. High pressure water wash is recommended to remove guano, slime, and salt.
 - (2) Topcoat Paint. Touch-up painting should be minimized, and it should not be done for strictly “cosmetic” reasons. However, if the paint has faded or if scraping and high pressure water wash are ineffective in removing guano, then touch-up painting can be done to restore the proper color. If touch-up painting is performed, refer to the *Coatings and Color Manual* COMDTINST M10360.3 (series) for guidance on materials, safety procedures, and application methods.
3. Battery Recharge Visit. Battery recharging cycles shall coincide with routine visits, mooring inspections, or reliefs to the maximum extent possible. Batteries shall be replaced as outlined in Chapter 9 of this manual. **When standard 6 swing bolt or non-standard 12 swing bolt battery pockets are opened, air tests on these pockets are not required.** However, air tests may be performed at the Commanding Officer’s discretion if on-station conditions warrant; for example, when buoys are frequently awash. **Buoys with V-band or bolted flange pocket closures shall be air tested after being opened.** If a servicing unit is unable to perform the required air test, V-band or bolted flange battery pocket closures shall not be opened. In this case, buoys requiring recharge shall be “hotpacked.” Care shall be taken when tightening the swing bolts. Overtightening the swing bolts could crack the gasket, which would compromise the watertight integrity of the battery pockets.
4. Buoy Relief. As outlined in the *Aids to Navigation Manual-Administration* COMDTINST 16500.7 (series), buoy relief cycles should be extended where possible.
- a. Removal of Fouling. Servicing units shall remove the majority of fouling to the greatest extent possible before transferring the buoys to the shoreside buoy maintenance facility. Fouling shall also be removed from underneath the counterweights of flat-bottom buoys and from inside the tubes of whistle buoys.
 - b. Removal of Components. Remove the following items from buoys before transferring the buoys to the shoreside buoy maintenance facility: batteries, battery racks, racons, horns, junction boxes, vent valves, lighting equipment, solar panels, solar panel stands, topmarks, and bridles.

2.K. General Description Data Sheets - Buoys. The general description data sheets for buoys are presented in this section. The function, physical characteristics, related equipment, operational characteristics, and reference documents are listed for each standard buoy type. The steel buoys are listed first, followed by the foam buoys and the plastic buoys. The non-standard steel buoy configurations and reference documents are given as well.

2.K. 1. 9X35LWR. The 9X35LWR is designed and constructed for the most exposed locations. It has an open counterweight tube to accommodate a whistle, horn, or wave turbine generator (WTG). The tower can accommodate a racon, flashtube, and passing light. Mounting holes are provided at the base of the tower for solar panels.

a. Standard Buoy Arrangements. 1987 Type 9X35LWR, 9X35LR, 9X35LHR.



Physical Characteristics. (no mooring)

Buoy Weight	18,500 lbs.
Buoy Draft	15 ft. 10 in.
Focal Height of Light (upr)	20 ft. 7 in.
Focal Height of Light (lwr)	15 ft. 8 in.
Freeboard	3 ft.
Minimum Freeboard	1 ft. 2 in.
Pounds per inch Immersion	300

Related Equipment.

Whistle	4-Ball
Horn	SA-850
Mooring Bridle	1-1/2 in x 20 ft.
Mooring Chain	1-1/2 in.
Sinker (concrete)	12,750 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.2 nm
Radar Range (w/o Racon)	4.0 nm
Mooring Depth (min.)	35 ft.

Maximum Mooring Depth.

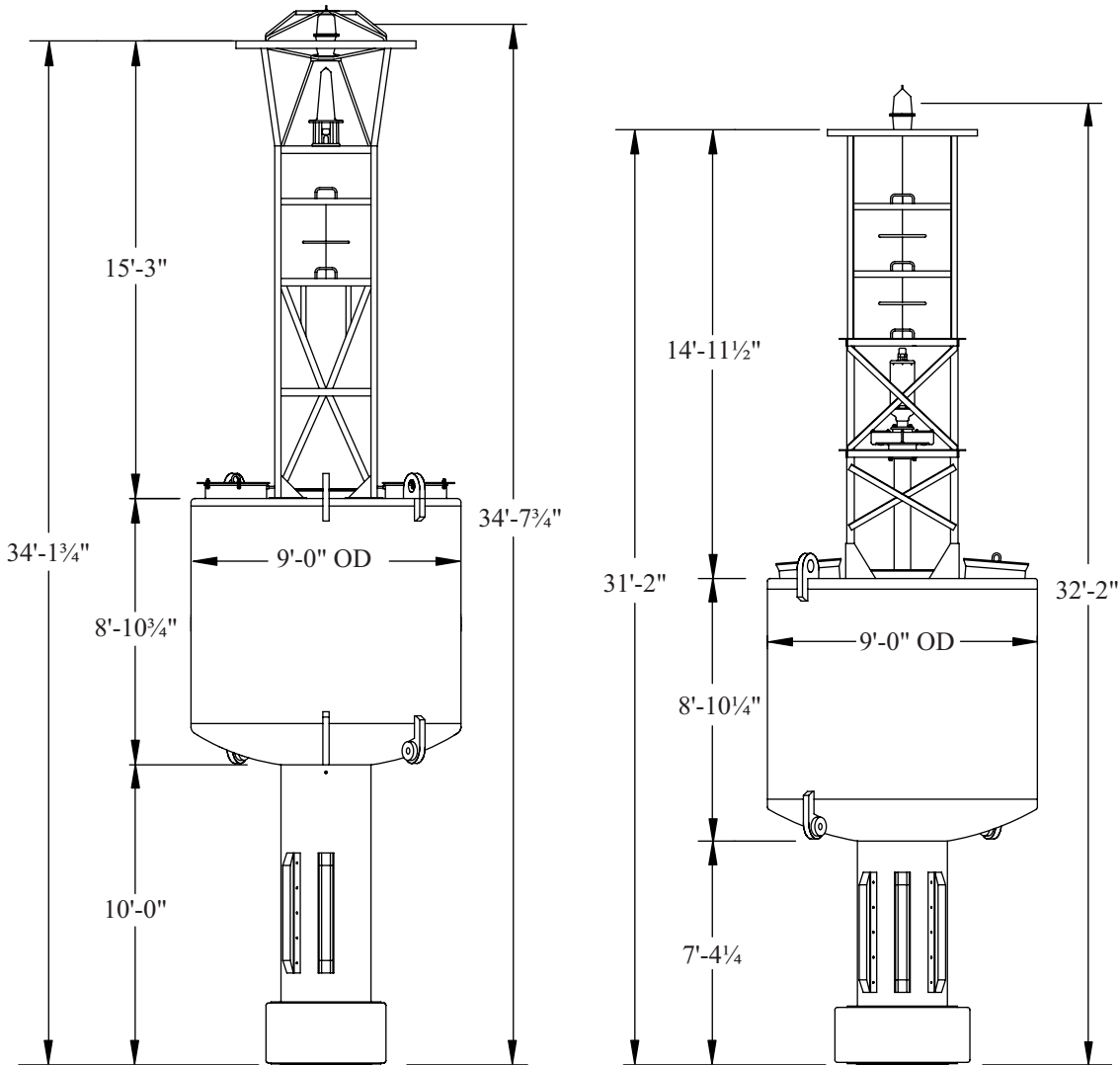
Chain Size	Max Mooring Depth
1-7/8"	127'
1-3/4"	144'
1-5/8"	165'
1-1/2"	191'

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121151
G-SEC Specification No. 464

Data Sheet 2.K.1. 9X35LWR Buoy.

2.K.1. b. Non-Standard Buoys. The 1983 type 9X35LHR buoy is designated an Exposed Location Buoy (ELB). This buoy was designed for weather gathering using equipment supported by the National Data Buoy Center. It is configured to accept a WTG but can be refitted for a whistle with minor modifications. Its tower has pipe legs for cables and venting.



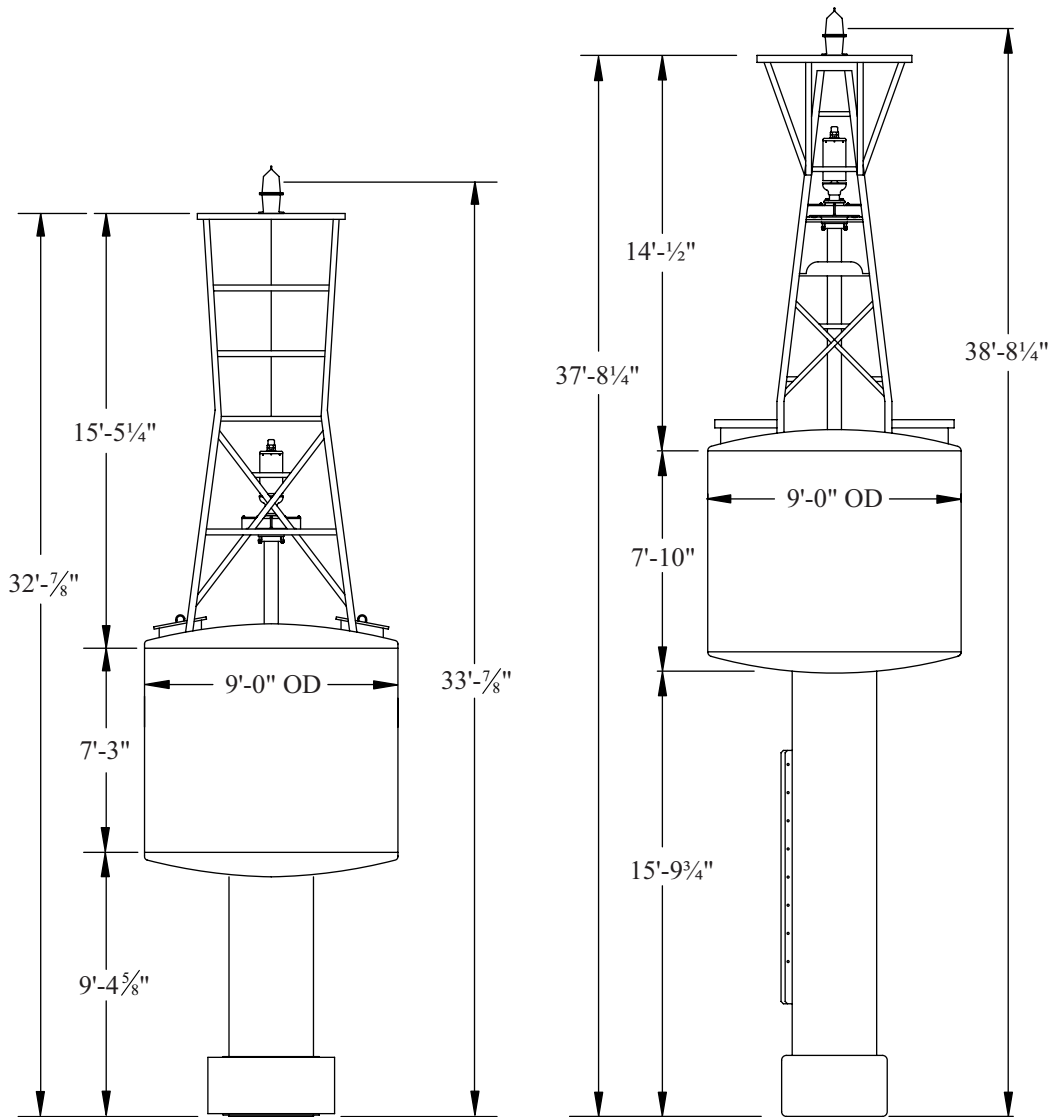
1983 TYPE
9X35LHR (ELB)
WEIGHT: 17,700 LBS
DRAWING: 121048

1962 TYPE
9X32LWR
WEIGHT: 18,616 LBS
DRAWING: 107326

Data Sheet 2.K.1. (cont'd).

2.K.1.

b. Non-Standard Buoys.



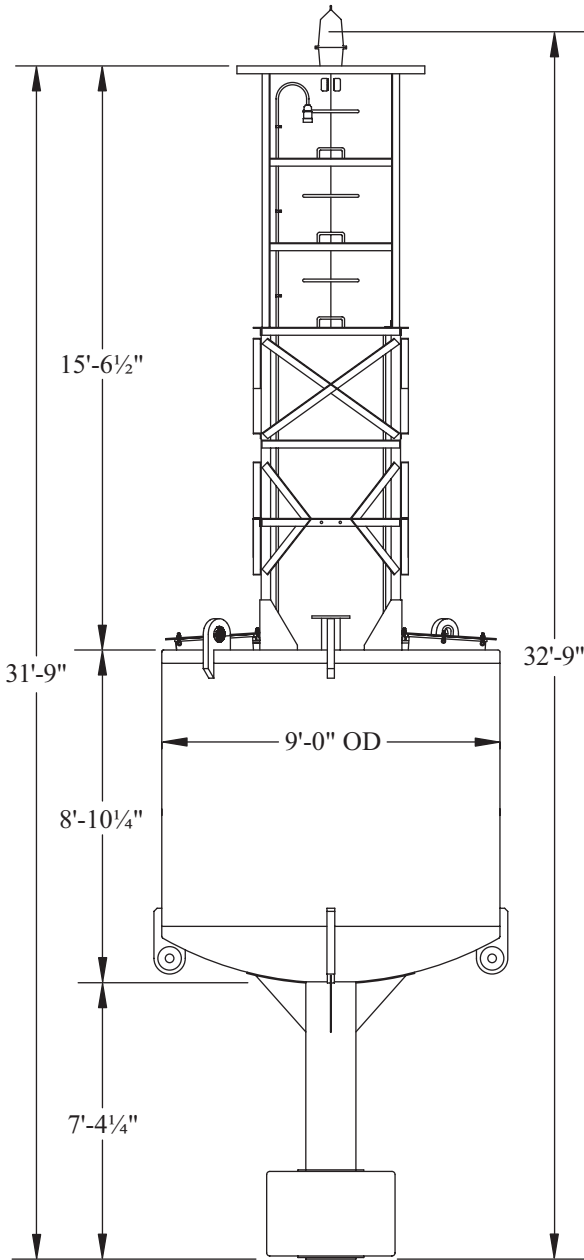
1952 TYPE
9X35LWR
WEIGHT: 18,800 LBS
DRAWING: BU-52-12

1942 TYPE
9X38LW
WEIGHT: 19,050 LBS
DRAWING: BU-41-146

Data Sheet 2.K.1. (cont'd).

2.K. 2. 9X32LR. The 9X32LR is designed and constructed for the most exposed locations. It is designed for use as a lighted buoy and can be fitted with a bell, gong, or horn.

a. Standard Buoy Arrangements. 1989 (1962) Type 9X32LR, 9X32LBR, 9X32LGR, 9X32LHR.



Physical Characteristics. (no mooring)

Buoy Weight	17,500 lbs.
Buoy Draft	11 ft. 7 in.
Focal Height of Light	21 ft. 2 in.
Freeboard	4 ft. 7 in.
Minimum Freeboard	1 ft. 10 in.
Pounds-Per-Inch Immersion	340

Related Equipment

Bell	225 lbs.
Gong	3 ea. 20 in.
Horn	SA-850
Mooring Bridle	1-1/2 in. x 18 ft.
Mooring Chain	1-1/2 in.
Sinker (concrete)	12,750 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.8 nm
Radar Range	4.5 nm
Mooring Depth (min.)	30 ft.

Maximum Mooring Depth.

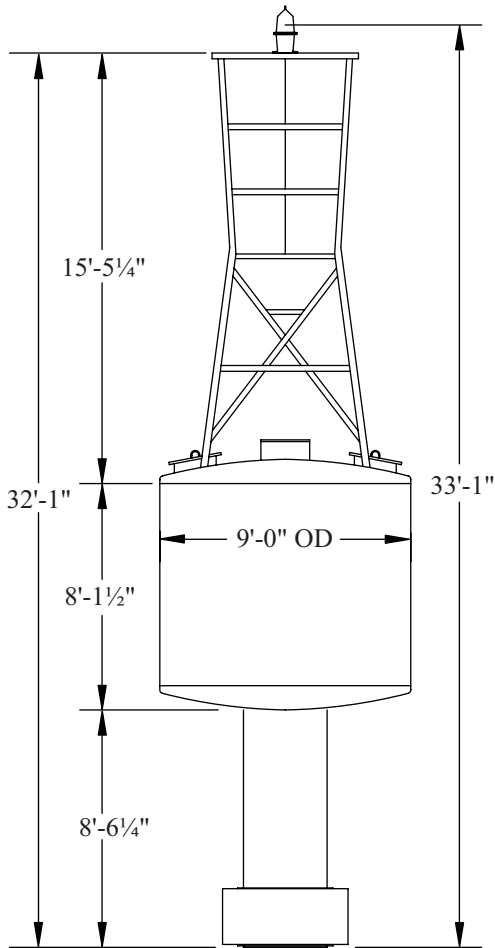
Chain Size	Max Mooring Depth
1-7/8"	217'
1-3/4"	248'
1-5/8"	285'
1-1/2"	332'

Reference Documents. (use latest rev.)

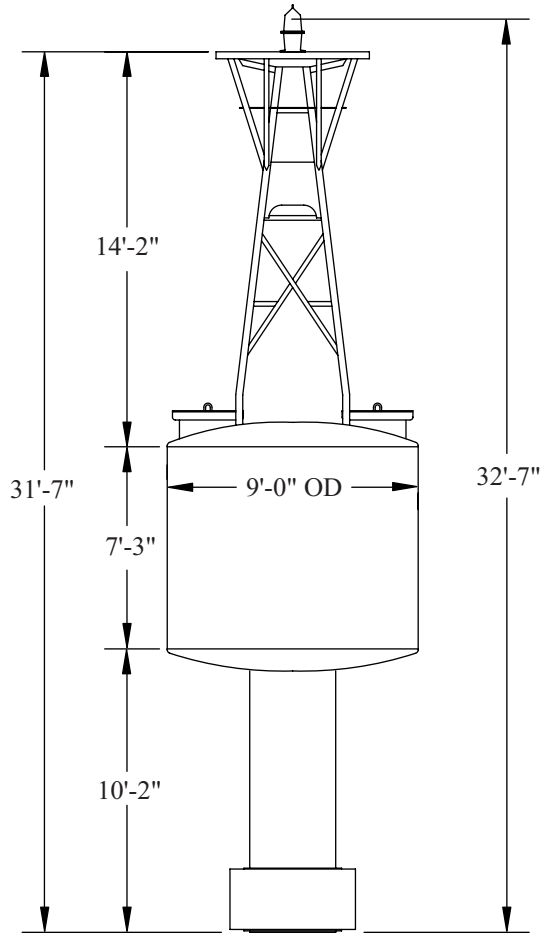
G-SEC Drawing No. 121132 (107326)
G-SEC Specification No. 464

Data Sheet 2.K.2. 9X32LR Buoy.

2.K.2. b. Non-Standard Buoys.



1952 TYPE
9X32LR
WEIGHT: 18,000 LBS
DRAWING: BU-52-12
DRAWING: BU-50-12 (LB)
DRAWING: BU-50-13 (LG)

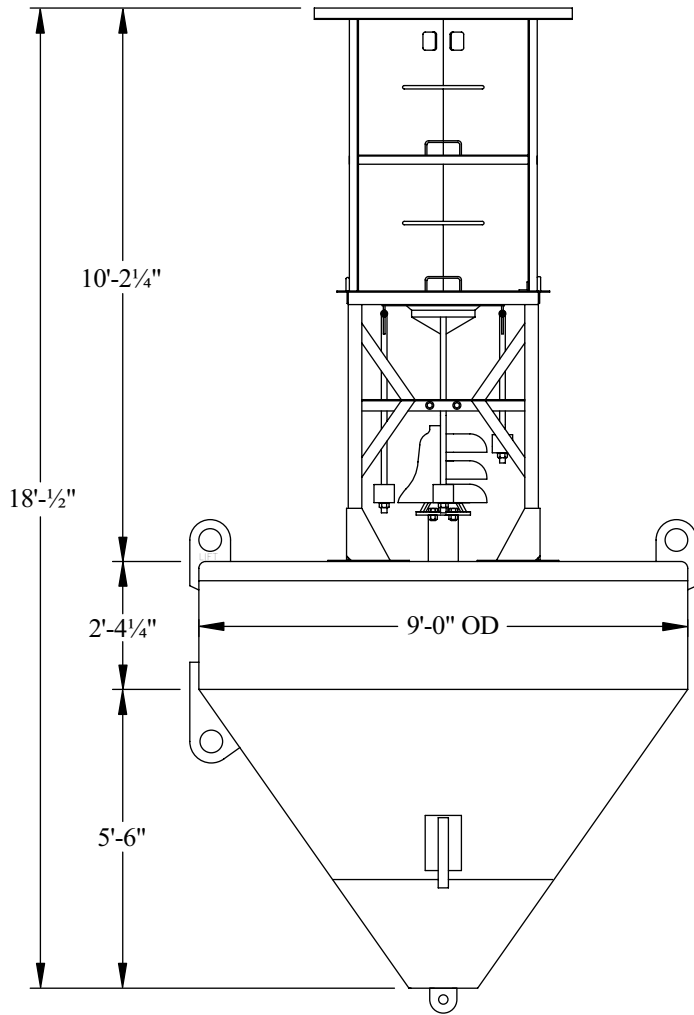


1942 TYPE
9X32L
WEIGHT: 22,000 LBS
DRAWING: BU-43-06 (Bell)
DRAWING: BU-43-31 (Gong)

Data Sheet 2.K.2. (cont'd).

2.K. 3. 9X20BR/GR. The 9X20BR/GR is designed and constructed for use as a wave-activated bell or gong sound signal buoy where lighting is not required.

a. Standard Buoy Arrangements. 1962 Type 9X20BR, 9X20GR.



Physical Characteristics. (no mooring)

Buoy Weight	8,000 lbs.
Buoy Draft	5 ft. 4 in.
Freeboard	2 ft. 6 in.
Minimum Freeboard	12 in.
Pounds-Per-inch Immersion	340

Related Equipment.

Bell	225 lb.
Gong	3ea. 20 in.
Mooring Bridle	1-1/4 in. x 15 ft.
Mooring Chain	1-1/4 in.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3 nm
Radar Range	3.7 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	183'
1-1/4"	261'

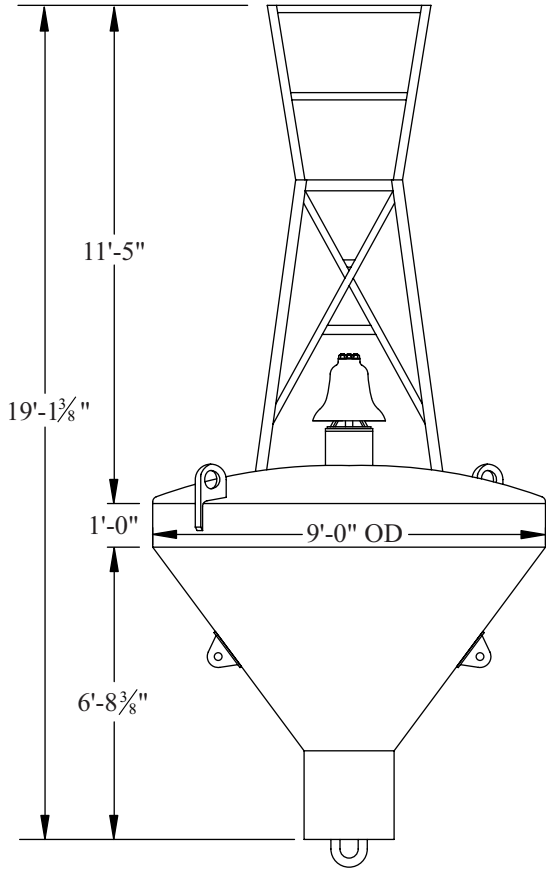
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121137

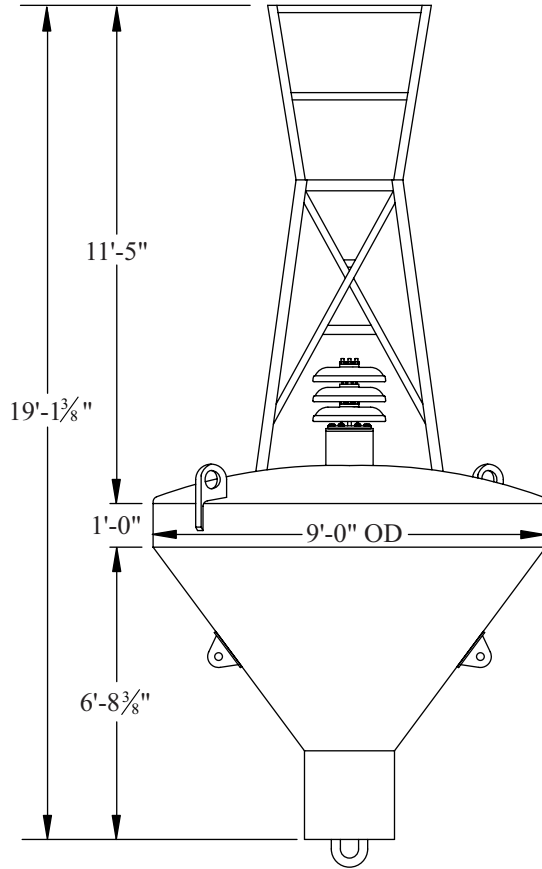
G-SEC Specification No. 464

2.K.3.

b. Non-Standard Buoys.



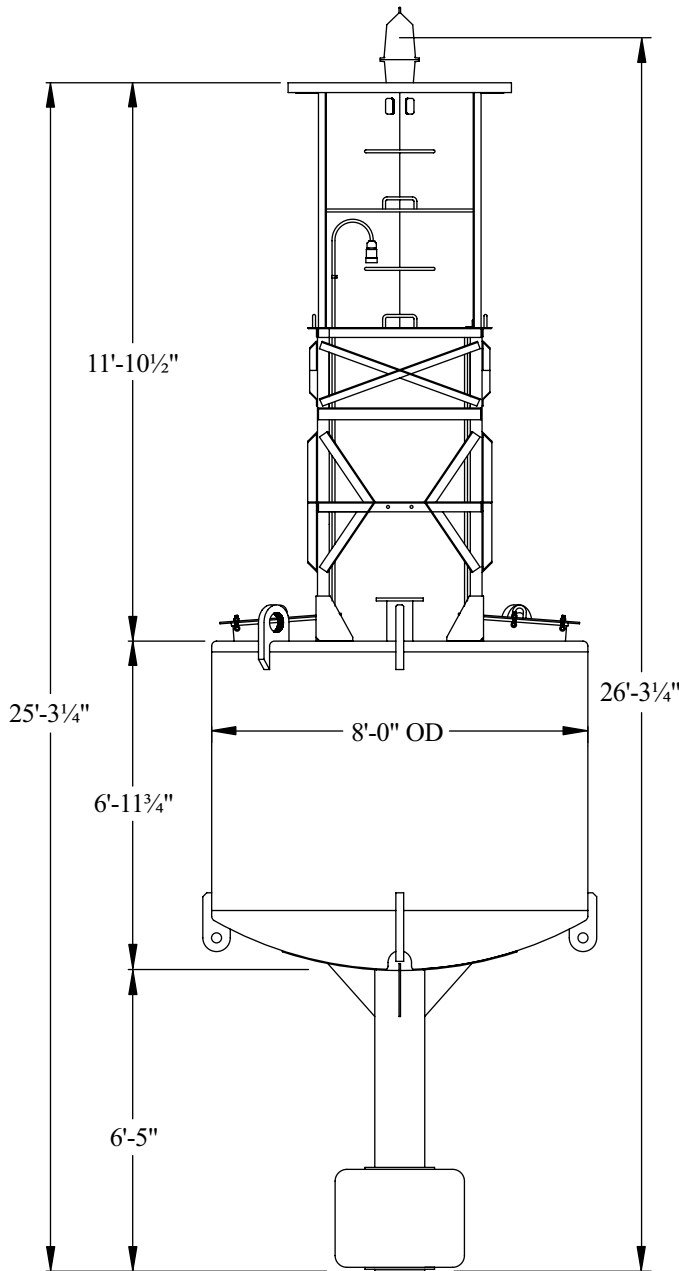
1952 TYPE
9X20BR
WEIGHT: 6,875 LBS
DRAWING: BU-52-19



1952 TYPE
9X20GR
WEIGHT: 6,800 LBS
DRAWING: BU-52-19

2.K. 4. 8X26LR. The 8X26LR is designed and constructed for exposed locations. It is designed for use as a lighted buoy and can be fitted with a bell, gong, or horn.

a. Standard Buoy Arrangements. 1989 (1962) Type 8X26LR, 8X26LBR, 8X26LGR, 8X26LHR.



Physical Characteristics. (no mooring)

Buoy Weight	11,800 lbs.
Buoy Draft	10 ft. 4 in.
Focal Height of Light	15 ft. 11 in.
Freeboard	3 ft. 1 in.
Minimum Freeboard	1 ft. 3 in.
Pounds-Per-Inch Immersion	264

Related Equipment.

Bell	225 lbs.
Gong	3 ea. 20 in.
Horn	SA-850
Mooring Bridle	1-1/4 in x 15 ft.
Mooring Chain	1 -1/4 in
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.2 nm
Radar Range	3.7 nm
Mooring Depth (min.)	25 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	175'
1-1/4"	250'

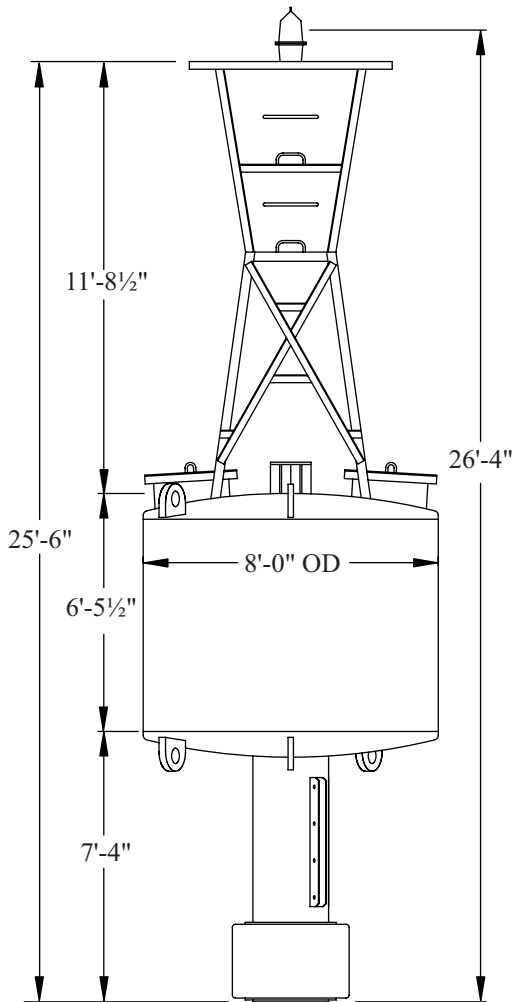
Reference Documents. (use latest rev.)

- G-SEC Drawing No. 121130 (107320)
- G-SEC Specification No. 464

Data Sheet 2.K.4. 8X26LR Buoy.

2.K.4.

b. Non-Standard Buoys.



1952 TYPE

8X26LR

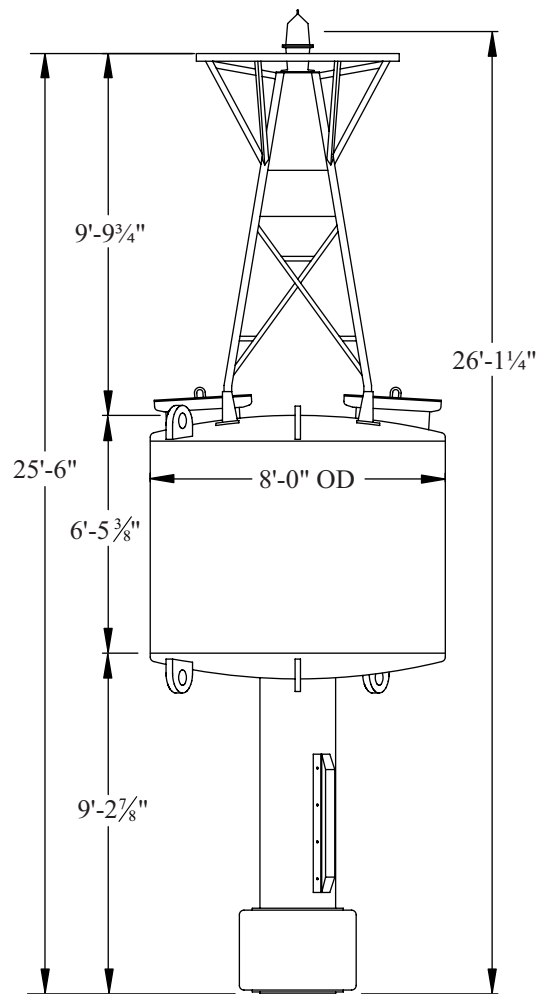
WEIGHT: 11,050 LBS

DRAWING: BU-52-11

DRAWING: BU-50-03 (L)

DRAWING: BU-50-04 (LB)

DRAWING: BU-50-05 (LG)



1942 TYPE

8X26L

WEIGHT: 12,000 LBS

DRAWING: BU-42-45

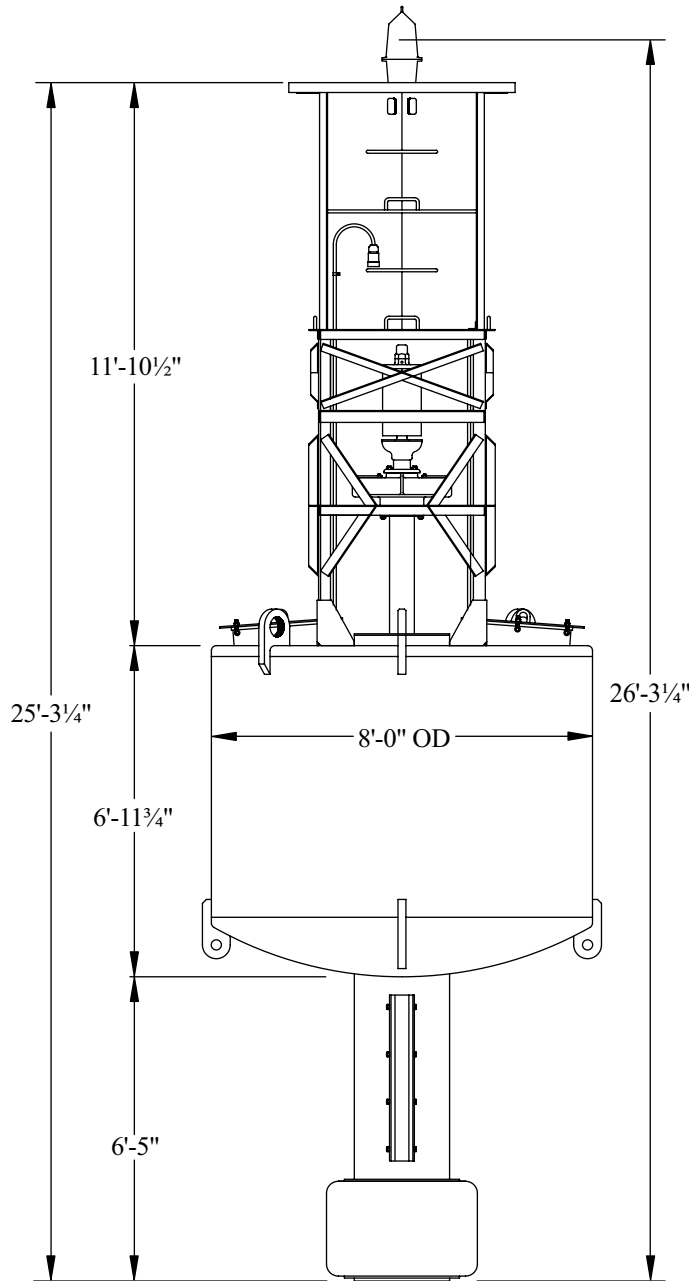
DRAWING: BU-41-151 (LB)

DRAWING: BU-43-30 (LG)

Data Sheet 2.K.4. (cont'd).

2.K. 5. 8X26LWR. The 8X26LWR is designed and constructed for exposed locations. It is designed with an open counterweight tube for use as a lighted whistle buoy.

a. Standard Buoy Arrangements. 1989 (1962) Type 8X26LWR.



Physical Characteristics. (no mooring)

Buoy Weight	12,100 lbs.
Buoy Draft	10 ft. 5 in.
Focal Height of Light	15 ft. 10 in.
Freeboard	3 ft. 0 in.
Minimum Freeboard	1 ft. 3 in.
Pounds-Per-Inch Immersion	250

Related Equipment.

Whistle	4-Ball
Mooring Bridle	1-1/4 in. x 15 ft.
Mooring Chain	1-1/4 in.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.2 nm
Radar Range	3.7 nm
Mooring Depth (min.)	25 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	166'
1-1/4"	236'

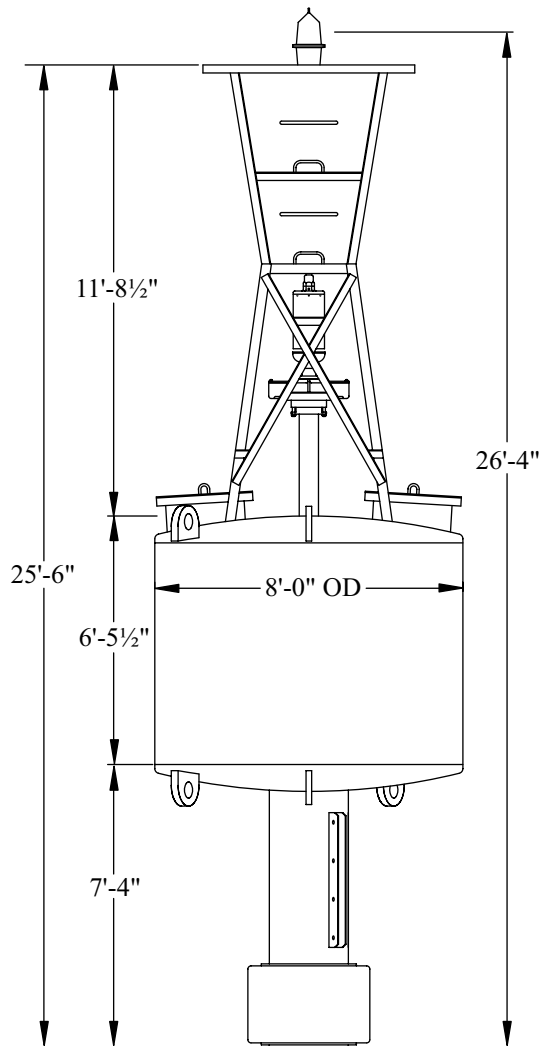
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121131(107320)
G-SEC Specification No. 464

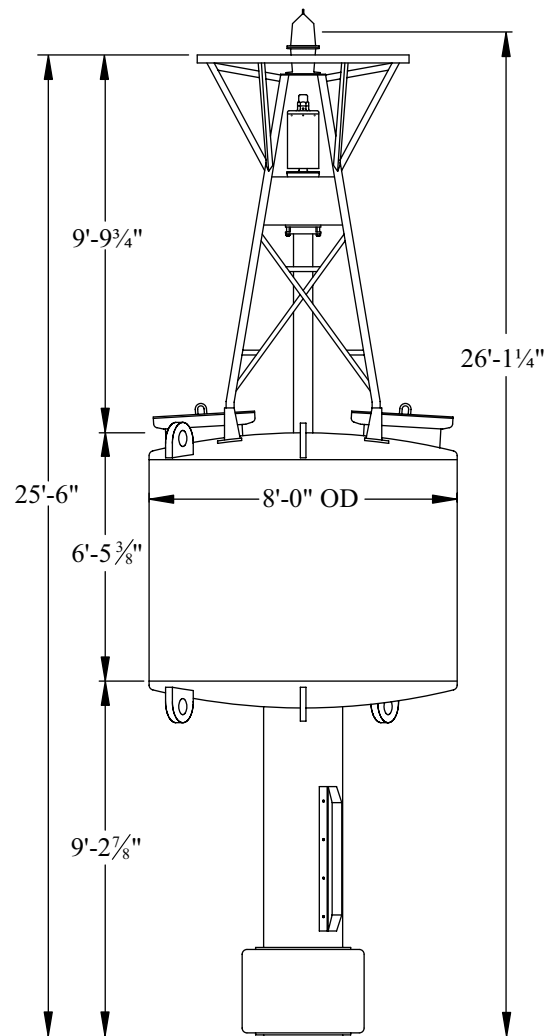
Data Sheet 2.K.5. 8X26LWR Buoy.

2.K.5.

b. Non-Standard Buoys.



1952 TYPE
8X26LWR
WEIGHT: 11,550 LBS
DRAWING: BU-52-11
DRAWING: BU-50-06 (LW)

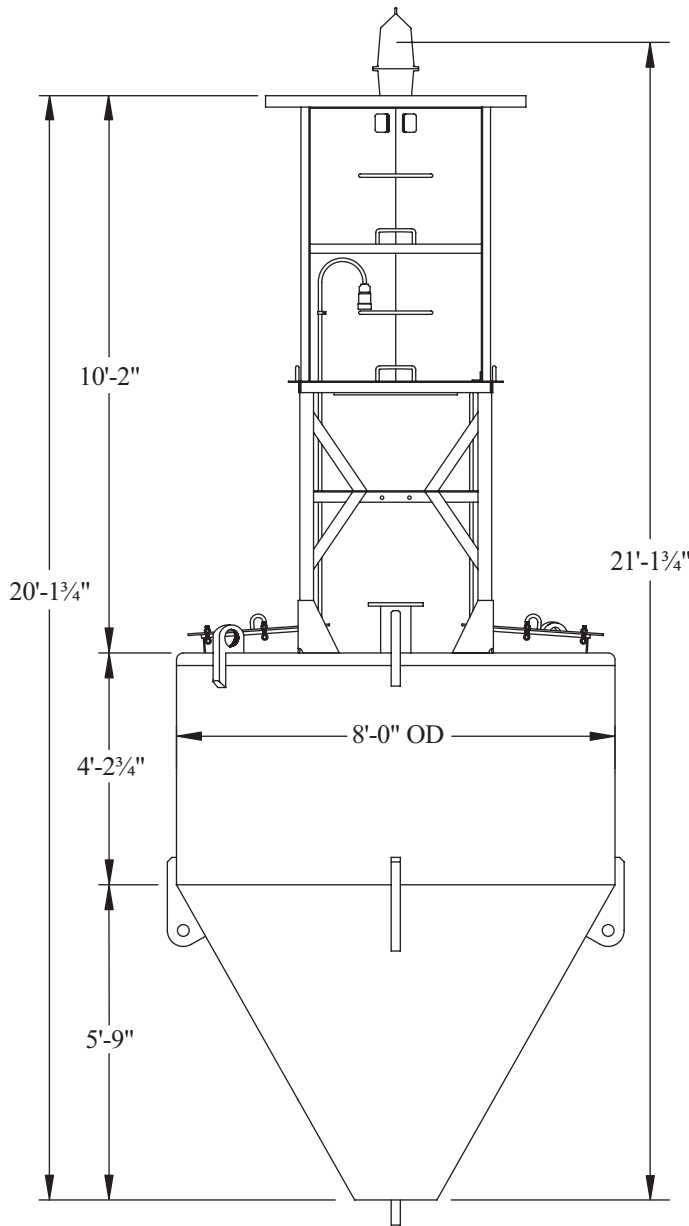


1942 TYPE
8X26LW
WEIGHT: 12,520 LBS
DRAWING: BU-43-27

Data Sheet 2.K.5. (cont'd).

2.K. 6. 8X21LR. The 8X21LR is designed and constructed for exposed locations with shallow water and rough sea conditions. It is designed for use as a lighted buoy and can be fitted with a bell, gong, or horn.

a. Standard Buoy Arrangements. 1991 Type 8X21LR.



Physical Characteristics. (no mooring)

Buoy Weight	13,900 lbs.
Buoy Draft	7 ft. 9 in.
Focal Height of Light	13 ft. 4 in.
Freeboard	2 ft. 3 in.
Minimum Freeboard	11 in.
Pounds-Per-Inch Immersion	264

Related Equipment.

Bell	225 lbs.
Gong	3 ea. 20 in.
Horn	SA-850
Mooring Bridle	1 1/4 in. x 15 ft.
Mooring Chain	1-1/4 in.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.0 nm
Radar Range	3.7 nm
Mooring Depth (min.)	18 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	128'
1-1/4"	182'
1-1/8"	224'

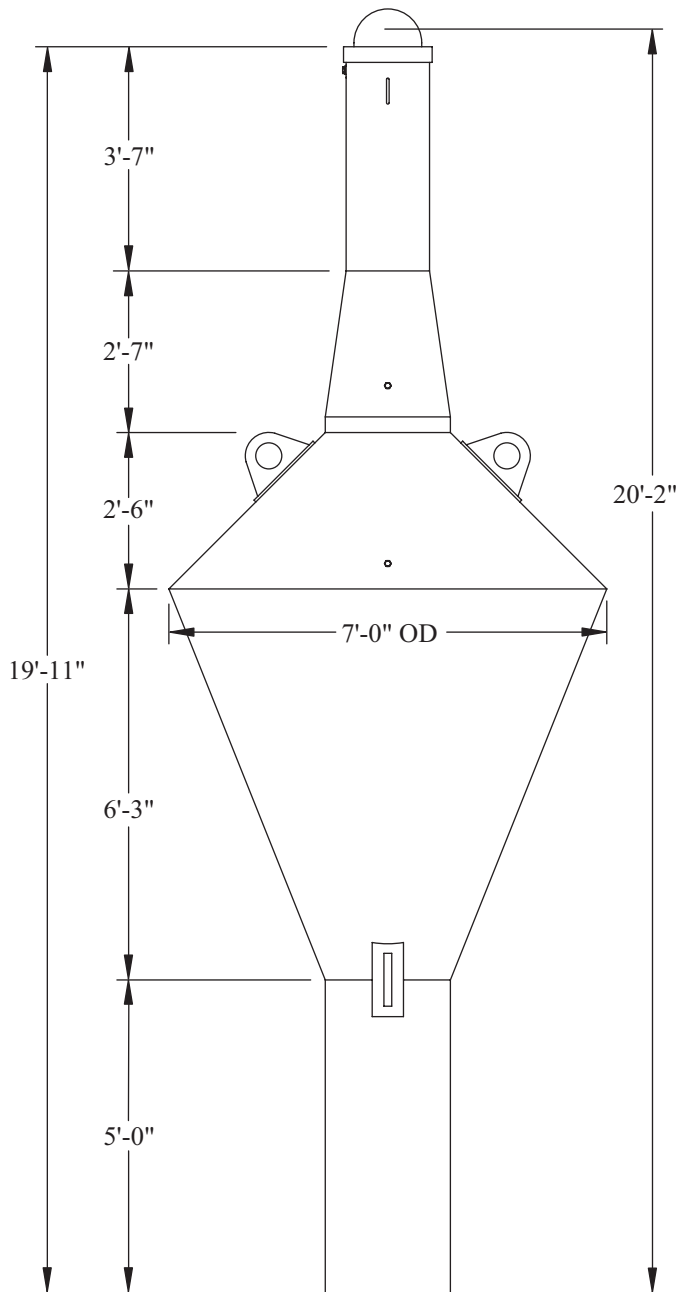
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121145
 G-SEC Specification No. 464

Data Sheet 2.K.6. 8X21LR Buoy.

2.K. 7. 7X20LI. The 7X20LI is designed and constructed for use as a seasonal aid in semi-exposed locations subject to ice conditions. It is designed with special lighting and battery equipment to survive entrapment under the ice. Note that the buoy has no radar reflector and has a very small visual profile.

a. Standard Buoy Arrangements. 1962 Type 7X20LI.



Physical Characteristics. (no mooring)

Buoy Weight	6,500 lbs.
Buoy Draft	10 ft. 7. in.
Focal Height of Light	9 ft. 10 in.
Freeboard	3 ft. 1 in.
Minimum Freeboard	2 ft. 6 in.
Pounds-Per-Inch Immersion	170+

Related Equipment.

Optic Protection	Polycarbonate Dome
Mooring Bridle	1 1/4 in. x 15 ft.
Mooring Riser	1/2 in.
Mooring Chain	(From permanent aid)
Sinker	(From permanent aid)

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	0.5 nm
Mooring Depth (min.)	25 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	33'
1-1/4"	47'
1-1/8"	60'
1"	75'

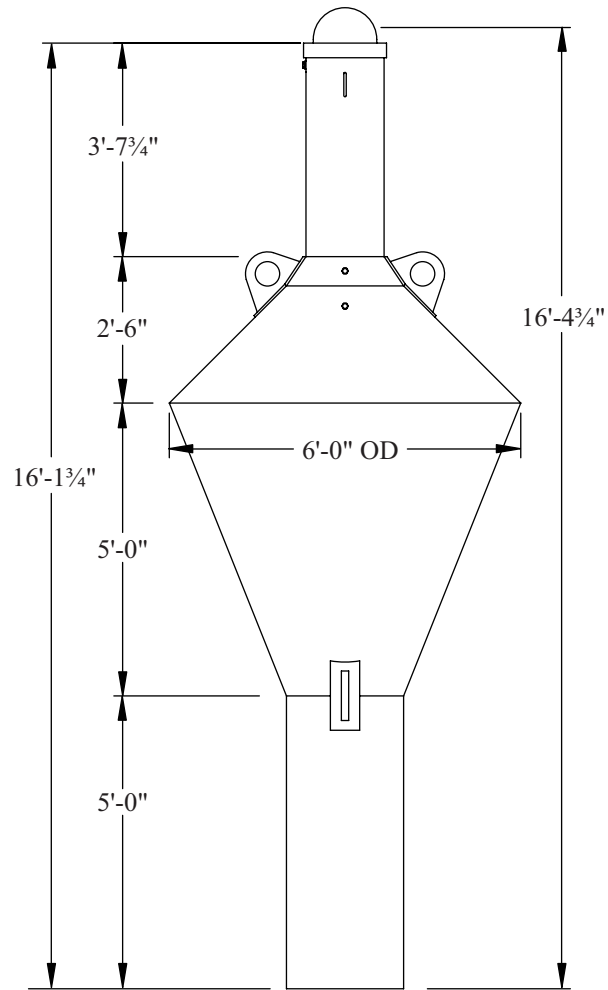
Reference Documents. (use latest rev.)

G-SEC Drawing No. 120976
 G-SEC Specification No. 464

Data Sheet 2.K.7. 7X20LI Buoy.

2.K.7.

b. Non-Standard Buoys.

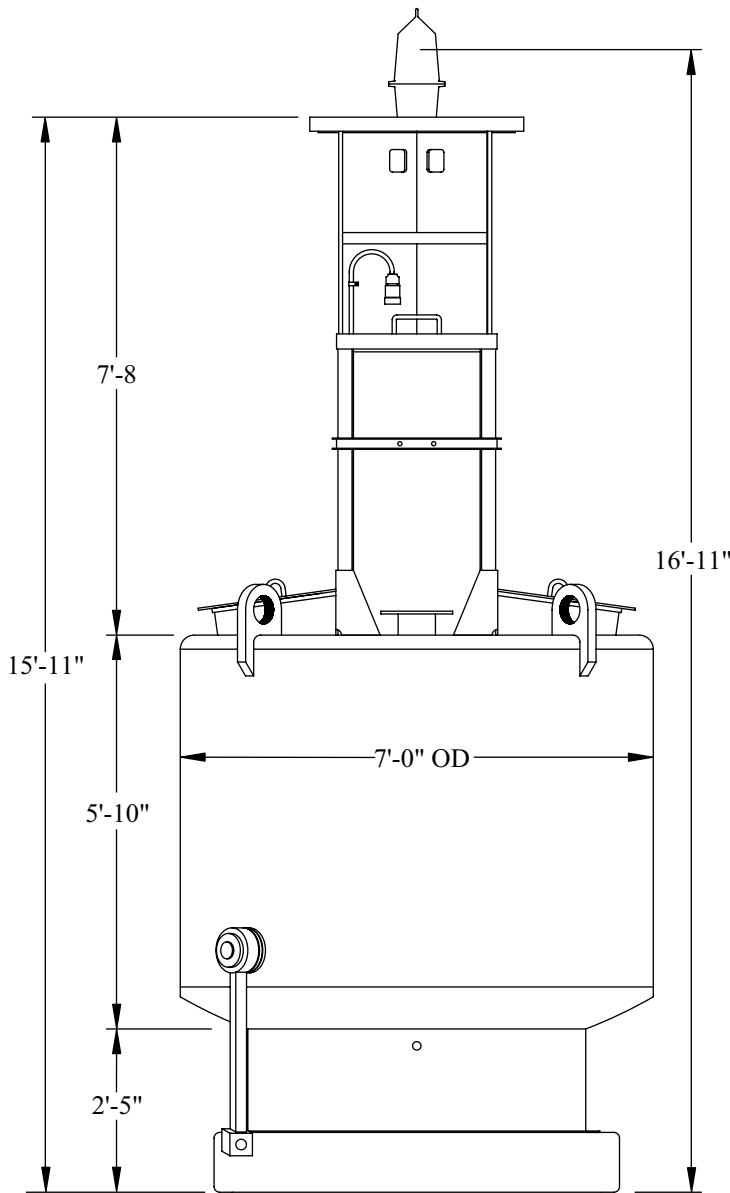


1980 TYPE
6X16LI
DRAWING: 120980

Data Sheet 2.K.7. (cont'd).

2.K. 8. 7X17LR. The 7X17LR is designed and constructed for semi-exposed locations. It is designed for use as a shallow water lighted buoy and can be fitted with a bell or horn.

a. Standard Buoy Arrangements. 1989 (1962) Type 7X17LR, 7X17LBR, 7X17LHR.



Physical Characteristics. (no mooring)

Buoy Weight	7,800 lbs.
Buoy Draft	5 ft. 6 in.
Focal Height of Light	11 ft. 5 in.
Freeboard	3 ft.
Minimum Freeboard	14 in.
Pounds-Per-Inch Immersion	205

Related Equipment.

Bell	85 lbs.
Horn	SA-850
Mooring Bridle	1-1/4 in. x 15 ft.
Mooring Chain	1-1/4 in.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.3 nm
Radar Range	2.7 nm
Mooring Depth (min.)	17 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	133'
1-1/4"	189'
1-1/8"	233'
1"	291'

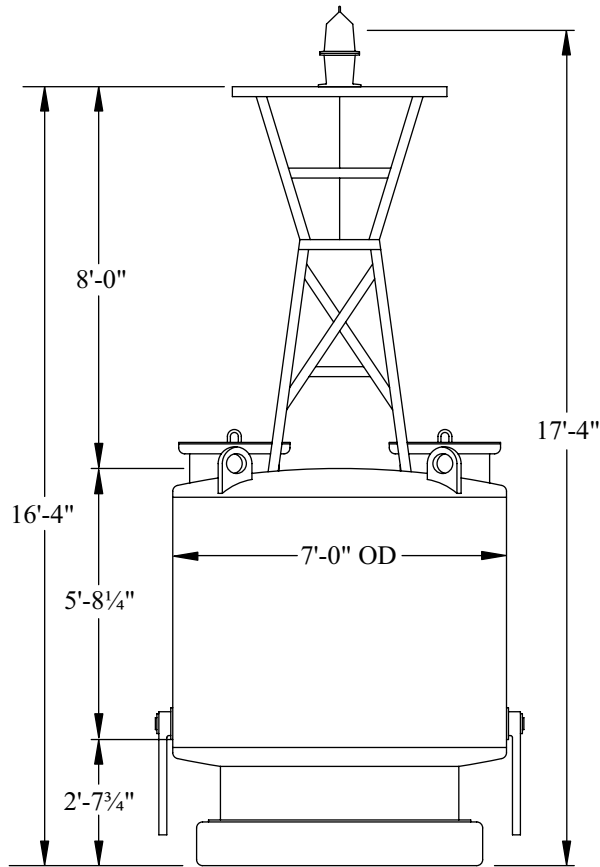
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121129(107323)
G-SEC Specification No. 464

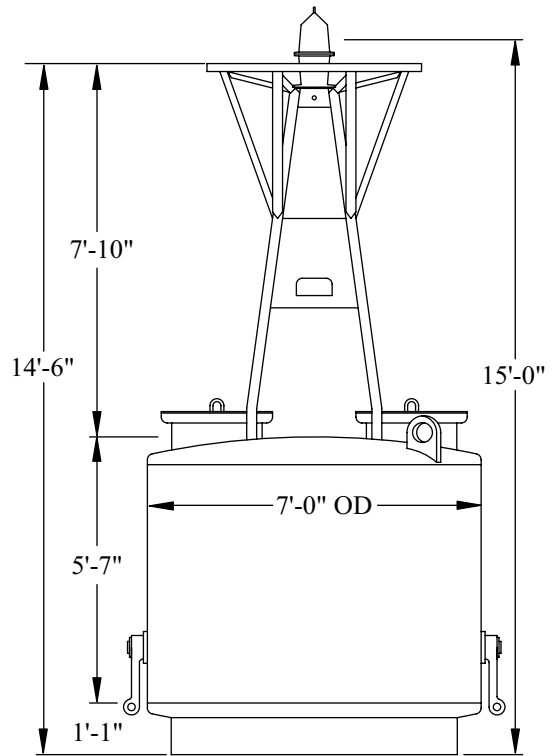
Data Sheet 2.K.8. 7X17LR Buoy.

2.K.8.

b. Non-Standard Buoys.



1952 TYPE
7X17LR
WEIGHT: 8,075 LBS
DRAWING: BU-52-16

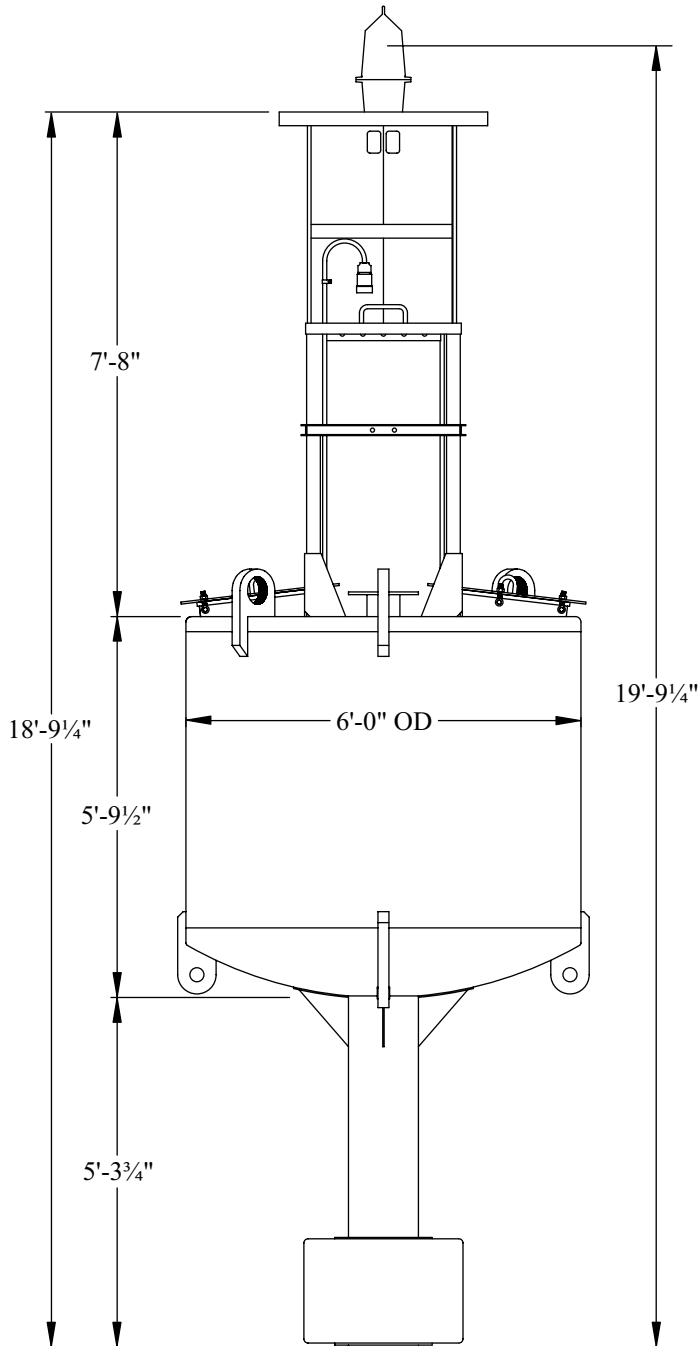


1942 TYPE
7X15L
WEIGHT: 5,760 LBS
DRAWING: BU-44-10

Data Sheet 2.K.8. (cont'd).

2.K. 9. 6X20LR. The 6X20LR is designed and constructed for semi-exposed locations. It is designed for use as a lighted buoy and can be fitted with a bell or horn.

a. Standard Buoy Arrangements. 1992 Type 6X20LR, 6X20LBR, 6X20LHR.



Physical Characteristics. (no mooring)

Buoy Weight	6,500 lbs.
Buoy Draft	9 ft. 0 in.
Focal Height of Light	10 ft. 9 in.
Freeboard	2 ft. 1 in.
Minimum Freeboard	10 in.
Pounds-Per-Inch Immersion	150

Related Equipment.

Bell	85 lbs.
Horn	SA-850
Mooring Bridle	1 in. x 12 ft.
Mooring Chain	1 1/4 in.
Sinker (concrete)	5,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.1 nm
Radar Range	2.4 nm
Mooring Depth (min.)	20 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	69'
1-1/4"	97'
1-1/8"	120'
1"	149'

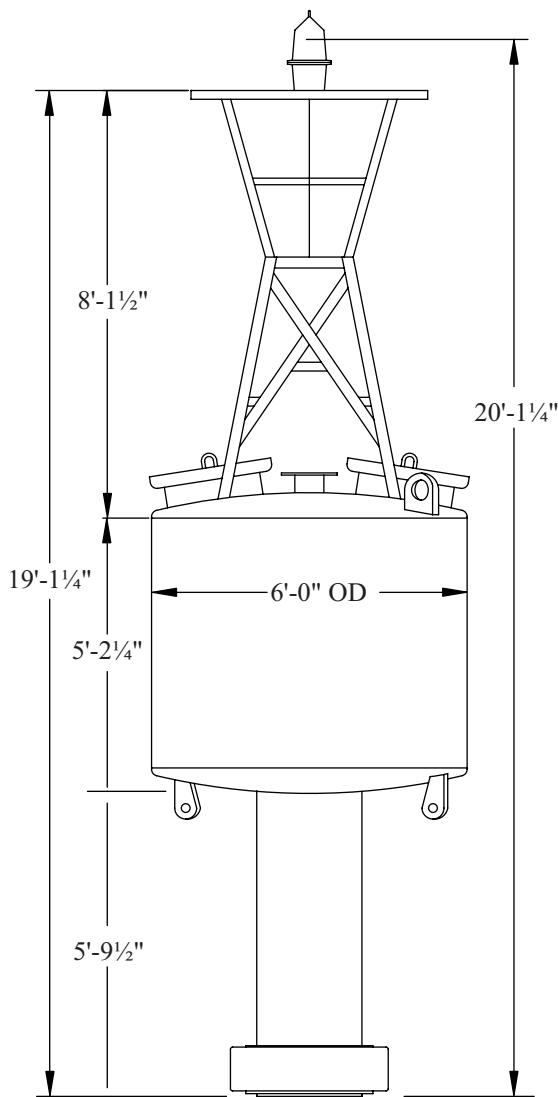
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121152(107324)
G-SEC Specification No. 464

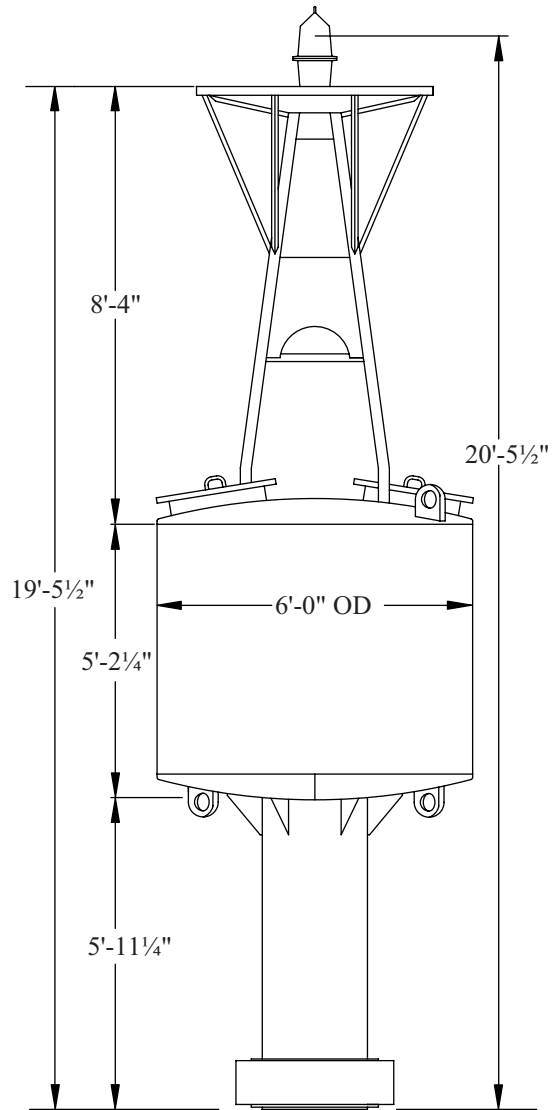
Data Sheet 2.K.9. 6X20LR Buoy.

2.K.9.

b. Non-Standard Buoys.



1952 TYPE
6X20LR
WEIGHT: 5,050 LBS
DRAWING: BU-52-13

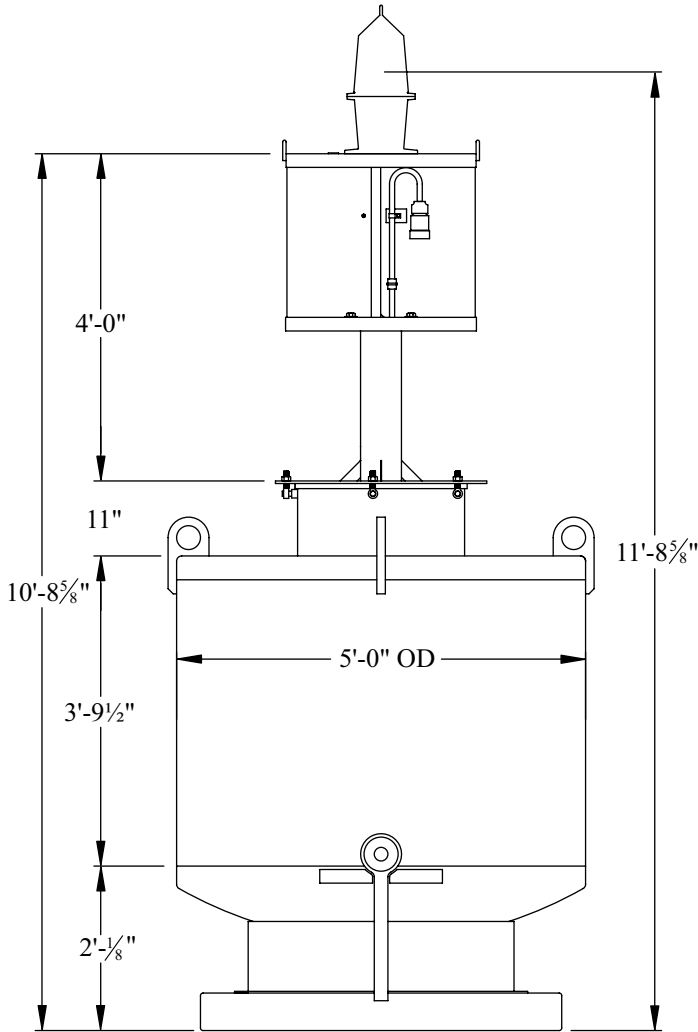


1942 TYPE
6X20L
WEIGHT: 4,900 LBS
DRAWING: BU-42-02
DRAWING: BU-44-17
DRAWING: BU-44-31
DRAWING: BU-46-17

Data Sheet 2.K.9. (cont'd).

2.K. 10. 5X11LR. The 5X11LR is designed and constructed for protected locations. It is designed for use as a shallow water lighted buoy. The radar relector has lateral significance. Can and nun tops are available.

a. Standard Buoy Arrangements. 1992 Type 5X11LCR, 5X11LNR.



Physical Characteristics. (no mooring)

Buoy Weight	3,000 lbs.
Buoy Draft	3 ft. 9 in.
Focal Height of Light	8 ft.
Freeboard	2 ft. 1 in.
Minimum Freeboard	10 in.
Pounds-Per-Inch Immersion	105

Related Equipment.

Mooring Bridle	1 in. x 12 ft.
Mooring Chain	1 in.
Sinker (concrete)	4,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	1.7 nm
Mooring Depth (min.)	13 ft.

Maximum Mooring Depth.

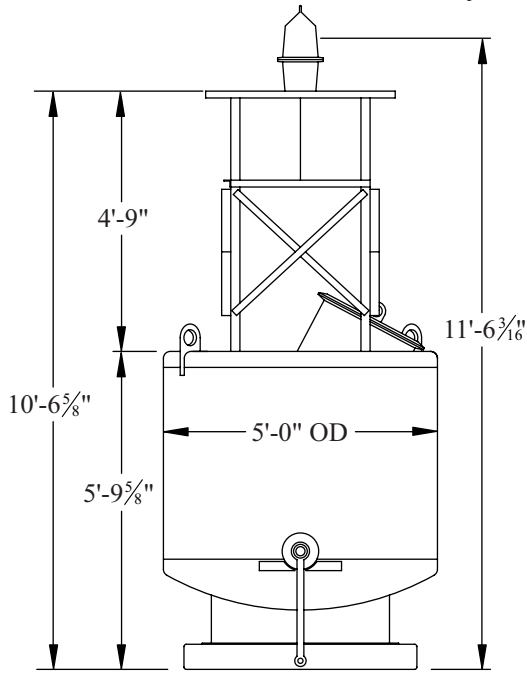
Chain Size	Max Mooring Depth
1-1/4"	69'
1-1/8"	84'
1"	105'

Reference Documents. (use latest rev.)

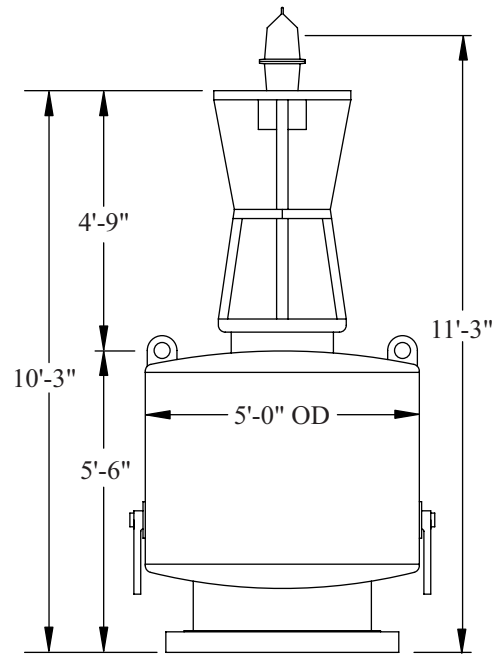
G-SEC Drawings:	
Buoy (5X11LR)	No. 121158(107379)
Nun Radar Reflector	No. 120316
Can Radar Reflector	No. 121024
G-SEC Specification	No. 464

Data Sheet 2.K.10. 5X11LR Buoy.

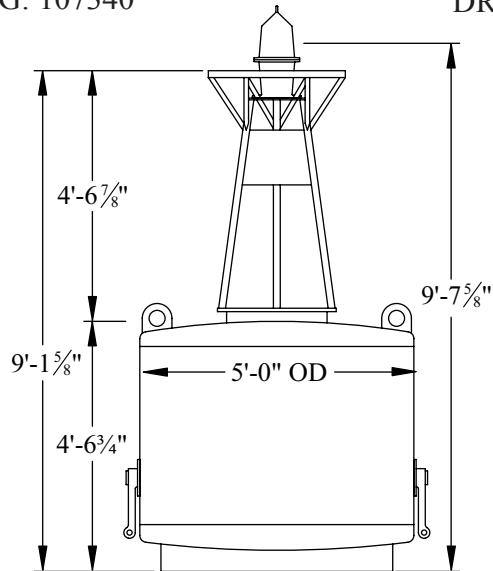
2.K.10. b. Non-Standard Buoys.



1962 TYPE
5X11LR
WEIGHT: 3,150 LBS
DRAWING: 107340



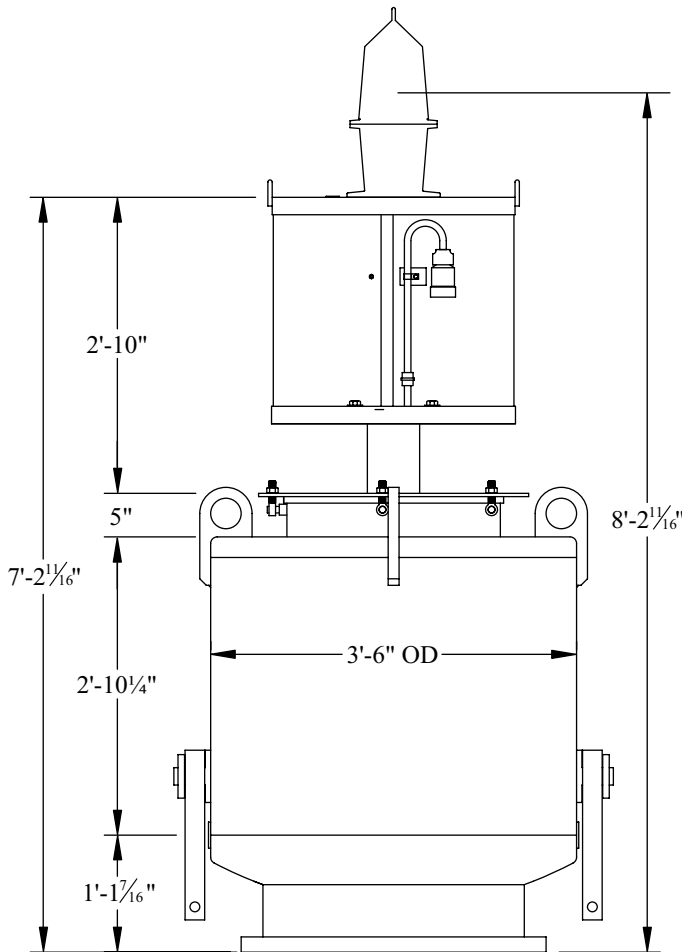
1952 TYPE
5X11LR
WEIGHT: 2,950 LBS
DRAWING: BU-52-17



1952 TYPE
5X11L
WEIGHT: 2,770 LBS
DRAWING: BU-44-12
Data Sheet 2.K.10. (cont'd).

2.K. 11. 3.5X8LR. The 3.5X8LR is designed and constructed for use in shallow water and the most protected locations. The radar reflector has lateral significance. Can and nun tops are available. Due to its limited freeboard, the use of solar power is recommended.

a. Standard Buoy Arrangements. 1992 Type 3.5X8LCR, 3.5X8LNR.



Physical Characteristics. (no mooring)

Buoy Weight	1,500 lbs.
Buoy Draft	2 ft. 9 in.
Focal Height of Light	5 ft. 7 in.
Freeboard	1 ft. 4 in.
Minimum Freeboard	6 in.
Pounds-Per-Inch Immersion	50

Related Equipment.

Mooring Bridle	7/8 in. x 10 ft.
Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lb.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	1.3 nm
Mooring Depth (min.)	11 ft.

Maximum Mooring Depth.

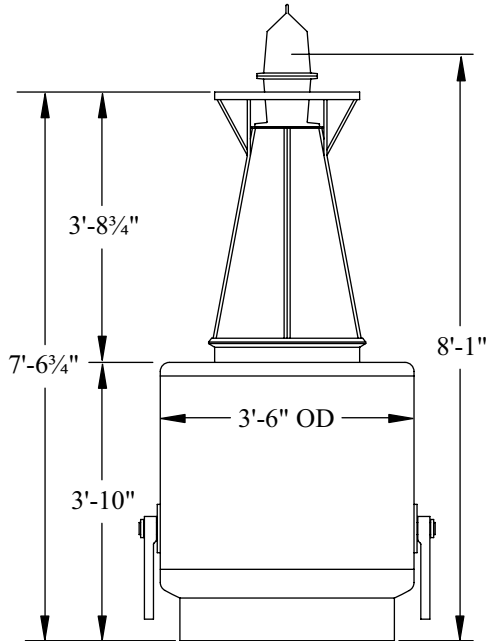
Chain Size	Max Mooring Depth
1"	33'
7/8"	41'
3/4"	55'

Reference Documents. (use latest rev.)

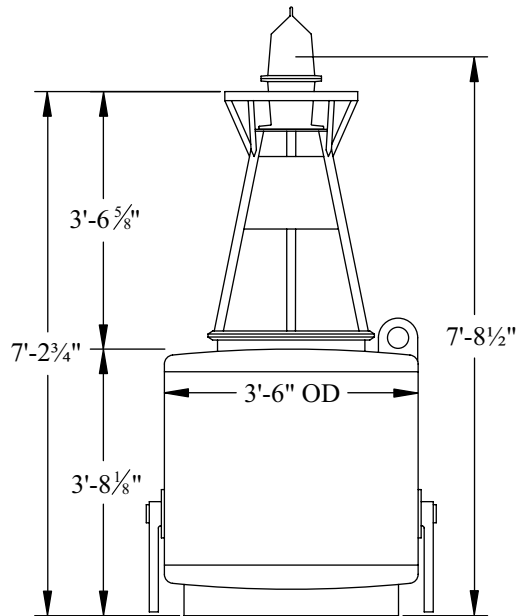
G-SEC Drawing	
Buoy (3.5X8LR):	No. 121157(107377)
Nun Radar Reflector:	No. 120316
Can Radar Reflector:	No. 121024
G-SEC Specification	No. 464

Data Sheet 2.K.11. 3.5X8LR Buoy.

2.K.11. b. Non-Standard Buoys.



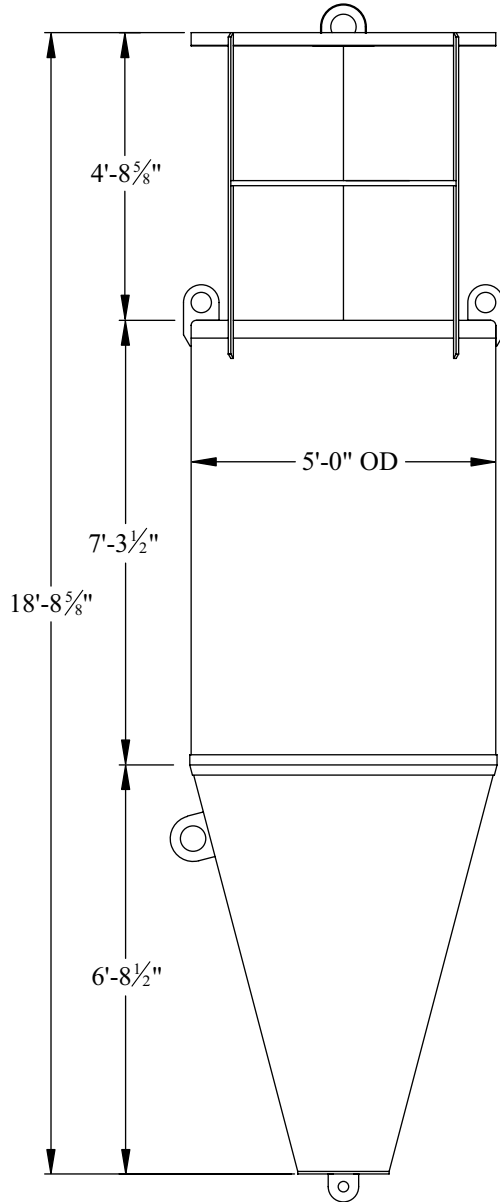
1962 TYPE
3.5X8LR
WEIGHT: 1,025 LBS
DRAWING: 107328



1952 TYPE
3.5X8L
WEIGHT: 1,115 LBS
DRAWING: BU-41-153

2.K. 12. 1CR. The 1CR is designed and constructed for the most exposed locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangements. 1988 Type 1CR.



Physical Characteristics. (no mooring)

Buoy Weight	6,100 lbs.
Buoy Draft	8 ft. 7 in.
Freeboard	5 ft. 5 in.
Minimum Freeboard	2 ft. 2 in.
Pounds-Per-Inch Immersion	104

Related Equipment.

Mooring Chain	1-1/4 in.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.8 nm
Radar Range	3.5 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

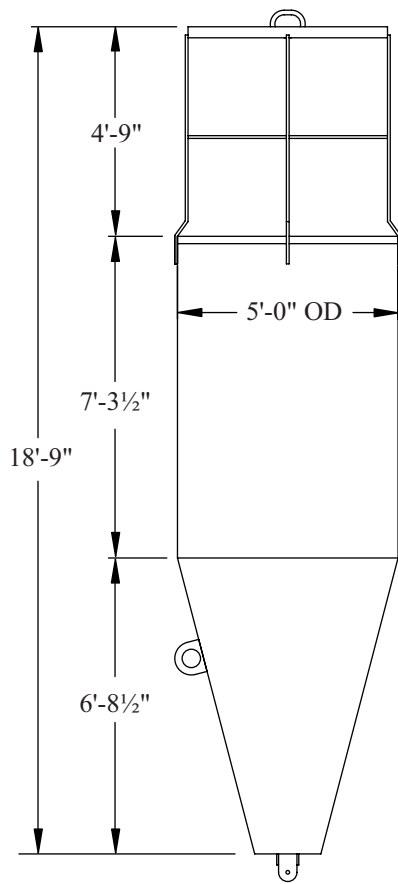
Chain Size	Max Mooring Depth
1-1/2"	121'
1-1/4"	174'
1-1/8"	216'

Reference Documents. (use latest rev.)

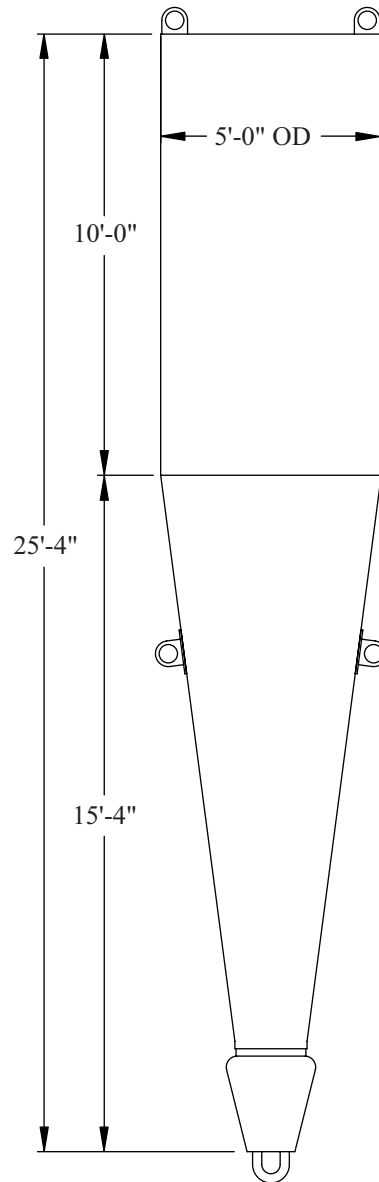
G-SEC Drawing No. 121109
G-SEC Specification No. 464

2.K.12.

b. Non-Standard Buoys.



1952 TYPE
1CR
WEIGHT: 5,255 LBS
DRAWING: BU-58-08
DRAWING: BU-52-06

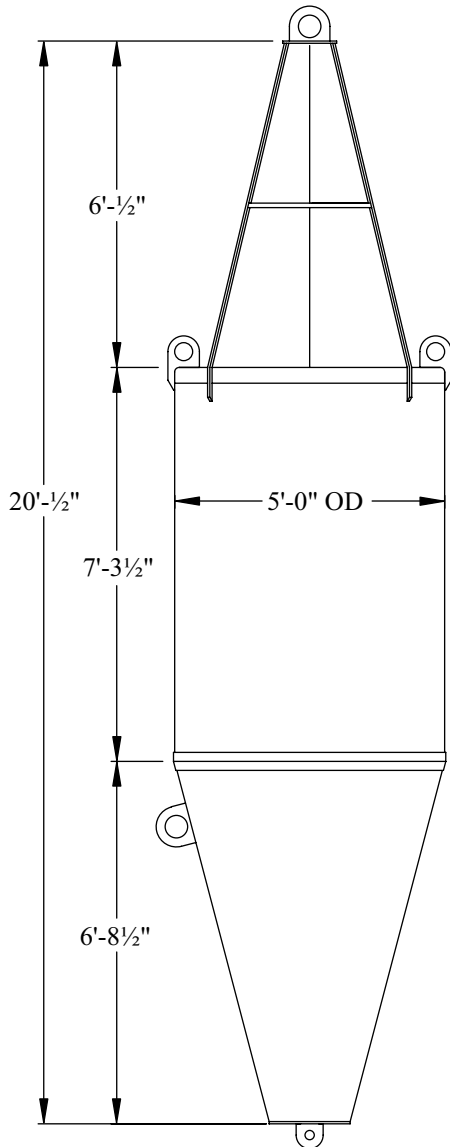


1942 TYPE
1CT
WEIGHT: 6,925 LBS
DRAWING: BU-43-32

Data Sheet 2.K.12. (cont'd).

2.K. 13. 1NR. The 1NR is designed and constructed for the most exposed locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1988 Type 1NR.



Physical Characteristics. (no mooring)

Buoy Weight	6,000 lbs.
Buoy Draft	8 ft. 4 in.
Freeboard	5 ft. 8 in.
Minimum Freeboard	2 ft. 3 in.
Pounds-Per-Inch Immersion	104

Related Equipment.

Mooring Chain	1-1/4 in.
Sinker (concrete)	8,500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	3.5 nm
Radar Range	3.5 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/2"	126'
1-1/4"	182'
1-1/8"	226'

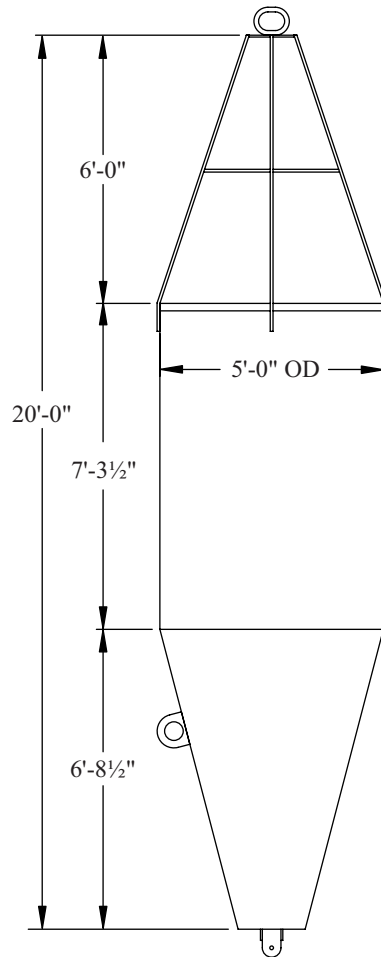
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121108
 G-SEC Specification No. 464

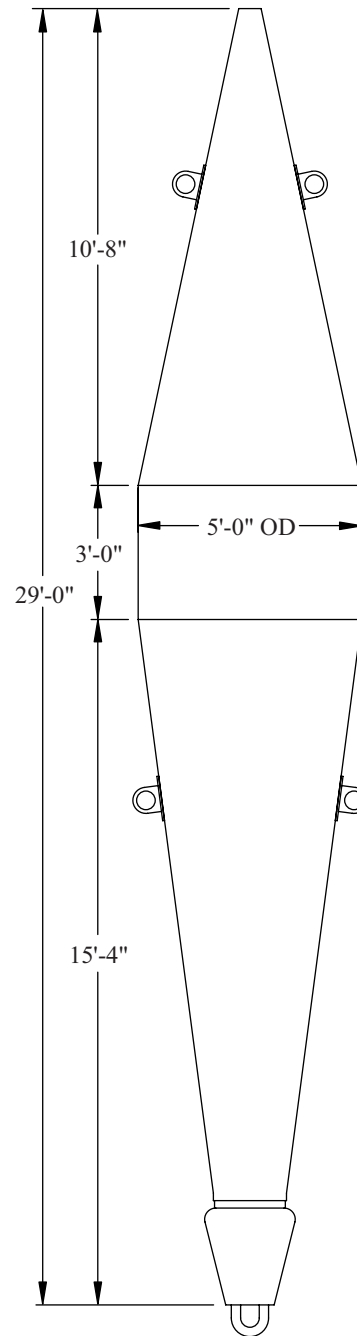
Data Sheet 2.K.13. 1NR Buoy.

2.K.13.

b. Non-Standard Buoys.



1952 TYPE
1NR
WEIGHT: 4,980 LBS
DRAWING: BU-58-05
DRAWING: BU-52-06

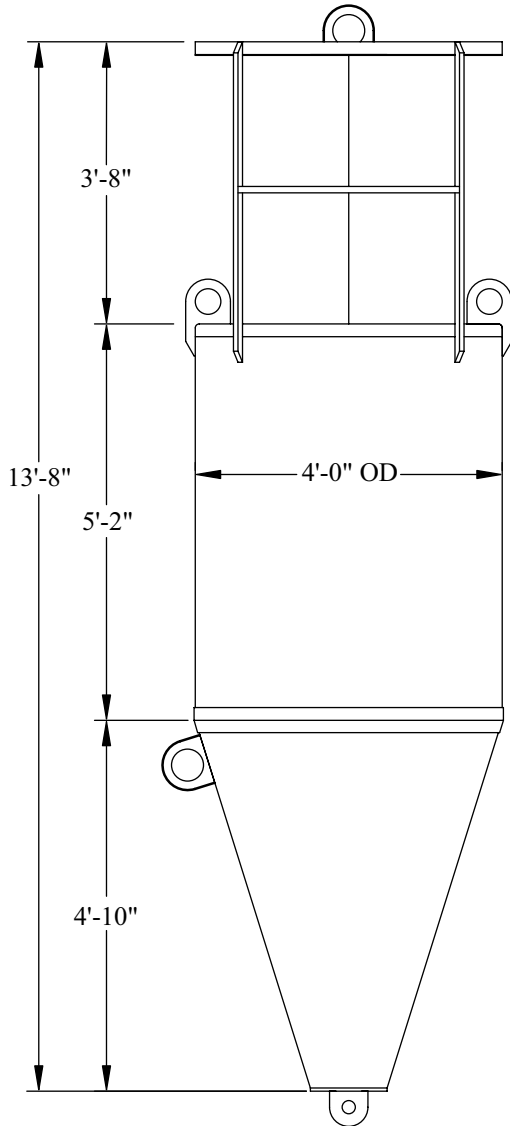


1942 TYPE
1NT
WEIGHT: 6,435 LBS
DRAWING: BU-43-32

Data Sheet 2.K.13. (cont'd).

2.K. 14. 2CR. The 2CR is designed and constructed for exposed locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1988 Type 2CR.



Physical Characteristics. (no mooring)

Buoy Weight	2,800 lbs.
Buoy Draft	6 ft. 3 in.
Freeboard	3 ft. 9 in.
Minimum Freeboard	1 ft. 6 in.
Pounds-Per-Inch Immersion	67

Related Equipment.

Mooring Chain	1 in.
Sinker (concrete)	5,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.8 nm
Radar Range	2.5 nm
Mooring Depth (min.)	15 ft.

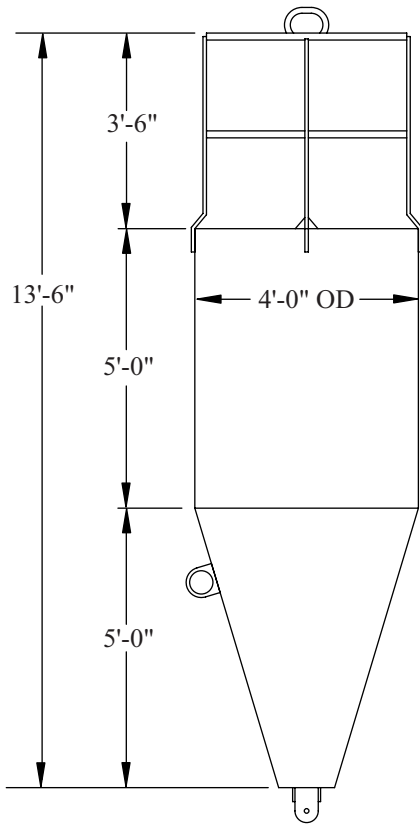
Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/4"	78'
1-1/8"	97'
1"	121'

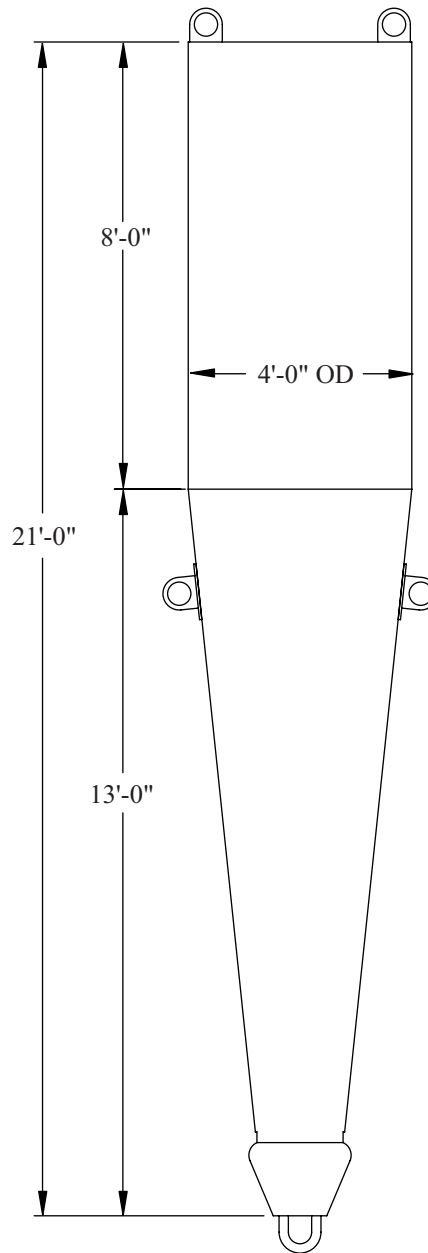
Reference Document. (use latest rev.)

G-SEC Drawing No. 121111
 G-SEC Specification No. 464

2.K.14. b. Non-Standard Buoys.



1952 TYPE
2CR
WEIGHT: 2,590 LBS
DRAWING: BU-58-08
DRAWING: BU-52-06

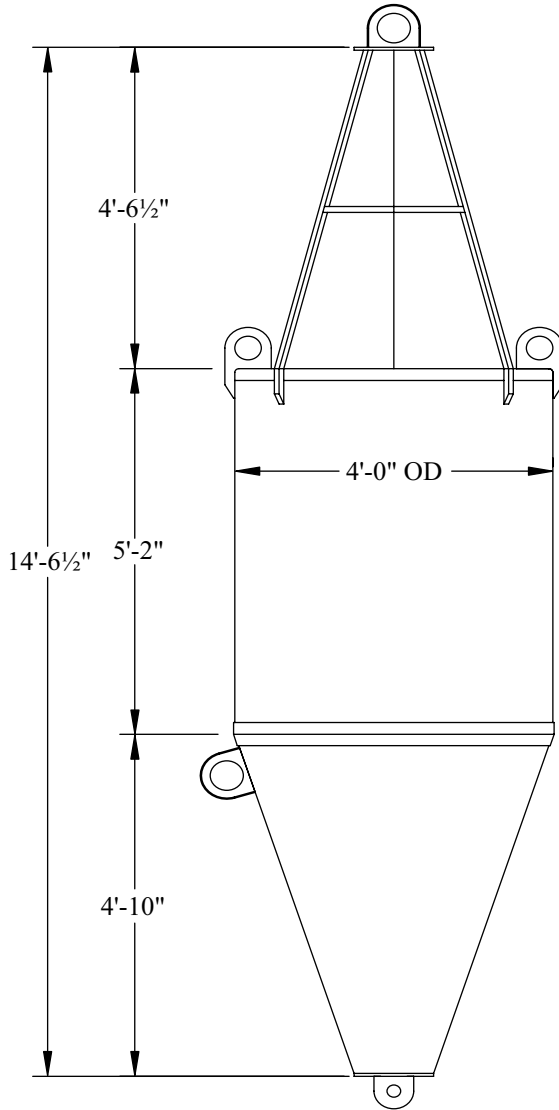


1942 TYPE
2CT
WEIGHT: 4,580 LBS
DRAWING: BU-43-32

Data Sheet 2.K.14. (cont'd).

2.K. 15. 2NR. The 2NR is designed and constructed for exposed locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1988 Type 2NR.



Physical Characteristics. (no mooring)

Buoy Weight	2,600 lbs.
Buoy Draft	6 ft. 1 in.
Freeboard	3 ft. 11 in.
Minimum Freeboard	1 ft. 7 in.
Pounds-Per-Inch Immersion	67

Related Equipment.

Mooring Chain	1 in.
Sinker (concrete)	5,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.6 nm
Radar Range	3.0 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/4"	81'
1-1/8"	101'
1"	127'

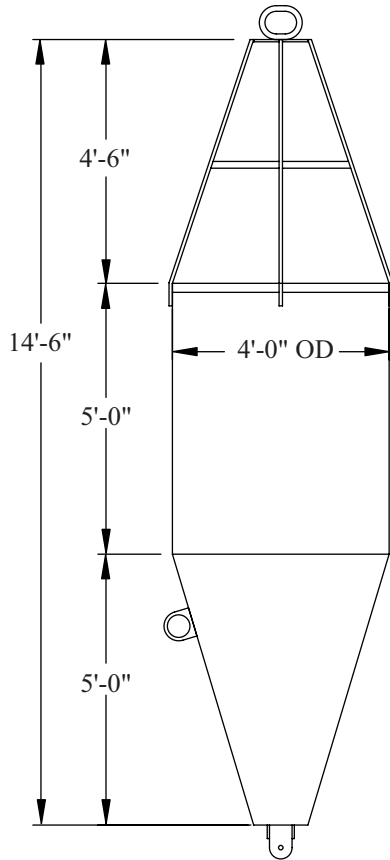
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121110
G-SEC Specification No. 464

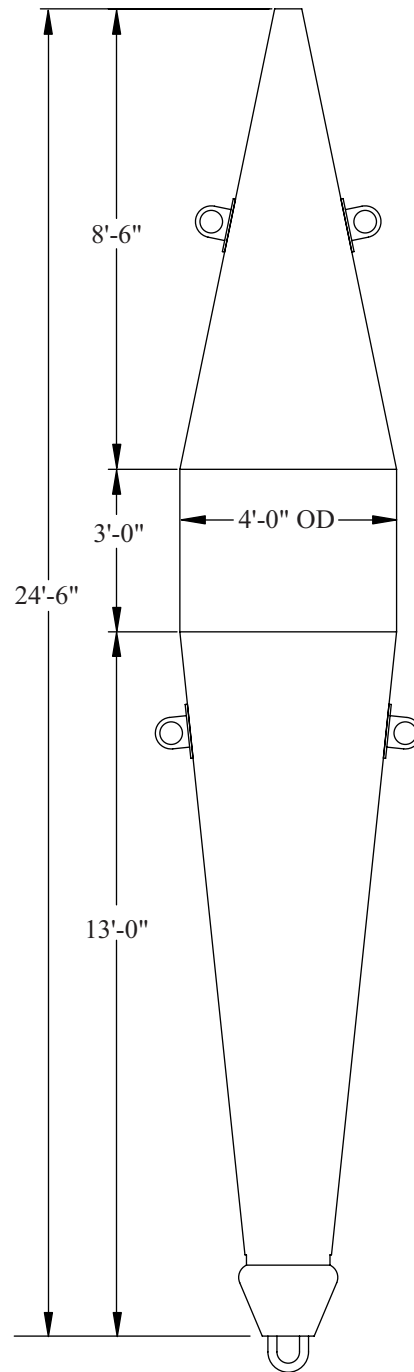
Data Sheet 2.K.15. 2NR Buoy.

2.K.15.

b. Non-Standard Buoys.



1952 TYPE
2NR
WEIGHT: 2,490 LBS
DRAWING: BU-58-08
DRAWING: BU-52-06

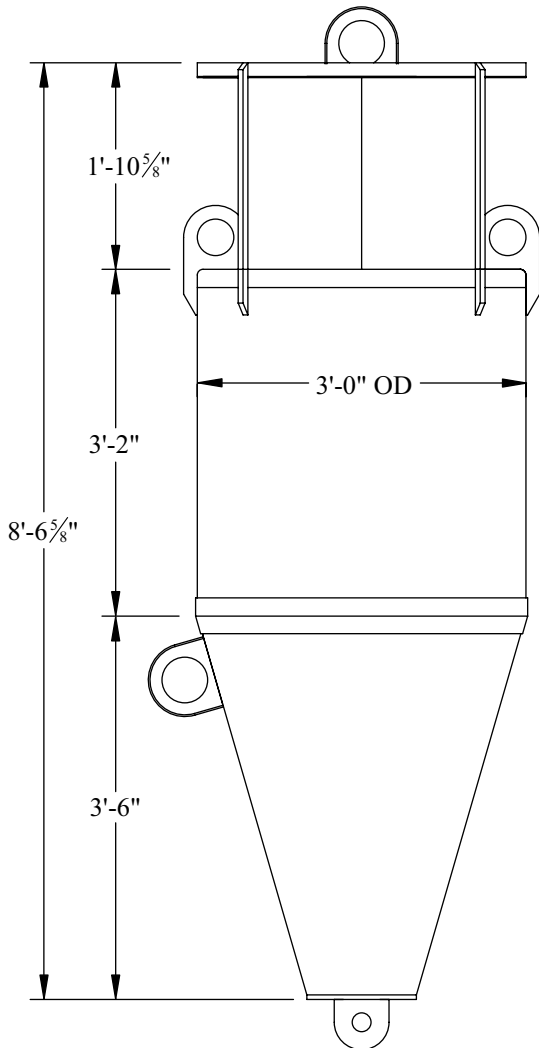


1942 TYPE
2NT
WEIGHT: 4,520 LBS
DRAWING: BU-43-32

Data Sheet 2.K.15. (cont'd).

2.K. 16. 3CR. The 3CR is designed and constructed for semi-exposed locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1988 Type 3CR.



Physical Characteristics. (no mooring)

Buoy Weight	1200 lbs.
Buoy Draft	4 ft. 4 in.
Freeboard	2 ft. 4 in.
Minimum Freeboard	11 in.
Pounds-Per-Inch Immersion	38

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	1.6 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

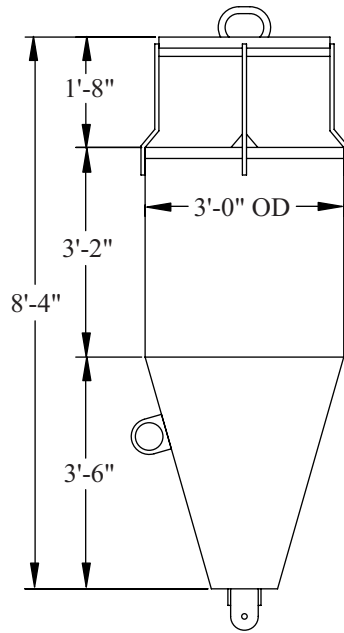
Chain Size	Max Mooring Depth
1"	43'
7/8"	56'
3/4"	76'

Reference Documents. (use latest rev.)

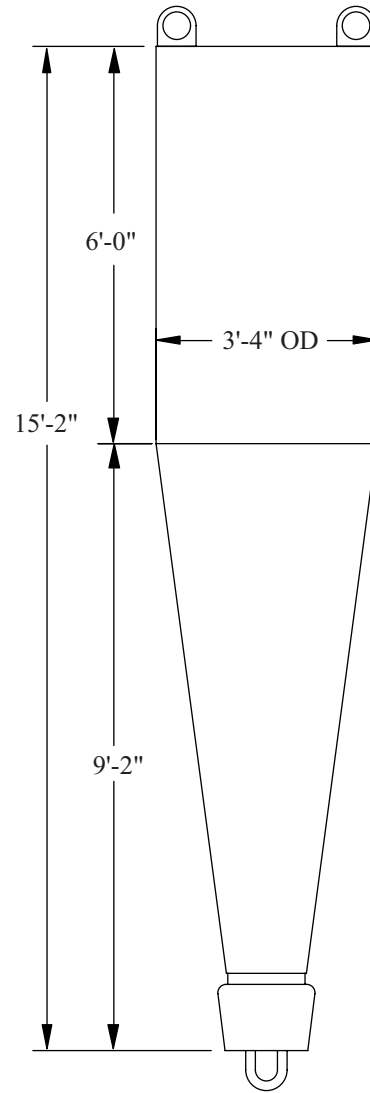
G-SEC Drawing No. 121113
 G-SEC Specification No. 464

2.K.16.

b. Non-Standard Buoys.



1952 TYPE
3CR
WEIGHT: 890 LBS
DRAWING: BU-58-09
DRAWING: BU-52-06

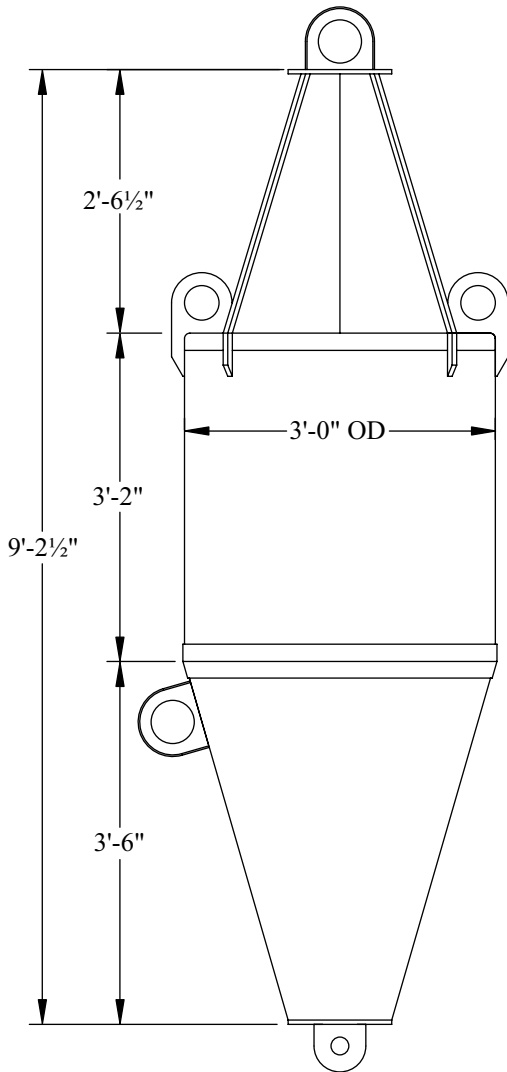


1942 TYPE
3CT
WEIGHT: 2,355 LBS
DRAWING: BU-43-32

Data Sheet 2.K.16. (cont'd).

2.K. 17. 3NR. The 3NR is designed and constructed for semi-exposed locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1988 Type 3NR.



Physical Characteristics. (no mooring)

Buoy Weight	1175 lbs.
Buoy Draft	4 ft. 4 in.
Freeboard	2 ft. 4 in.
Minimum Freeboard	11 in.
Pounds-Per-Inch Immersion	38

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	1.8 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

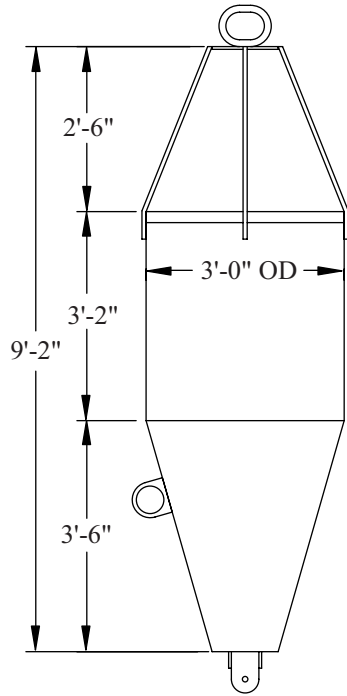
Chain Size	Max Mooring Depth
1"	43'
7/8"	56'
3/4"	76'

Reference Documents. (use latest rev.)

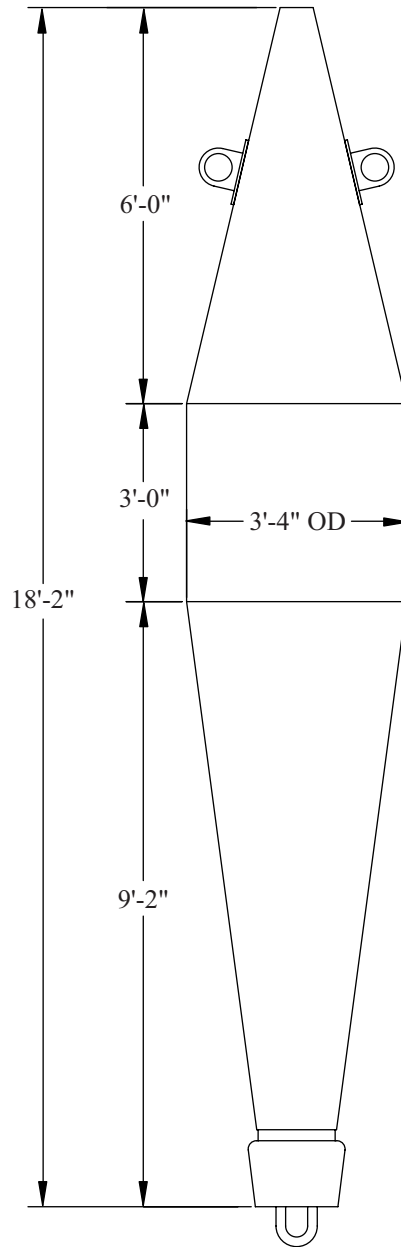
G-SEC Drawing No. 121112
G-SEC Specification No. 464

2.K.17.

b. Non-Standard Buoys.



1952 TYPE
3NR
WEIGHT: 880 LBS
DRAWING: BU-58-09

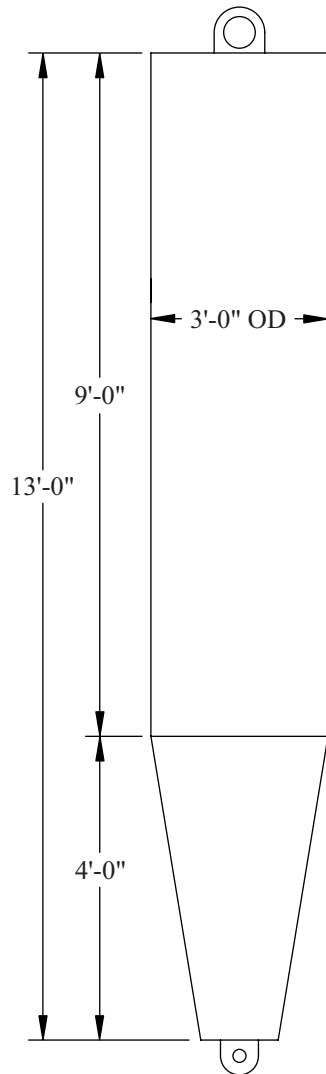


1942 TYPE
3NT
WEIGHT: 2,260 LBS
DRAWING: BU-43-32

Data Sheet 2.K.17. (cont'd).

2.K. 18. 3CI. The 3CI is designed and constructed for locations susceptible to ice where unlighted lateral buoys are required. Note that the buoy does not have a radar reflector.

a. Standard Buoy Arrangement. 1982 Type 3CI.



Physical Characteristics. (no mooring)

Buoy Weight	1,550 lbs.
Buoy Draft	7 ft. 7 in.
Freeboard	5 ft. 5 in.
Minimum Freeboard	3 ft. 9 in.
Pounds-Per-Inch Immersion	22

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	0.5 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

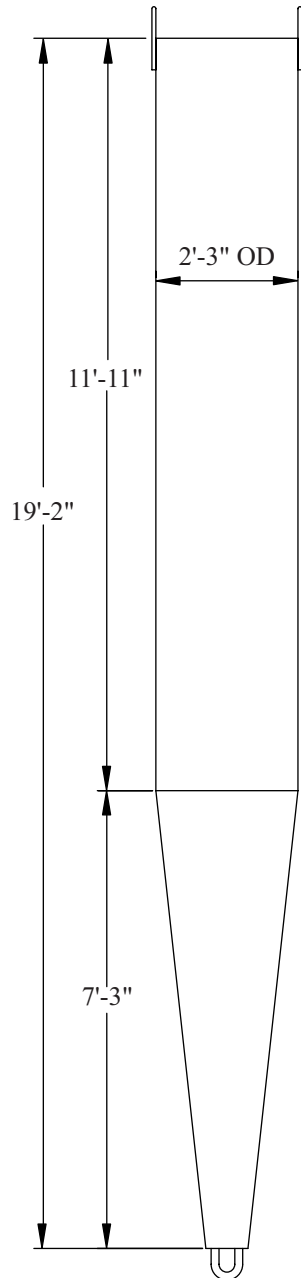
Chain Size	Max Mooring Depth
1"	30'
7/8"	39'
3/4"	53'

Reference Documents. (use latest rev.)

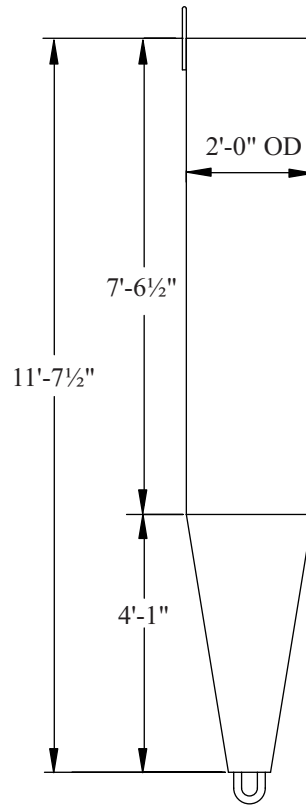
G-SEC Drawing No. 121028
G-SEC Specification No. 464

2.K.18.

b. Non-Standard Buoys.



1942 TYPE
1CS
WEIGHT: 2,090 LBS
DRAWING: BU-43-26

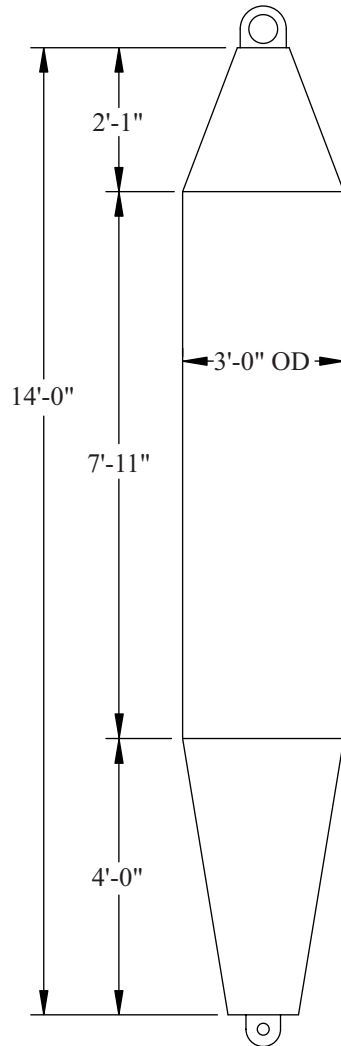


1942 TYPE
2CS
WEIGHT: 1,010 LBS
DRAWING: BU-43-26

Data Sheet 2.K.18. (cont'd).

2.K. 19. 3NI. The 3NI is designed and constructed for locations susceptible to ice where unlighted lateral buoys are required. Note the buoy does not have a radar reflector.

a. Standard Buoy Arrangement. 1982 Type 3NI.



Physical Characteristics. (no mooring)

Buoy Weight	1,550 lbs.
Buoy Draft	7 ft. 7 in.
Freeboard	6 ft. 5 in.
Minimum Freeboard	4 ft. 11 in.
Pounds-Per-Inch Immersion	22

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	0.5 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

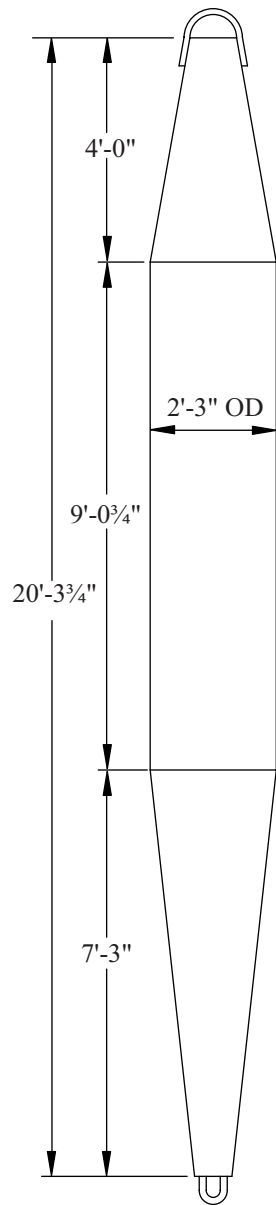
Chain Size	Max Mooring Depth
1"	27'
7/8"	35'
3/4"	48'

Reference Documents. (use latest rev.)

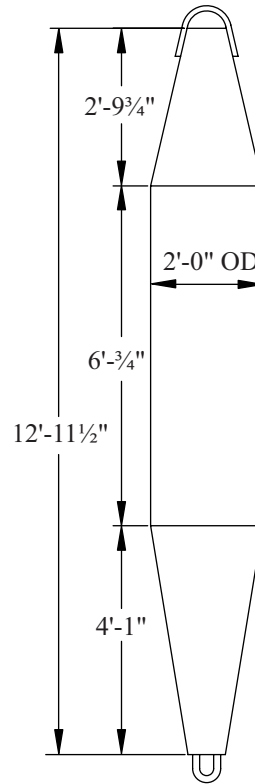
G-SEC Drawing No. 121028
G-SEC Specification No. 464

2.K.19.

b. Non-Standard Buoys.



1942 TYPE
1NS
WEIGHT: 2,035 LBS
DRAWING: BU-43-26

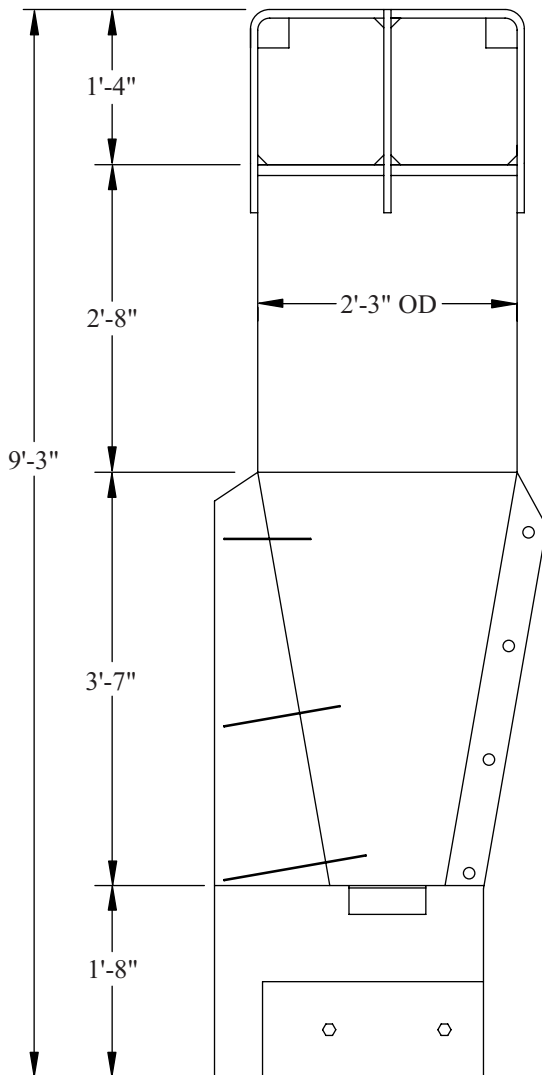


1942 TYPE
2NS
WEIGHT: 995 LBS
DRAWING: BU-43-26

Data Sheet 2.K.19. (cont'd).

2.K. 20. 4CR. The 4CR is designed and constructed for use in rivers and other waterways where unlighted lateral buoys are required. The buoys are designed to shed debris and have multiple mooring eyes to remain vertical in a variety of fast water situations. These buoys are filled with polyurethane foam. Non-standard buoys are no longer in use.

a. Standard Buoy Arrangement. 1988 Type 4CR.



Physical Characteristics. (no mooring)

Buoy Weight	465 lbs.
Buoy Draft	5 ft.
Freeboard	2 ft. 11 in.
Minimum Freeboard	1 ft.
Pounds-Per-Inch Immersion	21

Related Equipment.

Mooring Chain	1/2 in.
Mooring Wire Rope	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

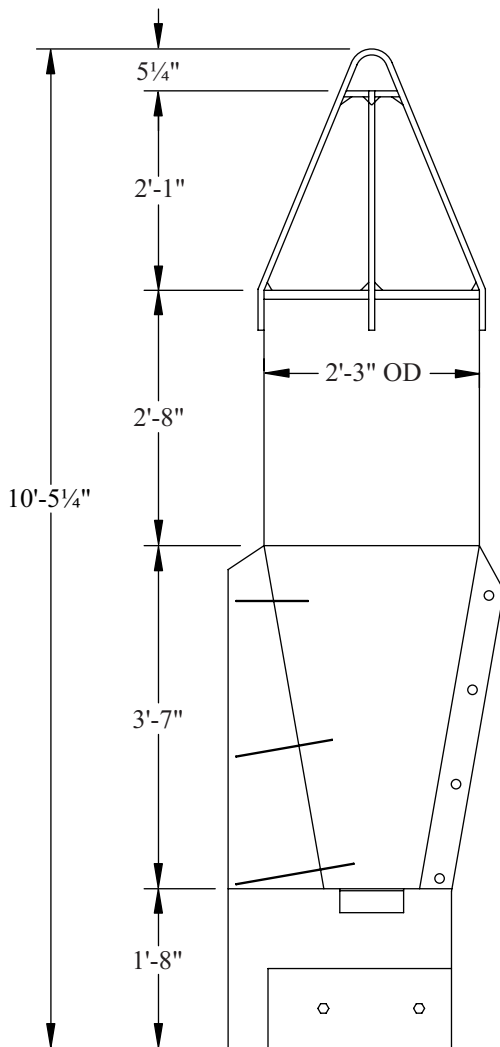
Daymark Visual Range	1.4 nm
Radar Range	1.5 nm
Mooring Depth (min.)	10 ft.
Mooring Depth (max. w/chain)	115 ft.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121117
G-SEC Specification No. 455

2.K. 21. 4NR. The 4NR is designed and constructed for use in rivers and other waterways where unlighted lateral buoys are required. The buoys are designed to shed debris and have multiple mooring eyes to remain vertical in a variety of fast water situations. These buoys are filled with polyurethane foam. Non-standard buoys are no longer in use.

a. Standard Buoy Arrangement. 1988 Type 4NR.



Physical Characteristics. (no mooring)

Buoy Weight	470 lbs.
Buoy Draft	5 ft.
Freeboard	2 ft. 11 in.
Minimum Freeboard	1 ft.
Pounds-Per-Inch Immersion	21

Related Equipment.

Mooring Chain	1/2 in.
Mooring Wire Rope	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

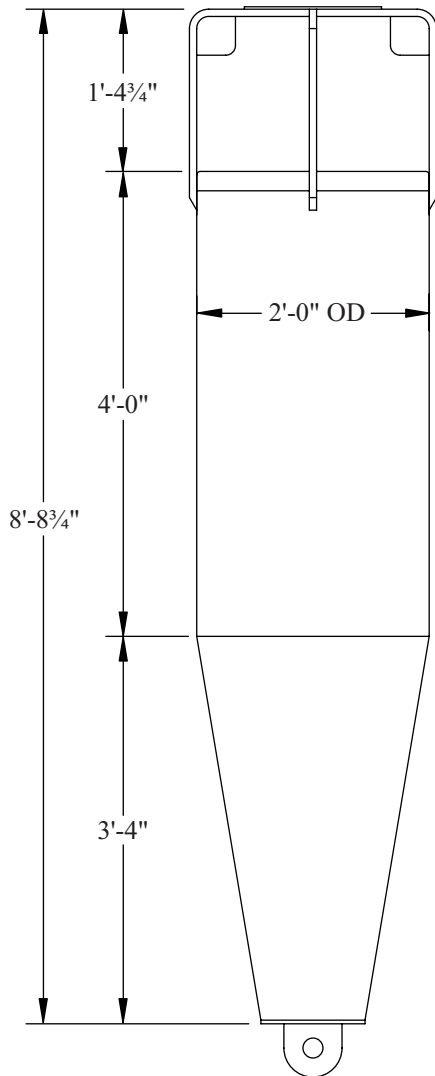
Daymark Visual Range	1.4 nm
Radar Range	1.5 nm
Mooring Depth (min.)	10 ft.
Mooring Depth (max. w/chain)	115 ft.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121116
G-SEC Specification No. 455

2.K. 22. 5CR. The 5CR is designed and constructed for protected locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1994 Type 5CR.



Physical Characteristics. (no mooring)

Buoy Weight	710 lbs.
Buoy Draft	5 ft. 1 in.
Freeboard	2 ft. 3 in.
Minimum Freeboard	11 in.
Pounds-Per-Inch Immersion	16

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.2 nm
Radar Range	1.25 nm
Mooring Depth (min.)	10 ft.

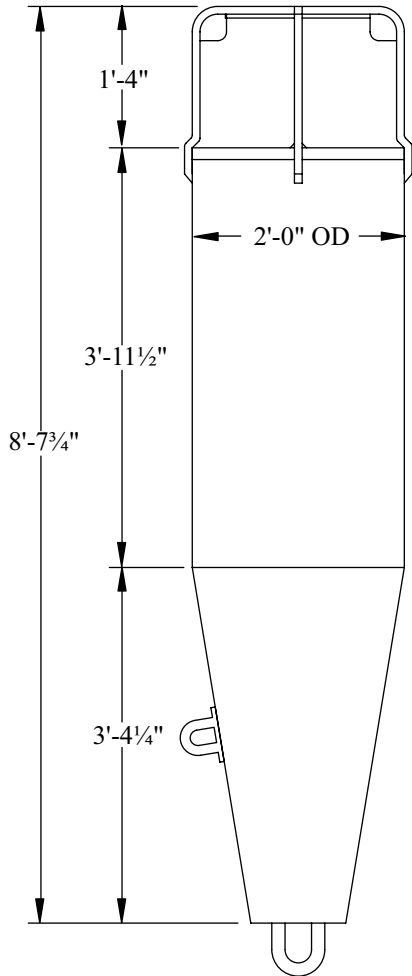
Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	67'

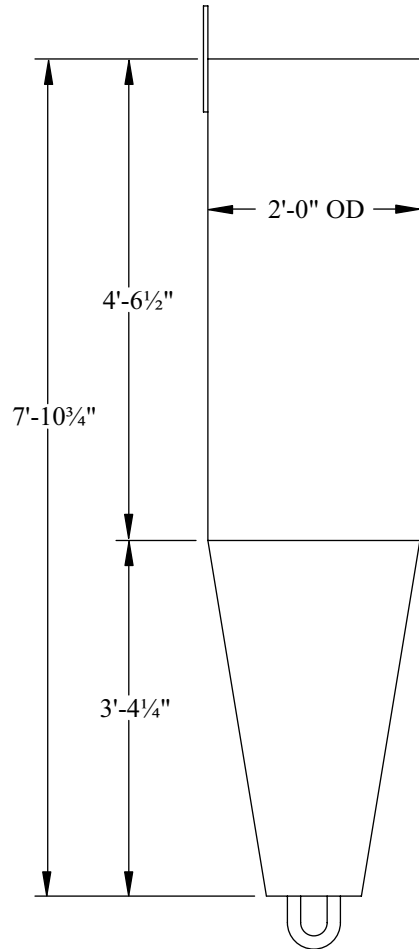
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121164
G-SEC Specification No. 464

2.K.22. b. Non-Standard Buoys.



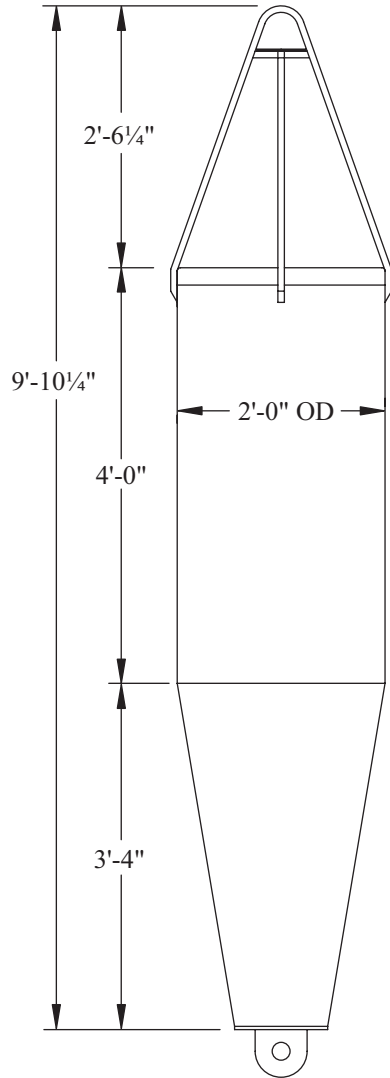
1952 TYPE
5CR
WEIGHT: 680 LBS
DRAWING: 1033



1942 TYPE
5C
WEIGHT: 665 LBS
DRAWING: BU-43-26

2.K. 23. 5NR. The 5NR is designed and constructed for protected locations where unlighted lateral buoys are required.

a. Standard Buoy Arrangement. 1994 Type 5NR.



Physical Characteristics. (no mooring)

Buoy Weight	710 lbs.
Buoy Draft	5 ft. 1 in.
Freeboard	2 ft. 3 in.
Minimum Freeboard	11 in.
Pounds-Per-Inch Immersion	16

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.2 nm
Radar Range	1.25 nm
Mooring Depth (min.)	10 ft.

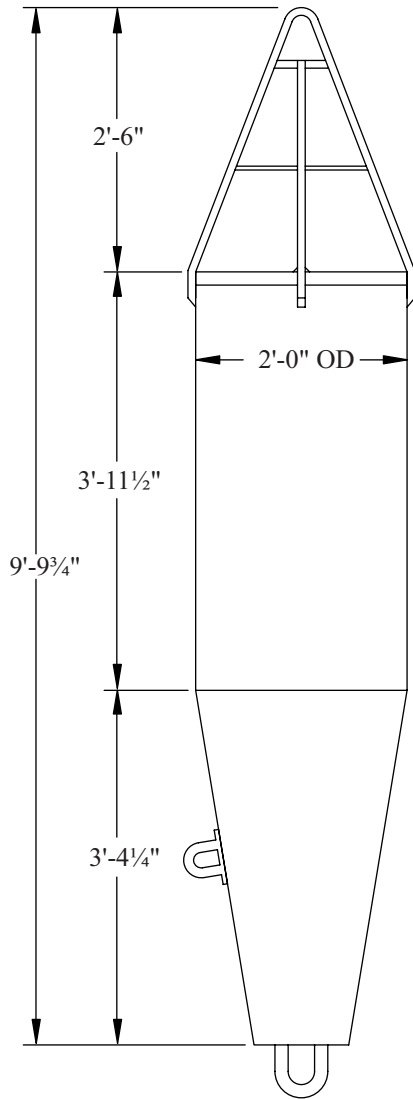
Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	67'

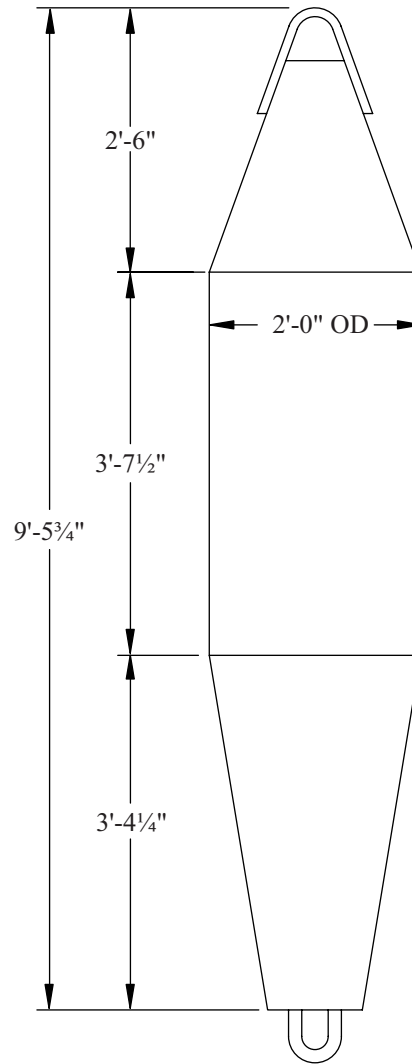
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121163
 G-SEC Specification No. 464

2.K.23. b. Non-Standard Buoys.



1952 TYPE
5NR
WEIGHT: 690 LBS
DRAWING: 1033

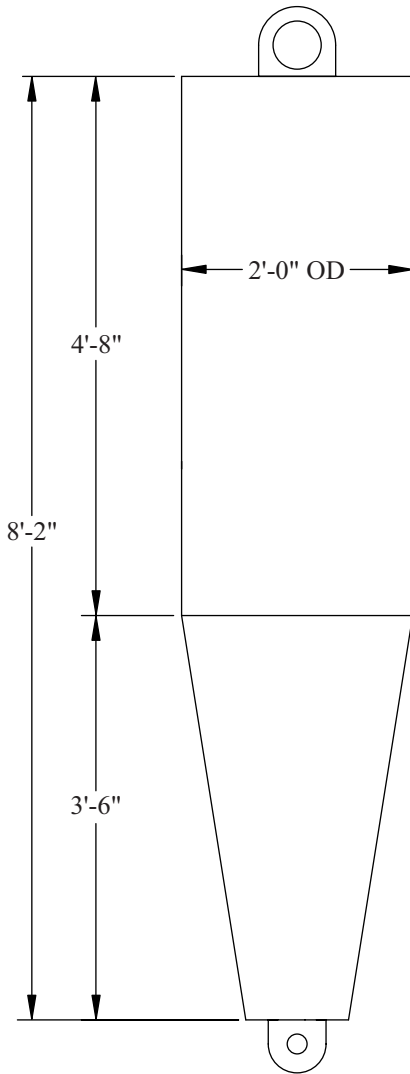


1942 TYPE
5N
WEIGHT: 680 LBS
DRAWING: BU-43-26

Data Sheet 2.K.23. (cont'd).

2.K. 24. 5CI. The 5CI is designed and constructed for locations susceptible to ice where unlighted lateral buoys are required. Note the buoy does not have a radar reflector.

a. Standard Buoy Arrangement. 1981 Type 5CI.



Physical Characteristics. (no mooring)

Buoy Weight	700 lbs.
Buoy Draft	5 ft. 0 in.
Freeboard	3 ft. 2 in.
Minimum Freeboard	2 ft. 2 in.
Pounds-Per-Inch Immersion	16

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.2 nm
Radar Range	0.5 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

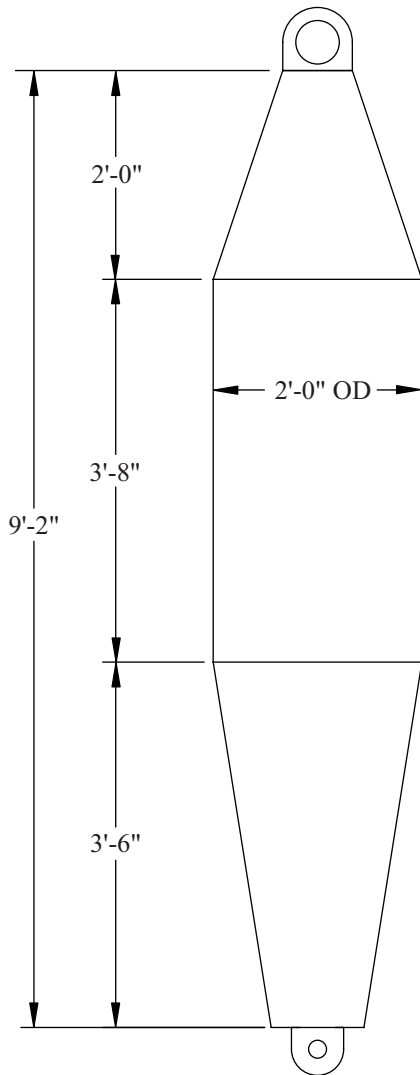
Chain Size	Max Mooring Depth
1/2"	50'

Reference Documents. (use latest rev.)

G-SEC Drawing No. 120990
G-SEC Specification No. 464

2.K. 25. 5NI. The 5NI is designed and constructed for locations susceptible to ice where unlighted lateral buoys are required. Note the buoy does not have a radar reflector.

a. Standard Buoy Arrangement. 1981 Type 5NI.



Physical Characteristics. (no mooring)

Buoy Weight	700 lbs.
Buoy Draft	5 ft. 0 in.
Freeboard	4 ft. 2 in.
Minimum Freeboard	3 ft. 2 in.
Pounds-Per-Inch Immersion	16

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.2 nm
Radar Range	0.5 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

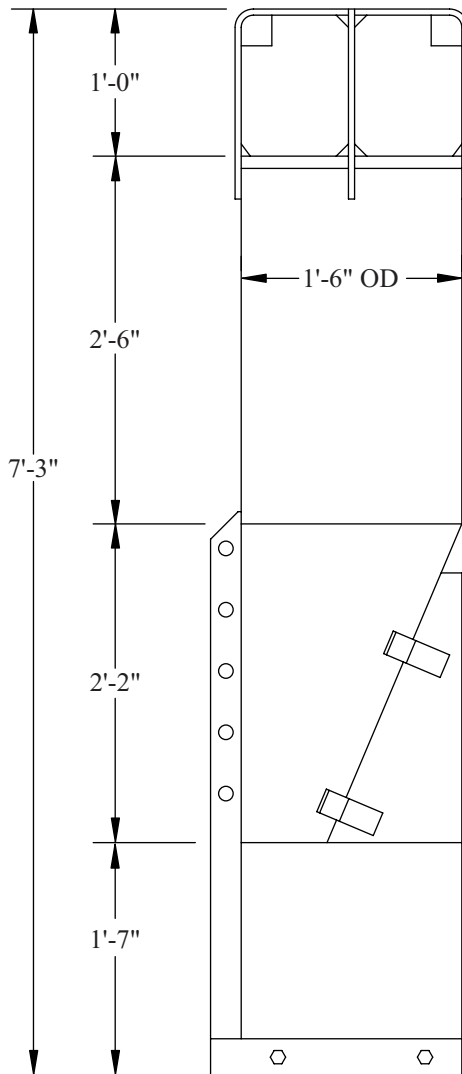
Chain Size	Max Mooring Depth
1/2"	50'

Reference Documents. (use latest rev.)

G-SEC Drawing No. 120990
G-SEC Specification No. 464

2.K. 26. 6CR. The 6CR is designed and constructed for use in rivers and other waterways where unlighted lateral buoys are required. The buoys are designed to shed debris and have multiple mooring eyes to remain vertical in a variety of fast water situations. These buoys are filled with polyurethane foam. Non-standard buoys are no longer in use.

a. Standard Buoy Arrangement. 1988 Type 6CR.



Physical Characteristics. (no mooring)

Buoy Weight	160 lbs.
Buoy Draft	3 ft. 10 in.
Freeboard	2 ft. 5 in.
Minimum Freeboard	6 in.
Pounds-Per-Inch Immersion	9

Related Equipment.

Mooring Chain	1/2 in.
Mooring Wire Rope	3/8 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

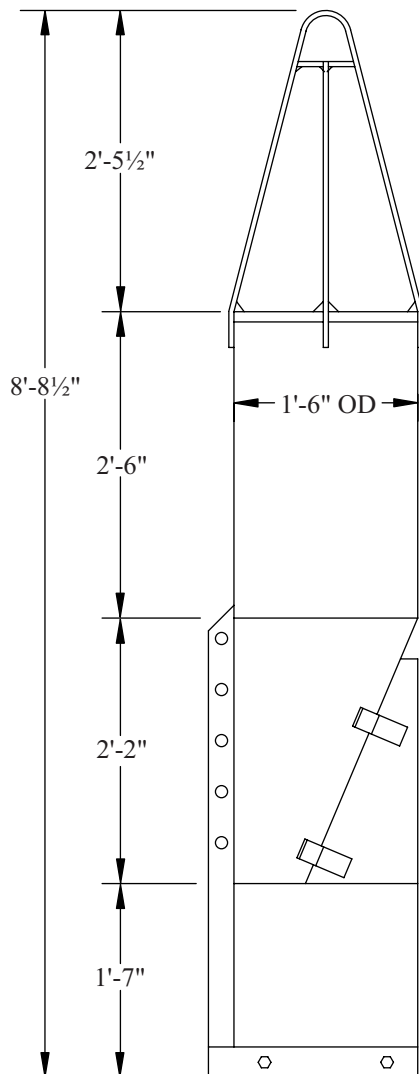
Daymark Visual Range	1 nm
Radar Range	1 nm
Mooring Depth (min.)	6 ft.
Mooring Depth (max. w/chain)	60 ft.

Reference Documents. (use latest rev.)

- G-SEC Drawing No. 121119
- G-SEC Specification No. 455

2.K. 27. 6NR. The 6NR is designed and constructed for use in rivers and other waterways where unlighted lateral buoys are required. The buoys are designed to shed debris and have multiple mooring eyes to remain vertical in a variety of fast water situations. These buoys are filled with polyurethane foam. Non-standard buoys are no longer in use.

a. Standard Buoy Arrangement. 1988 Type 6NR.



Physical Characteristics. (no mooring)

Buoy Weight	165 lbs.
Buoy Draft	3 ft. 10 in.
Freeboard	2 ft. 5 in.
Minimum Freeboard	6 in.
Pounds-Per-Inch Immersion	9

Related Equipment.

Mooring Chain	1/2 in.
Mooring Wire Rope	3/8 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

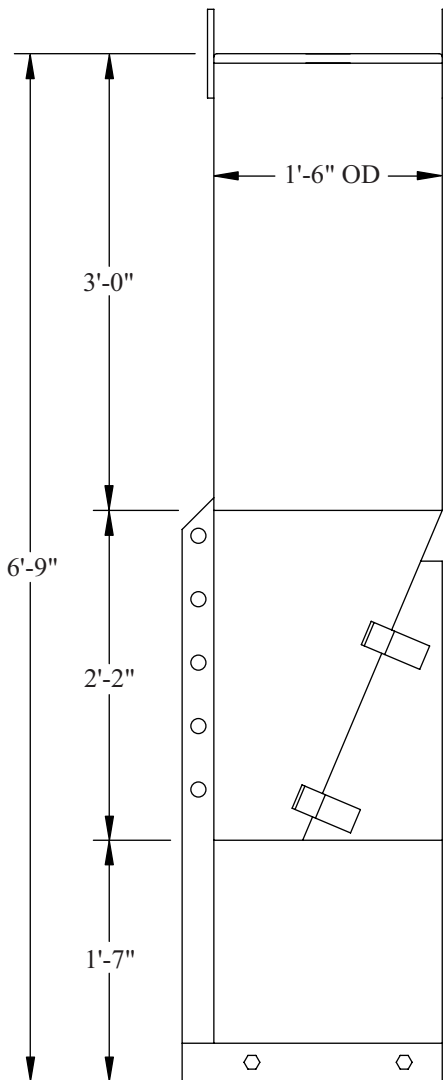
Daymark Visual Range	1 nm
Radar Range	1 nm
Mooring Depth (min.)	6 ft.
Mooring Depth (max. w/chain)	60 ft.

Reference Documents. (use latest rev.)

- G-SEC Drawing No. 121118
- G-SEC Specification No. 455

2.K. 28. 6CT. The 6CT is designed and constructed for use in the swiftest western rivers where unlighted lateral buoys are required. This "tall type" buoy has no radar reflector. The buoys are designed to shed debris and have multiple mooring eyes to remain vertical in a variety of fast water situations. These buoys are filled with polyurethane foam. Non-standard buoys are no longer in use.

a. Standard Buoy Arrangement. 1988 Type 6CT.



Physical Characteristics. (no mooring)

Buoy Weight	165 lbs.
Buoy Draft	4 ft.
Freeboard	2 ft. 9 in.
Minimum Freeboard	1 ft. 6 in.
Pounds-Per-Inch Immersion	9

Related Equipment.

Mooring Chain	1/2 in.
Mooring Wire Rope	3/8 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

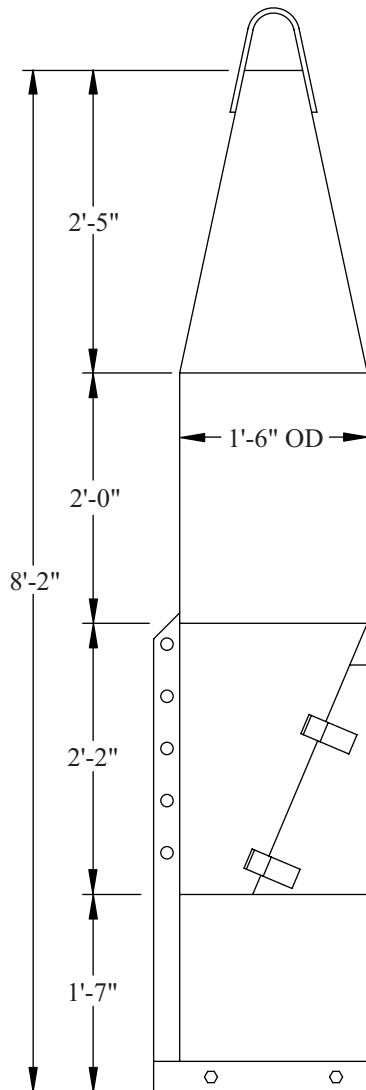
Daymark Visual Range	1 nm
Radar Range	0.5 nm
Mooring Depth (min.)	6 ft.
Mooring Depth (max. w/chain)	37 ft.

Reference Documents. (use latest rev.)

- G-SEC Drawing No. 121121
- G-SEC Specification No. 455

2.K. 29. 6NT. The 6NT is designed and constructed for use in the swiftest western rivers where unlighted lateral buoys are required. This "tall type" buoy has no radar reflector. The buoys are designed to shed debris and have multiple mooring eyes to remain vertical in a variety of fast water situations. These buoys are filled with polyurethane foam. Non-standard buoys are no longer in use.

a. Standard Buoy Arrangement. 1988 Type 6NT.



Physical Characteristics. (no mooring)

Buoy Weight	170 lbs.
Buoy Draft	4 ft.
Freeboard	4 ft. 2 in.
Minimum Freeboard	2 ft. 6 in.
Pounds-Per-Inch Immersion	9

Related Equipment.

Mooring Chain	1/2 in.
Mooring Wire Rope	3/8 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

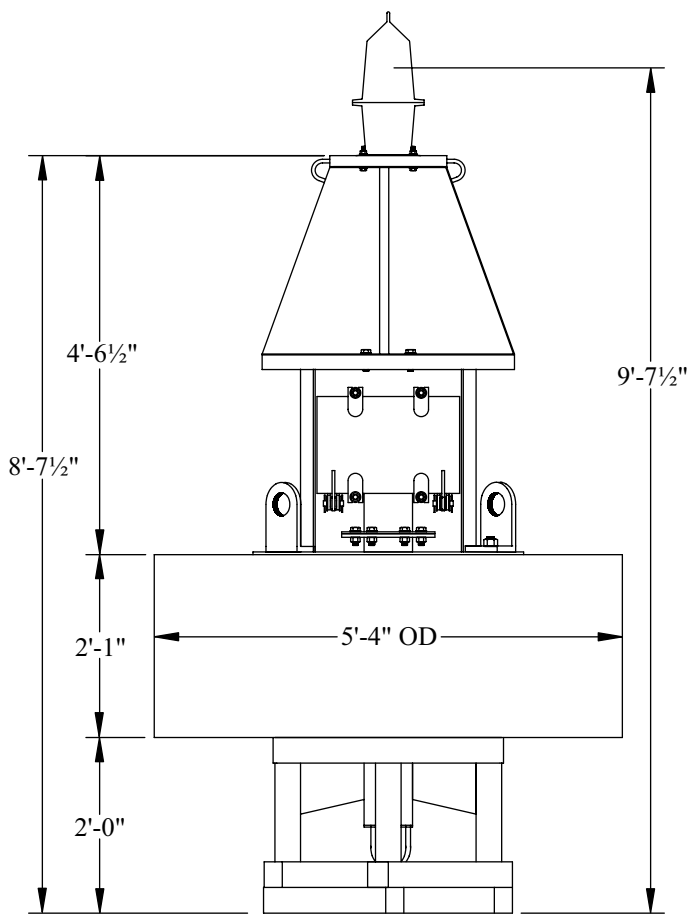
Daymark Visual Range	1 nm
Radar Range	0.5 nm
Mooring Depth (min.)	6 ft.
Mooring Depth (max. w/chain)	49 ft.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121120
G-SEC Specification No. 455

2.K. 30. 5X9LFR. The 5X9LFR is designed and constructed for protected locations. It is designed for use as a shallow water lighted buoy. The aluminum radar reflector has lateral significance. Can and nun tops are available. The buoy hull is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The tower and structural members are steel. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangements. 1991 Type 5X9LFR.



Physical Characteristics. (no mooring)

Buoy Weight	1,500 lbs.
Buoy Draft	2 ft. 9 in.
Focal Height of Light	6 ft. 7 in.
Freeboard	1 ft. 1 in.
Minimum Freeboard	5 in.
Pounds-Per-Inch Immersion	119

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	4,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	1.3 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1"	62'
7/8"	81'
3/4"	110'

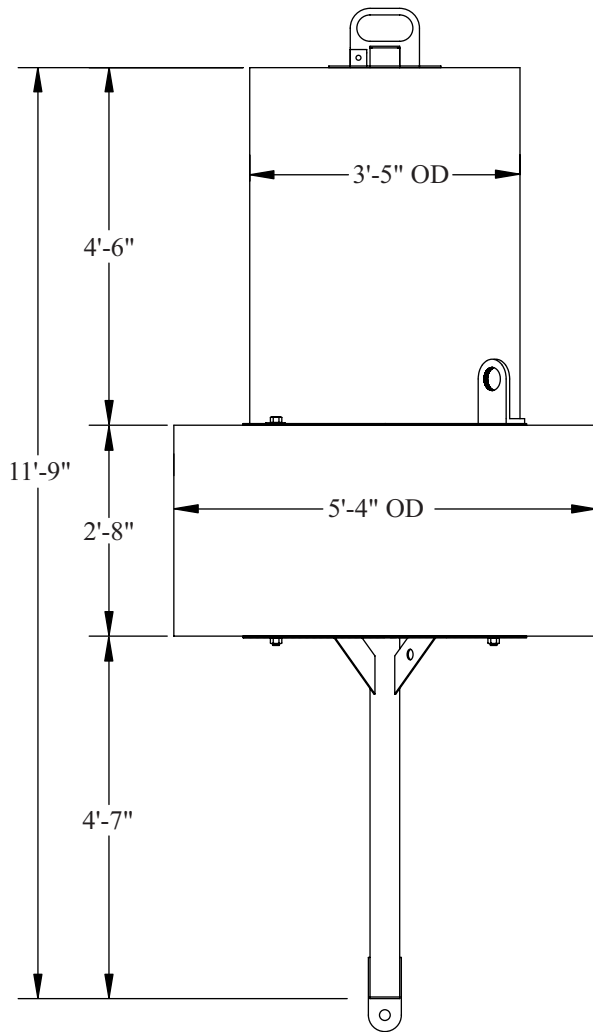
Reference Documents. (use latest rev.)

G-SEC Drawings:
 Complete Buoy No. 121148
 Nun Radar Reflector No. 120316
 Can Radar Reflector No. 121024
 G-SEC Specification No. 450

Data Sheet 2.K.30. 5X9LFR Buoy.

2.K. 31. 2CFR. The 2CFR is designed and constructed for exposed locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 2CFR.



Physical Characteristics. (no mooring)

Buoy Weight	1,100 lbs.
Buoy Draft	5 ft. 3 in.
Freeboard	2 ft.
Minimum Freeboard	10 in.
Pounds-Per-Inch Immersion	119

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.6 nm
Radar Range	1.5 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1 1/8"	91'
1"	115'
7/8"	149'
3/4"	204'

Reference Documents. (use latest rev.)

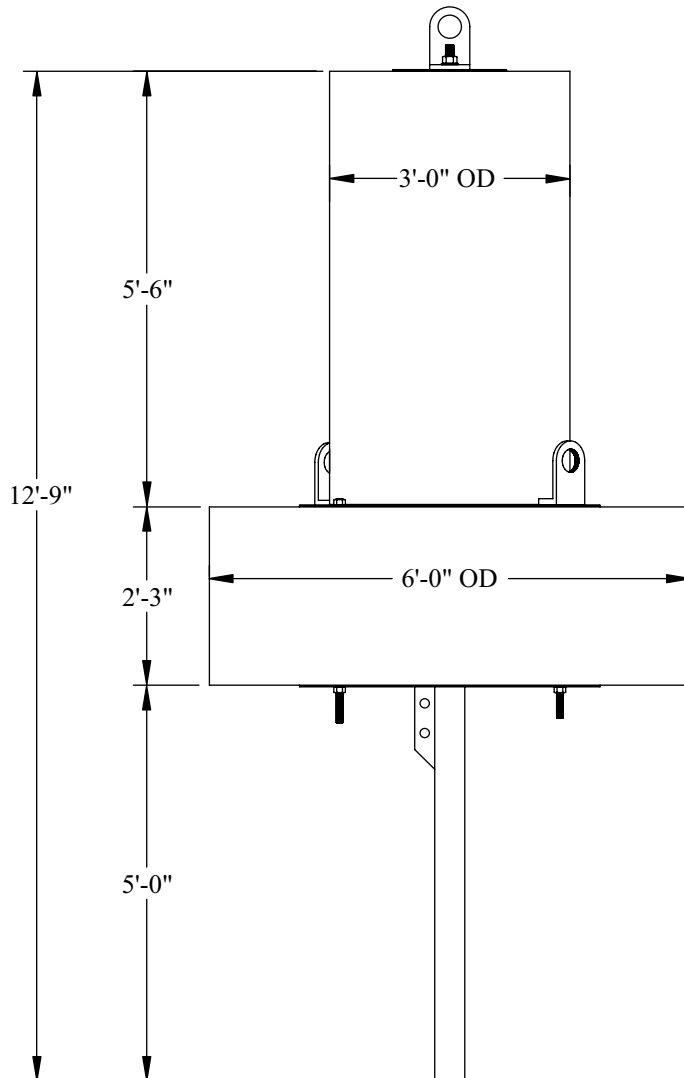
- G-SEC Drawing No. 121166
- G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide foam daymark onto the center pipe (retro up).
3. Push the top plate firmly against the daymark. Bolt the top plate to the top support gussets just below the lifting eye. Washers shall be placed between the bolt head and the gusset as well as between the lock nut and the gusset.

Data Sheet 2.K.31. 2CFR Buoy.

2.K.31. b. Non-Standard Buoy.

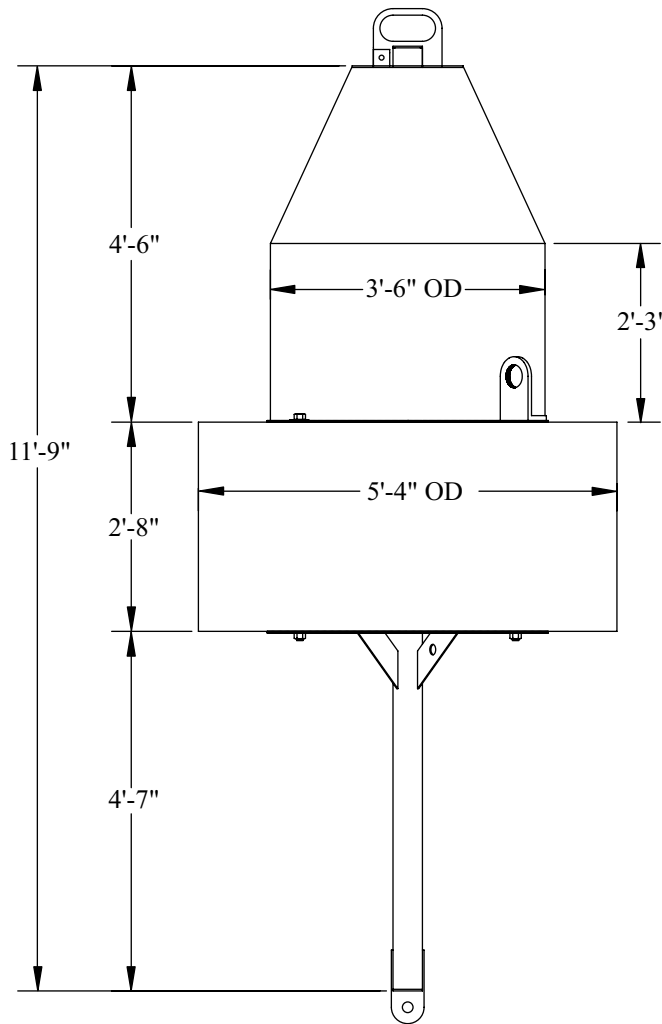


1989 TYPE
2CFR
BUOY WEIGHT: 820 lbs
DRAWING: 121122

Data Sheet 2.K.31. (cont'd).

2.K. 32. 2NFR. The 2NFR is designed and constructed for exposed locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 2NFR.



Physical Characteristics. (no mooring)

Buoy Weight	1,025 lbs.
Buoy Draft	5 ft. 3 in.
Freeboard	2 ft.
Minimum Freeboard	10 in.
Pounds-Per-Inch Immersion	119

Related Equipment.

Mooring Chain	3/4 in.
Sinker (concrete)	3,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.6 nm
Radar Range	1.5 nm
Mooring Depth (min.)	15 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1-1/8"	91'
1"	115'
7/8"	149'
3/4"	204'

Reference Documents. (use latest rev.)

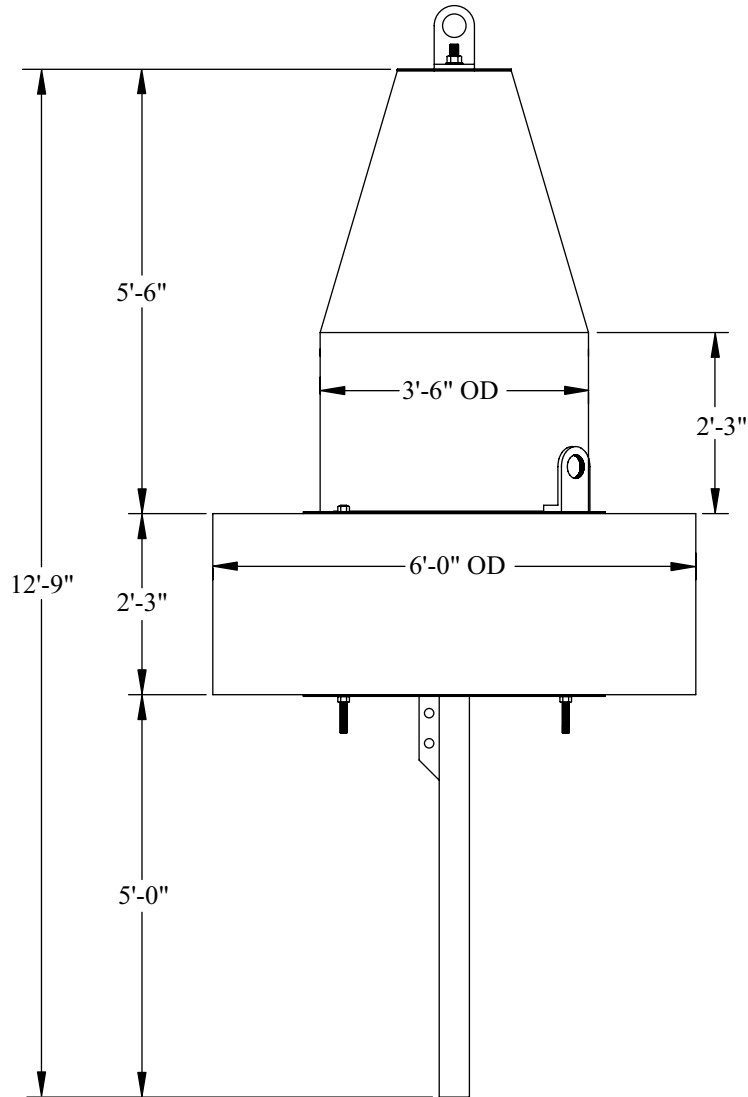
G-SEC Drawing No. 121166
G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide foam daymark onto the center pipe (retro up).
3. Push the top plate firmly against the daymark. Bolt the top plate to the top support gussets just below the lifting eye. Washers shall be placed between the bolt head and the gusset as well as between the lock nut and the gusset.

2.K.32.

b. Non-Standard Buoy.

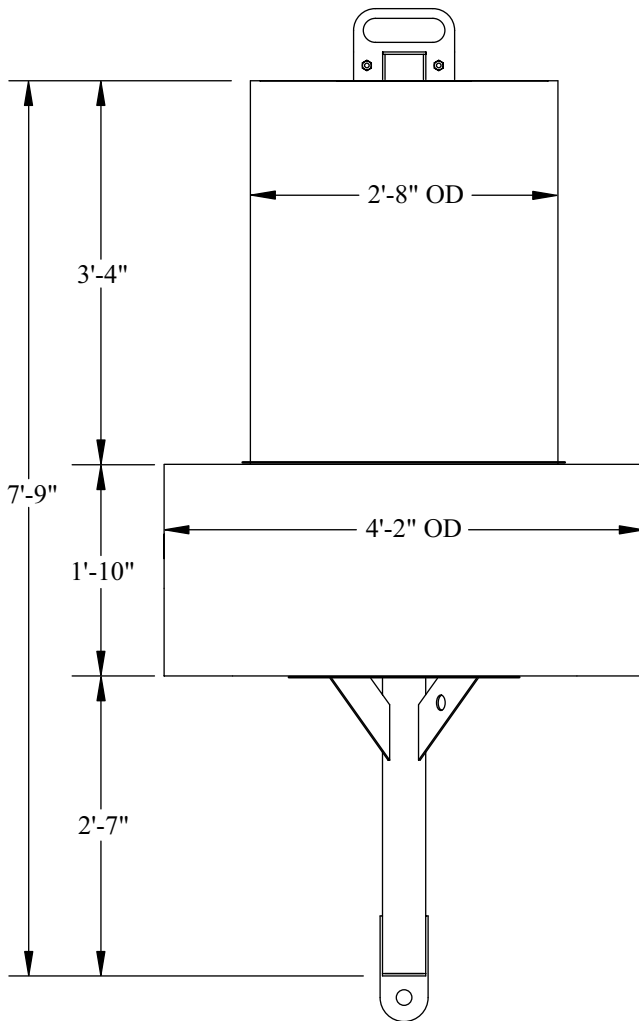


1989 TYPE
2NFR
BUOY WEIGHT: 820 lbs
DRAWING NO.: 121122

Data Sheet 2.K.32. (cont'd).

2.K. 33. 3CFR. The 3CFR is designed and constructed for semi-exposed locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 3CFR.



Physical Characteristics. (no mooring)

Buoy Weight	525 lbs.
Buoy Draft	3 ft. 1 in.
Freeboard	1 ft. 4 in.
Minimum Freeboard	6 in.
Pounds-Per-Inch Immersion	72

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.0 nm
Radar Range	1.5 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
7/8"	60'
3/4"	82'
1/2"	179'

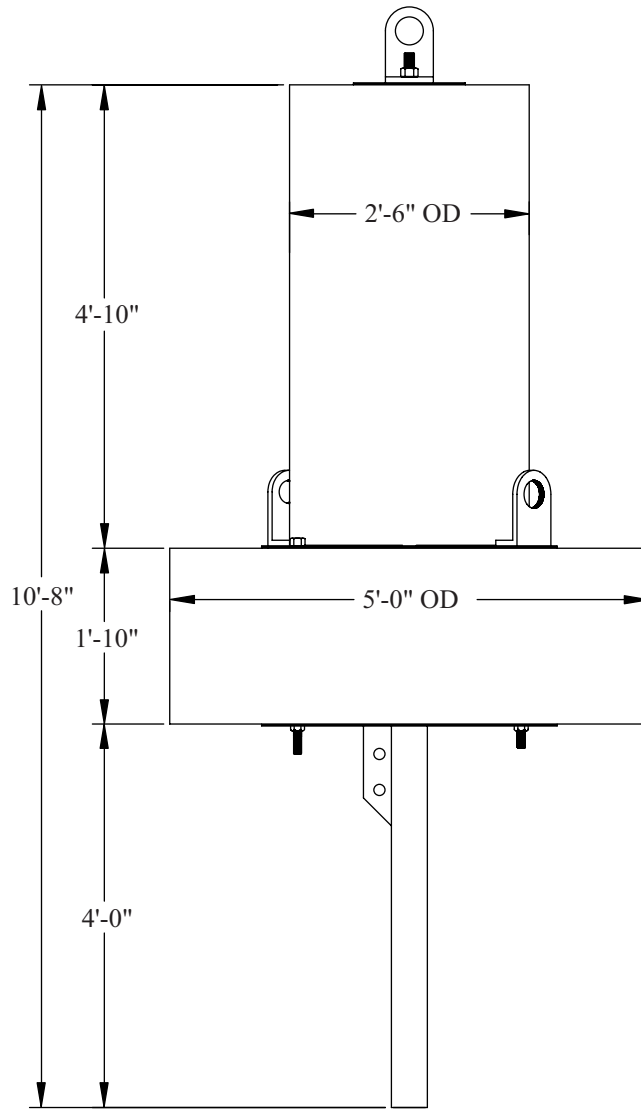
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121167
G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide foam daymark onto the center pipe (retro up).
3. Push the top plate firmly against the daymark. Bolt the top plate to the top support gussets just below the lifting eye. Washers shall be placed between the bolt head and the gusset as well as between the lock nut and the gusset.

2.K.33. b. Non-Standard Buoy.

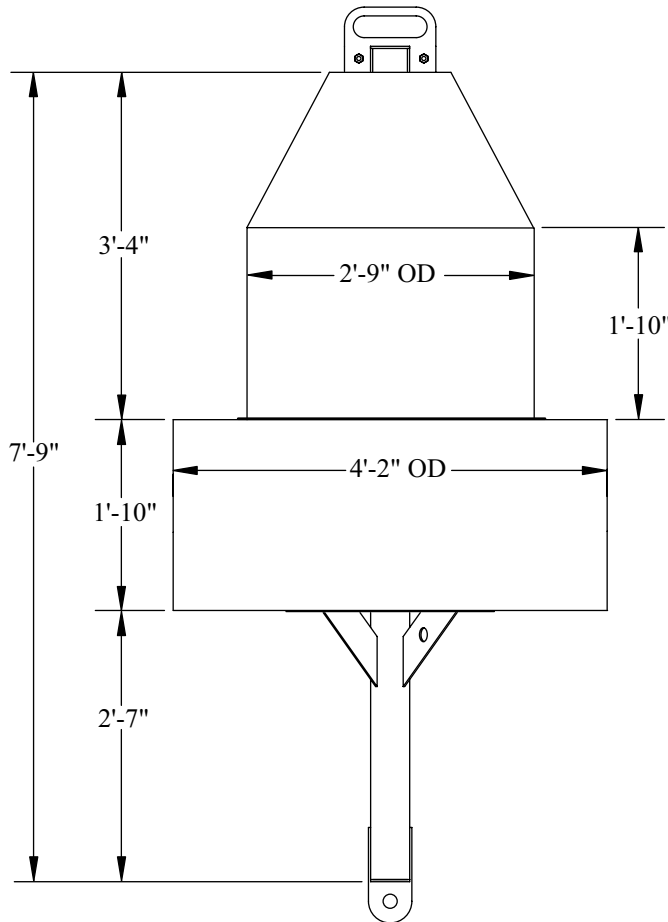


1989 TYPE
3CFR
BUOY WEIGHT: 530 lbs
DRAWING NO.: 121123

Data Sheet 2.K.33. (cont'd).

2.K. 34. 3NFR. The 3NFR is designed and constructed for semi-exposed locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 3NFR.



Physical Characteristics. (no mooring)

Buoy Weight	500 lbs.
Buoy Draft	3 ft. 1 in.
Freeboard	1 ft. 4 in.
Minimum Freeboard	6 in.
Pounds-Per-Inch Immersion	72

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	2,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	2.0 nm
Radar Range	1.5 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
7/8"	60'
3/4"	82'
1/2"	179'

Reference Documents. (use latest rev.)

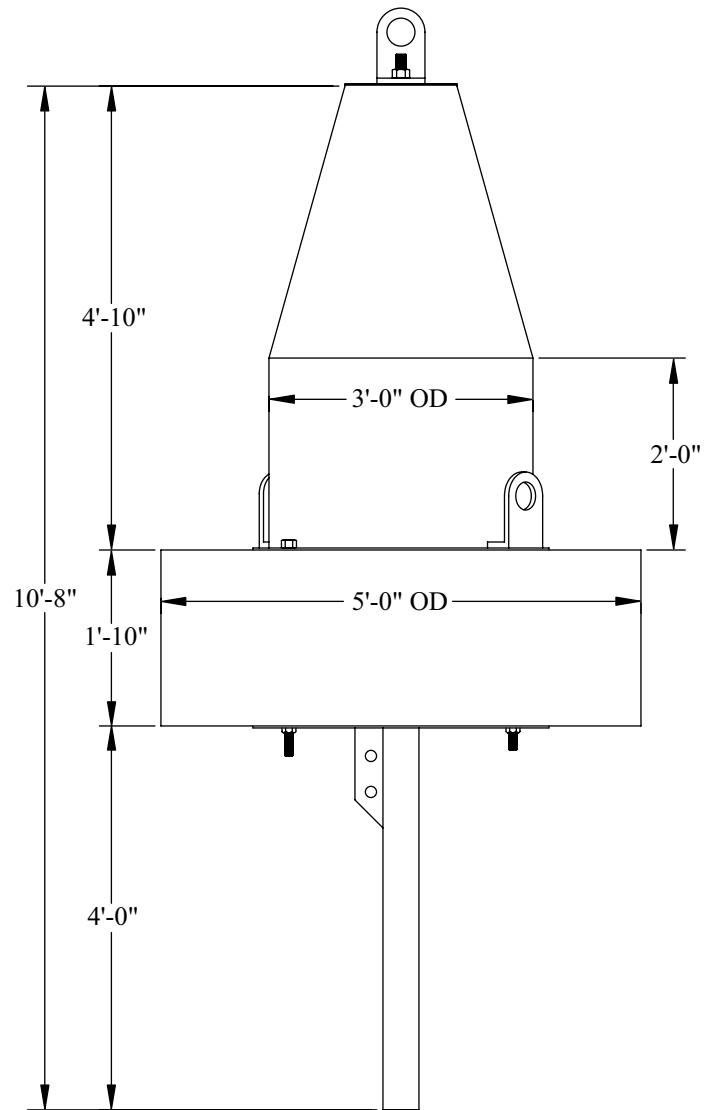
G-SEC Drawing No. 121167
G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide foam daymark onto the center pipe (retro up).
3. Push the top plate firmly against the daymark. Bolt the top plate to the top support gussets just below the lifting eye. Washers shall be placed between the bolt head and the gusset as well as between the lock nut and the gusset.

2.K.34.

b. Non-Standard Buoy.

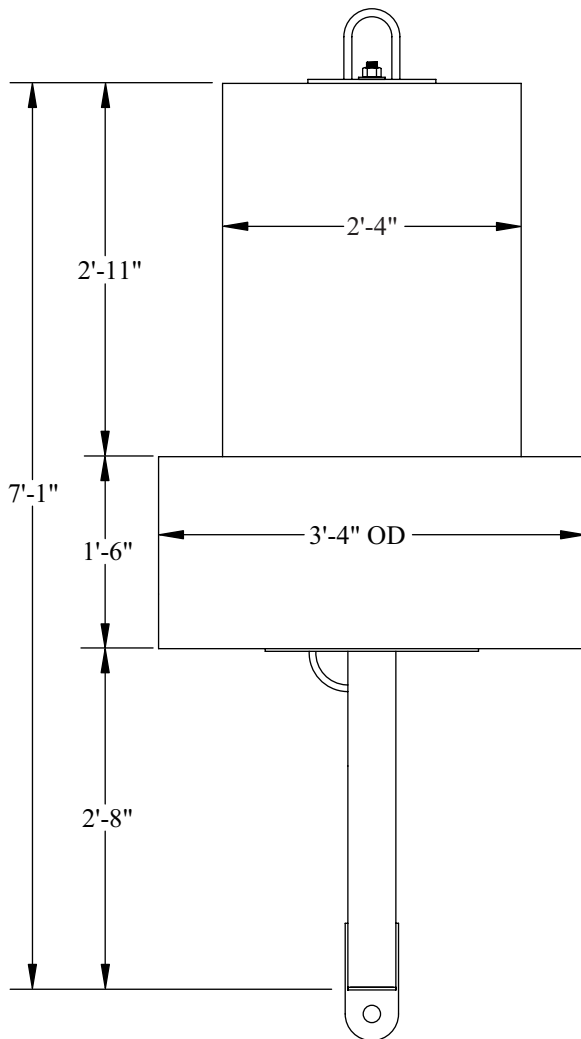


1989 TYPE
3NFR
BUOY WEIGHT: 530 lbs
DRAWING NO.: 121123

Data Sheet 2.K.34. (cont'd).

2.K. 35. 4CFR. The 4CFR is designed and constructed for semi-exposed locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 4CFR.



Physical Characteristics. (no mooring)

Buoy Weight	195 lbs.
Buoy Draft	2 ft. 10 in.
Freeboard	11 in.
Minimum Freeboard	4 in.
Pounds-Per-Inch Immersion	47

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	1,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	0.75 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
3/4"	37'
1/2"	80'

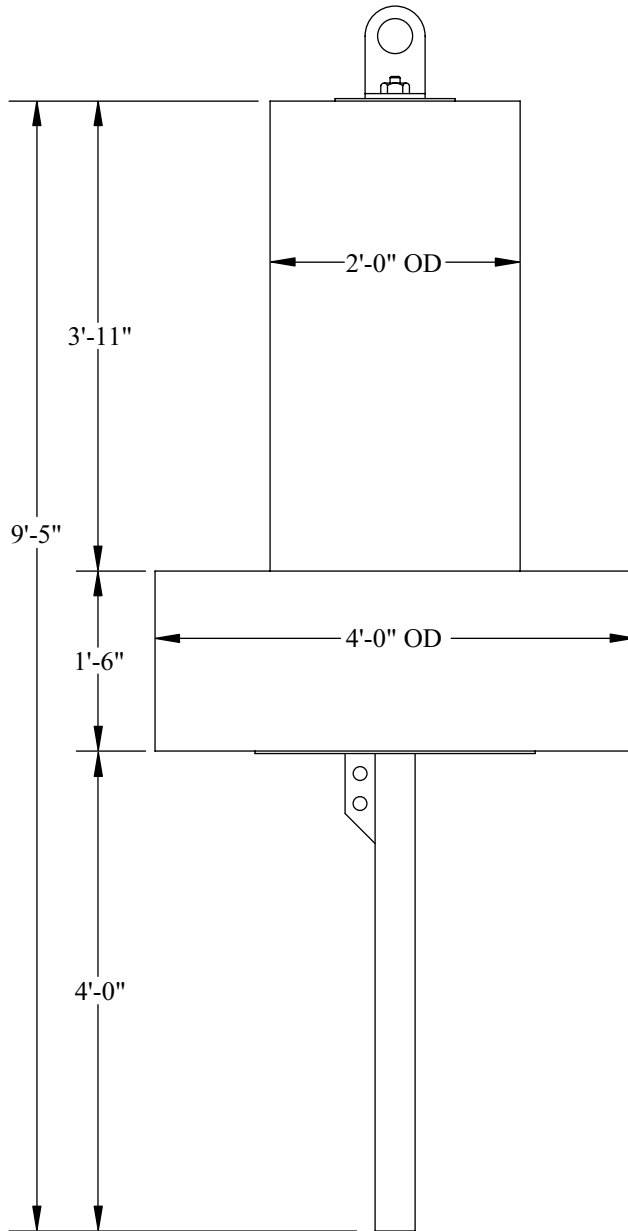
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121168
G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam flotation collar and then the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

2.K.35. b. Non-Standard Buoy.

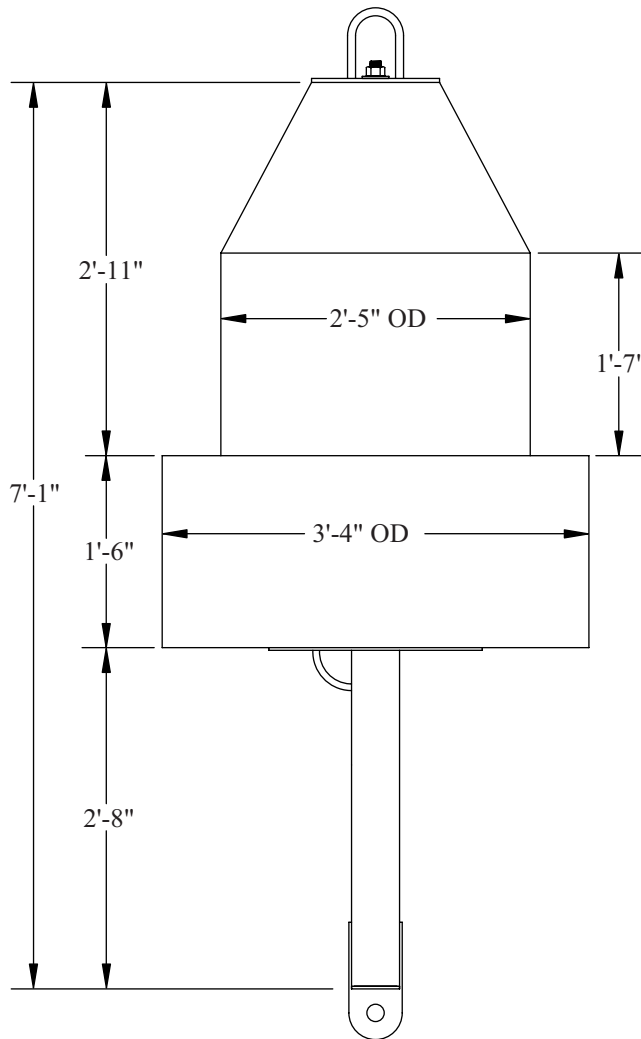


1989 TYPE
4CFR
BUOY WEIGHT: 232 lbs
DRAWING NO.: 121124

Data Sheet 2.K.35. (cont'd).

2.K. 36. 4NFR. The 4NFR is designed and constructed for semi-exposed locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 4NFR.



Physical Characteristics. (no mooring)

Buoy Weight	180 lbs.
Buoy Draft	2 ft. 10 in.
Freeboard	11 in.
Minimum Freeboard	4 in.
Pounds-Per-Inch Immersion	47

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	1,000 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.4 nm
Radar Range	0.75 nm
Mooring Depth (min.)	10 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
3/4"	37'
1/2"	80'

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121168

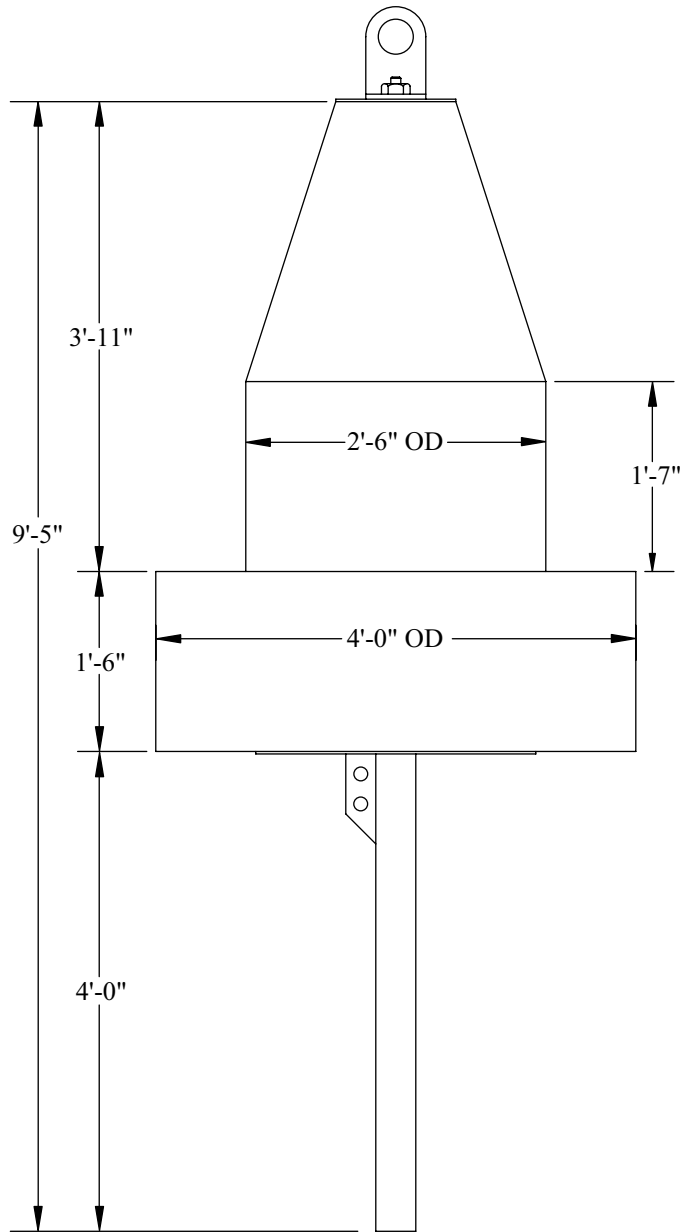
G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam flotation collar and then the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

2.K.36.

b. Non-Standard Buoy.

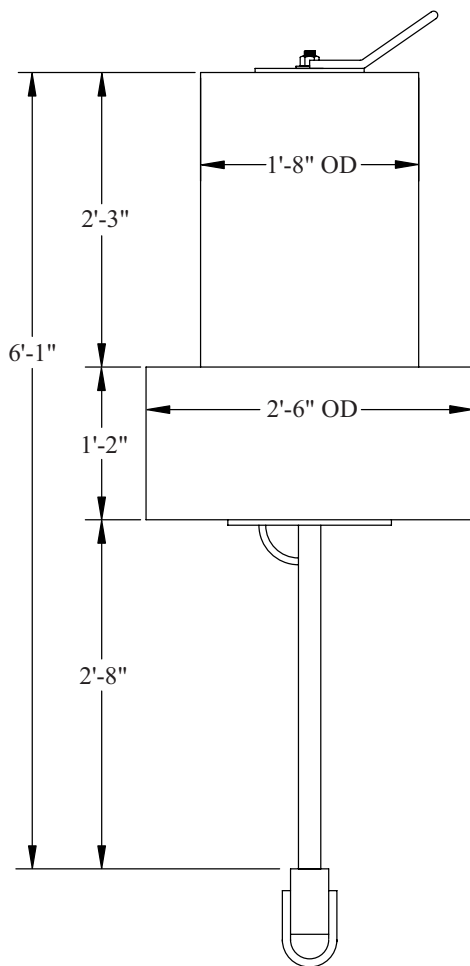


1989 TYPE
4NFR
BUOY WEIGHT: 232 lbs
DRAWING NO.: 121124

Data Sheet 2.K.36. (cont'd).

2.K. 37. 5CFR. The 5CFR is designed and constructed for protected locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present. The lifting eye plate is designed to accommodate the self-contained LED lantern described in Chapter 6 of this manual. In this configuration, the 5CFR can be deployed as a lighted discrepancy buoy. This buoy/lantern combination is the authorized replacement for the plastic discrepancy buoy shown on Data Sheet 2.K.45.

a. Standard Buoy Arrangement. 2000 Type 5CFR.



Physical Characteristics. (no mooring)

Buoy Weight	115 lbs.
Buoy Draft	3 ft. 0 in.
Freeboard	10 in.
Minimum Freeboard	4 in.
Pounds-Per-Inch Immersion	26

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.2 nm
Radar Range	0.5 nm
Mooring Depth (min)	6 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	40'

Reference Documents. (use latest rev.)

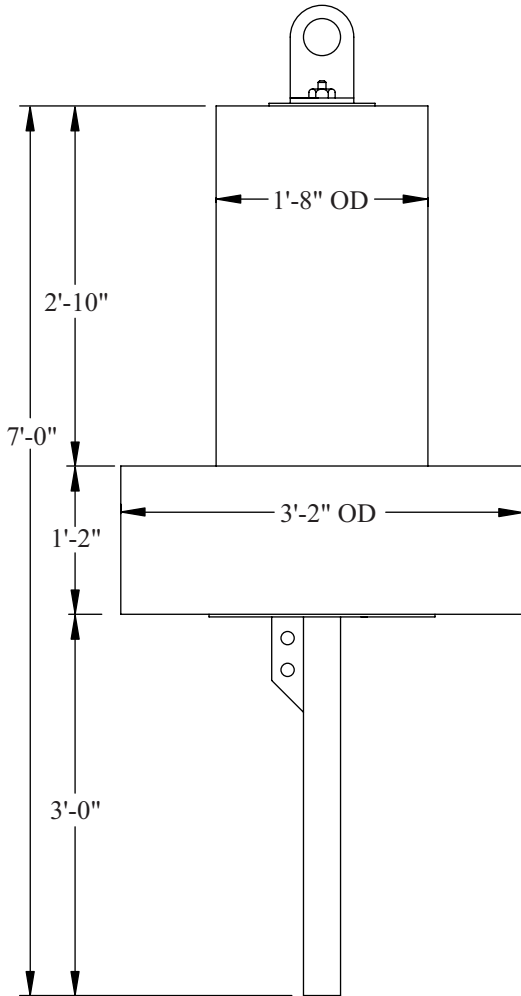
- G-SEC Drawing No. 121169
- G-SEC Specification No. 450

Assembly Instructions.

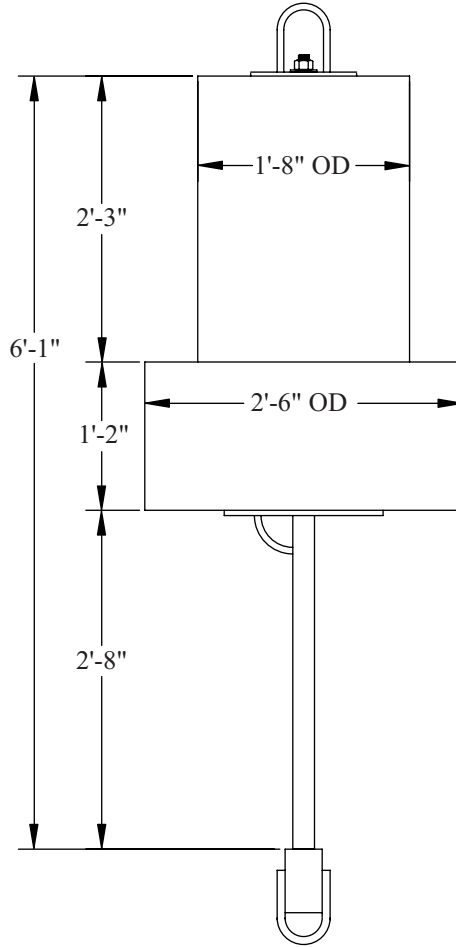
1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam flotation collar and then the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

Data Sheet 2.K.37. 5CFR Buoy.

2.K.37. b. Non-Standard Buoy.



1989 TYPE
5CFR
BUOY WEIGHT: 147 lbs
DRAWING NO.: 121125

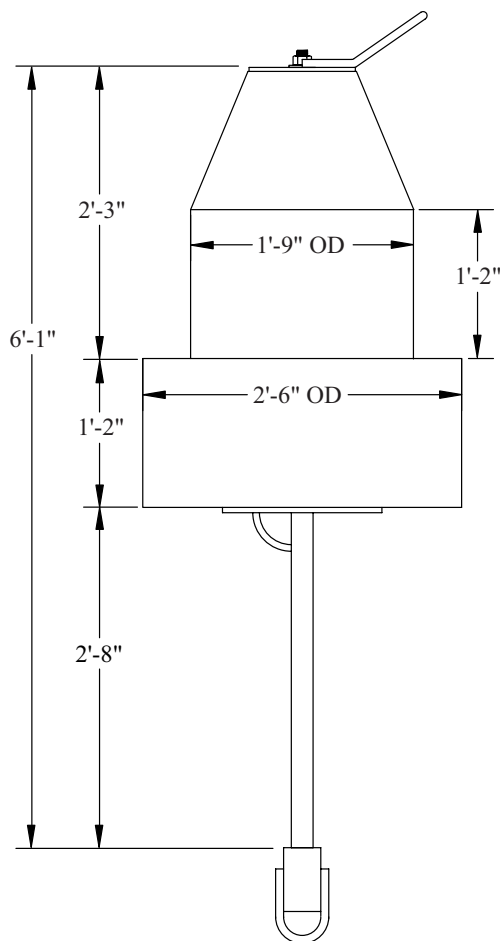


1995 TYPE
5CFR
BUOY WEIGHT: 115 lbs
DRAWING NO.: 121169

Data Sheet 2.K.37. (cont'd).

2.K. 38. 5NFR. The 5NFR is designed and constructed for protected locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present. The lifting eye plate is designed to accommodate the self-contained LED lantern described in Chapter 6 of this manual. In this configuration, the 5NFR can be deployed as a lighted discrepancy buoy. This buoy/lantern combination is the authorized replacement for the plastic discrepancy buoy shown on Data Sheet 2.K.45.

a. Standard Buoy Arrangement. 1995 Type 5NFR.



Physical Characteristics. (no mooring)

Buoy Weight	115 lbs.
Buoy Draft	3 ft. 0 in.
Freeboard	10 in.
Minimum Freeboard	4 in.
Pounds-Per-Inch Immersion	26

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.2 nm
Radar Range	0.5 nm
Mooring Depth (min.)	6 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	40'

Reference Documents. (use latest rev.)

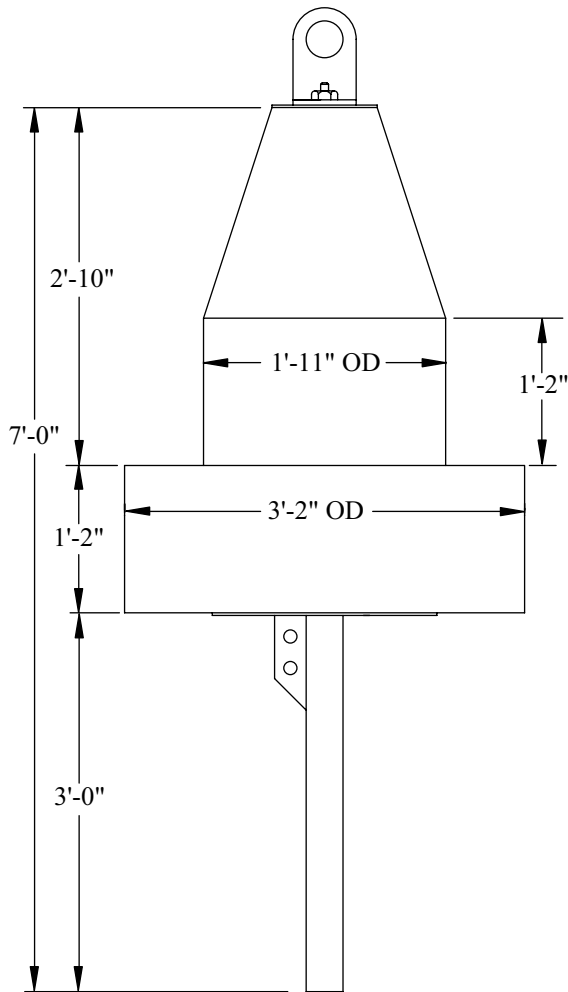
- G-SEC Drawing No. 121169
- G-SEC Specification No. 450

Assembly Instructions.

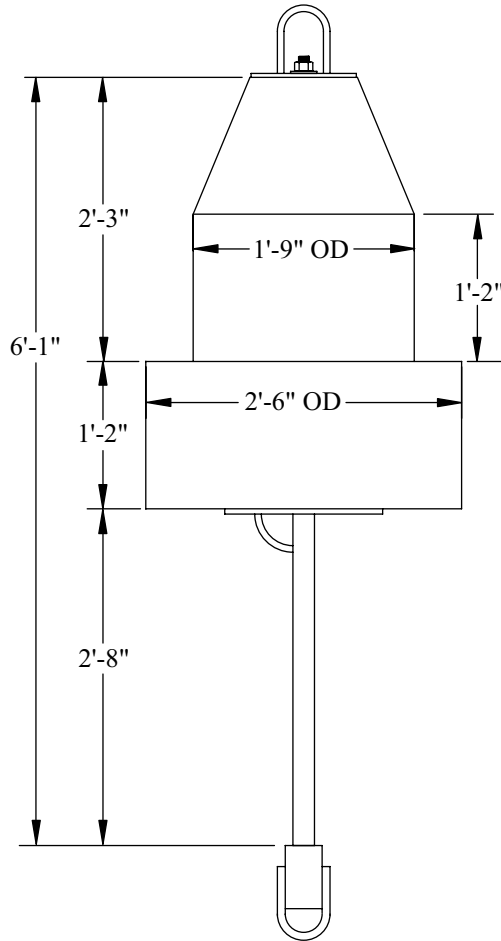
1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam flotation collar and then the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

Data Sheet 2.K.38. 5NFR Buoy.

2.K.38. b. Non-Standard Buoy.



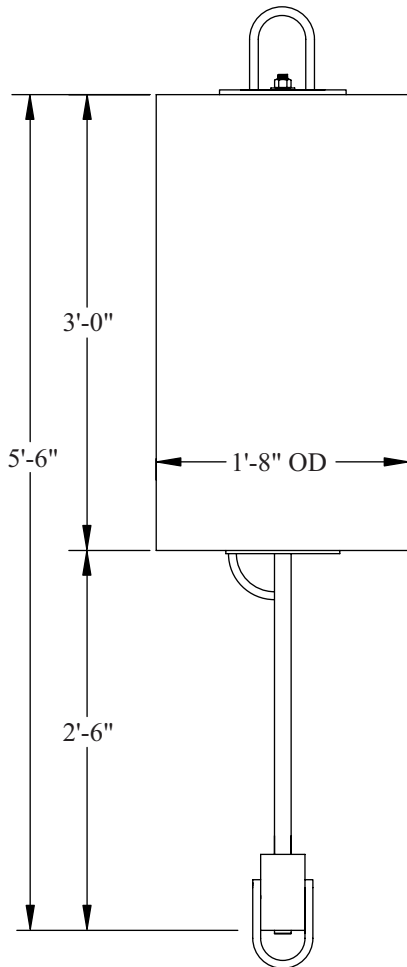
1989 TYPE
5NFR
BUOY WEIGHT: 147 lbs
DRAWING NO.: 121125



1995 TYPE
5NFR
BUOY WEIGHT: 115 lbs
DRAWING NO.: 121169

2.K. 39. 6CFR. The 6CFR is designed and constructed for the most protected locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 6CFR.



Physical Characteristics. (no mooring)

Buoy Weight	65 lbs.
Buoy Draft	3 ft.
Freeboard	2 ft. 6 in.
Minimum Freeboard	1 ft. 4 in.
Pounds-Per-Inch Immersion	12

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.0 nm
Radar Range	0.4 nm
Mooring Depth (min.)	6 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	21'

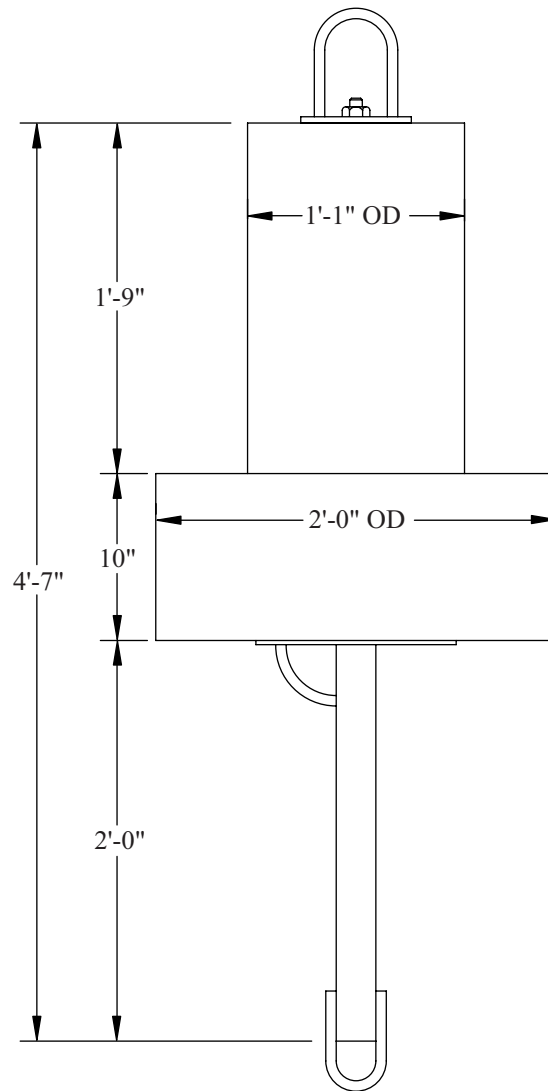
Reference Documents. (use latest rev.)

- G-SEC Drawing No. 121171
- G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

2.K.39. b. Non-Standard Buoy.

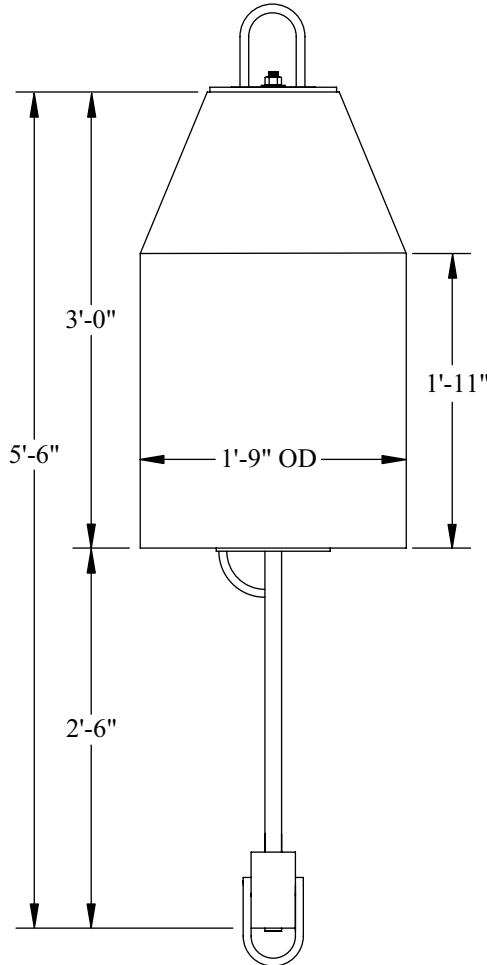


1989 TYPE
6CFR
BUOY WEIGHT: 40 lbs
DRAWING NO.: 121126

Data Sheet 2.K.39. (cont'd).

2.K. 40. 6NFR. The 6NFR is designed and constructed for the most protected locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 1995 Type 6NFR.



Physical Characteristics. (no mooring)

Buoy Weight	70 lbs.
Buoy Draft	3 ft.
Freeboard	2 ft. 6 in.
Minimum Freeboard	1 ft. 4 in.
Pounds-Per-Inch Immersion	12

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1.0 nm
Radar Range	0.4 nm
Mooring Depth (min.)	6 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	21'

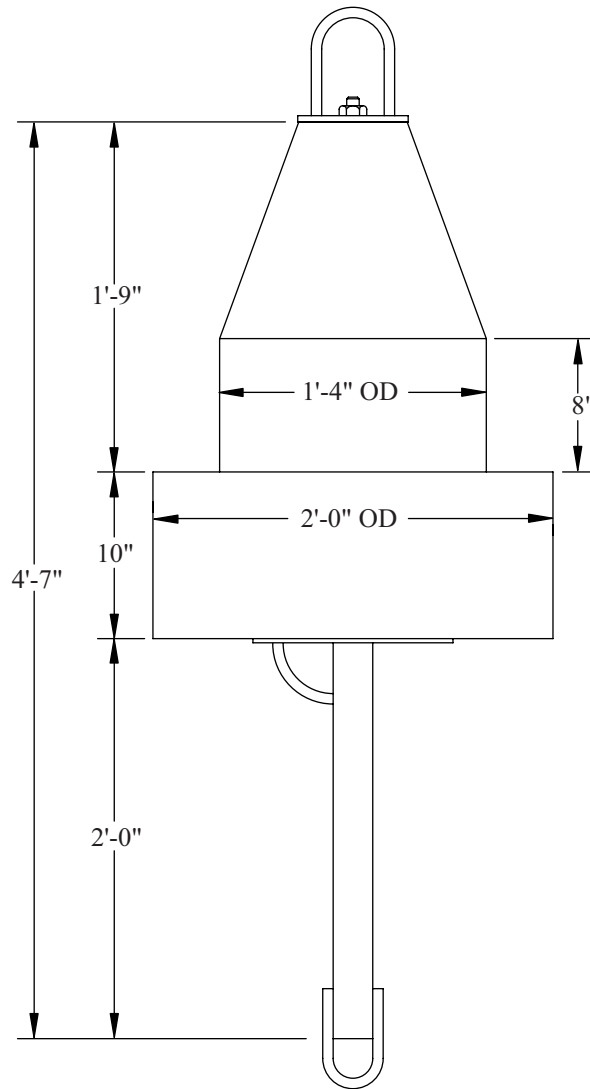
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121171
G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

2.K.40. b. Non-Standard Buoy.

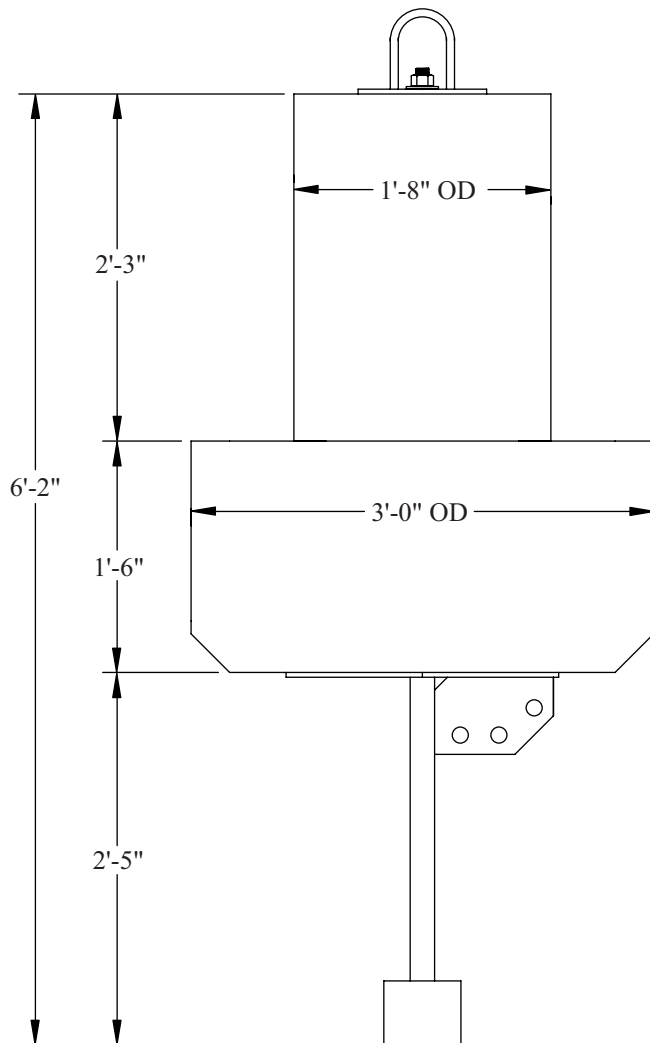


1989 TYPE
6NFR
BUOY WEIGHT: 40 lbs
DRAWING NO.: 121126

Data Sheet 2.K.40. (cont'd).

2.K. 41. FWCFR. The FWCFR buoy is designed and constructed for fast water locations where unlighted lateral buoys are required. This buoy is constructed of concentrically-wrapped sheets of ionomer foam with a "densified" outer surface for abrasion resistance. The structural members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 2002 Type FWCFR.



Physical Characteristics. (no mooring)

Buoy Weight	207 lbs.
Buoy Draft	1 ft. 1 in.
Freeboard	1 ft.
Minimum Freeboard	5 in.
Pounds-Per-Inch Immersion	38

Related Equipment.

Mooring Chain	1/2 in.
Wire Rope	1/2 in.
Sinker (concrete)	1000+ lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1 nm
Radar Range	0.5 nm
Mooring Depth (min.)	3 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	71'

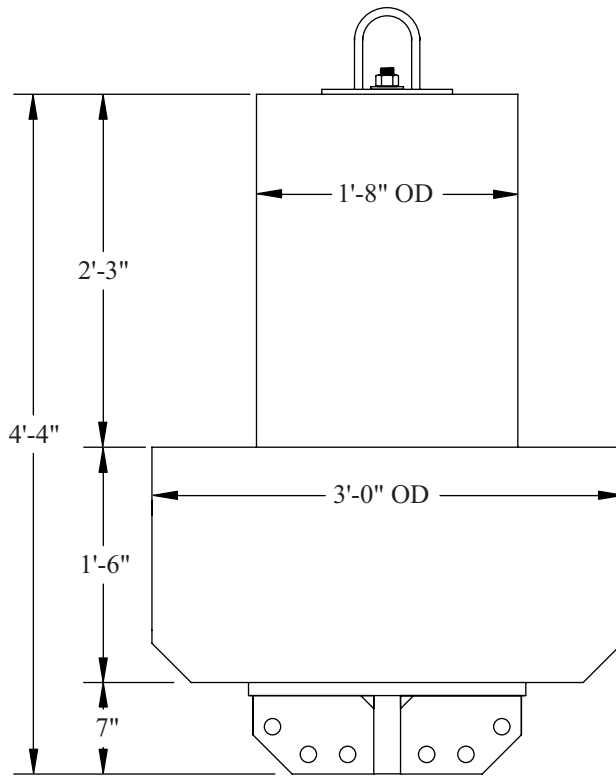
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121170
 G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

2.K.41. b. Non-Standard Buoy.

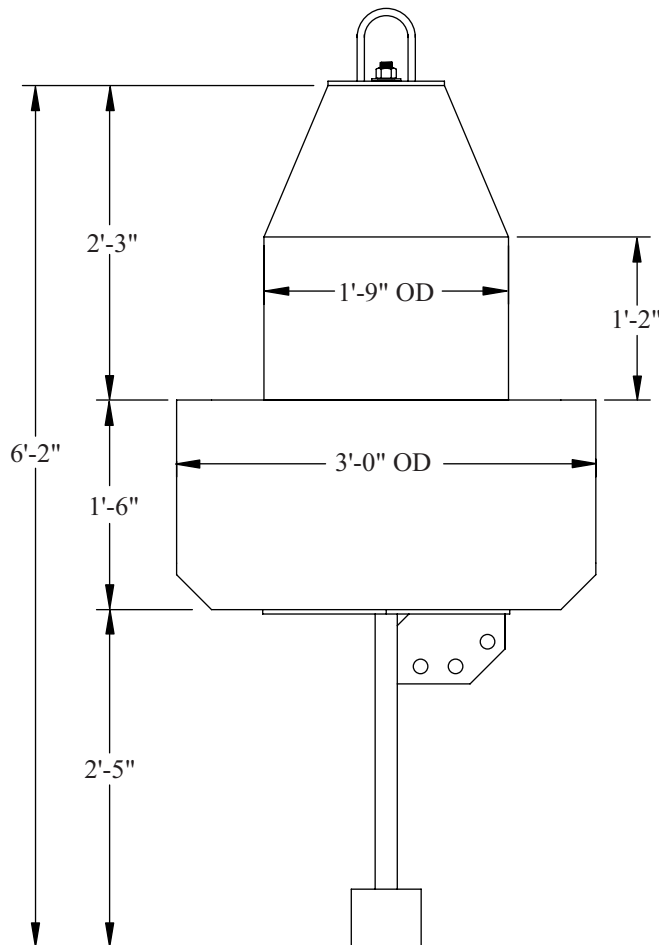


1995 TYPE
FWCFR
BUOY WEIGHT: 200 lbs.
DRAWING NO.: 121170

Data Sheet 2.K.41. (cont'd).

2.K. 42. FWNFR. The FWNFR buoy is designed and constructed for fast water locations where unlighted lateral buoys are required. This buoy is constructed of concentrically wrapped sheets of ionomer foam with a densified outer surface for abrasion resistance. The strength members are galvanized steel. The radar reflector is internal. This buoy is not suitable for use where ice is present.

a. Standard Buoy Arrangement. 2002 Type FWNFR.



Physical Characteristics. (no mooring)

Buoy Weight	203 lbs.
Buoy Draft	1 ft. 1 in.
Freeboard	1 ft.
Minimum Freeboard	5 in.
Pounds-Per-Inch Immersion	38

Related Equipment.

Mooring Chain	1/2 in.
Wire Rope	1/2 in.
Sinker (concrete)	1000+ lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1 nm
Radar Range	0.5 nm
Mooring Depth (min.)	3 ft.

Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	71'

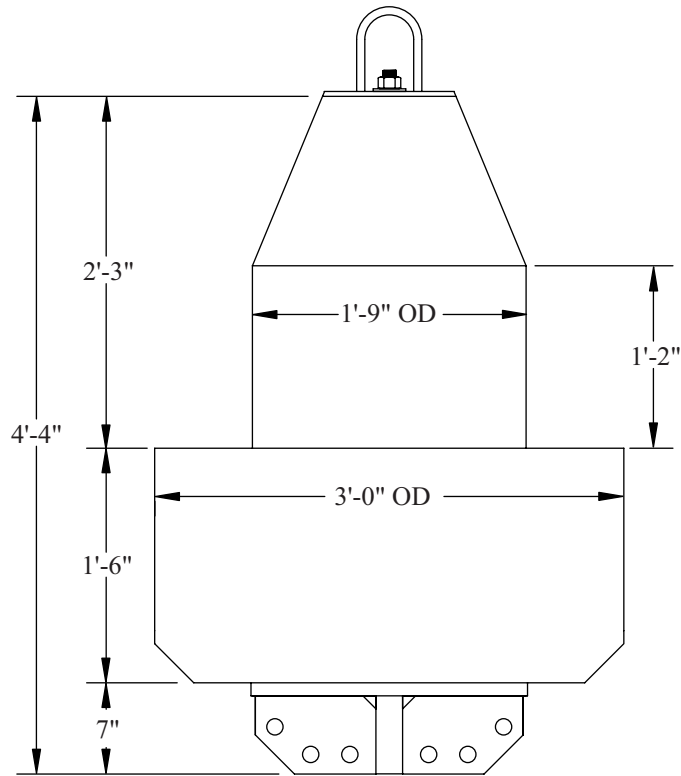
Reference Documents. (use latest rev.)

- G-SEC Drawing No. 121170
- G-SEC Specification No. 450

Assembly Instructions.

1. See general assembly guidelines in paragraph 2.F.1.
2. Slide the foam daymark (retro up) onto the center pipe.
3. Push the lifting eye plate firmly against the daymark. Bolt the lifting eye plate to the top of the center pipe. Place a washer between the lock nut and the lifting eye plate.

2.K.42. b. Non-Standard Buoy.

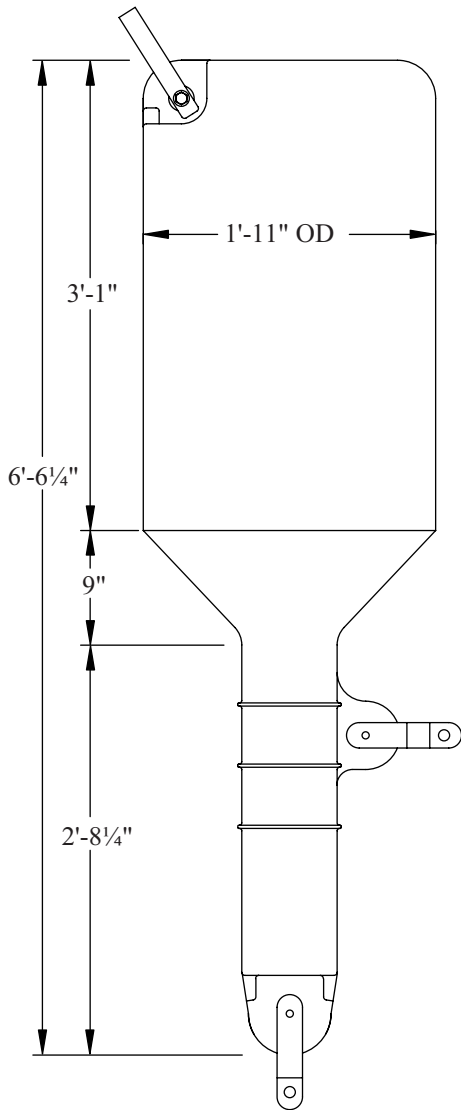


1995 TYPE
FWNFR
BUOY WEIGHT: 195 lbs.
DRAWING NO.: 121170

Data Sheet 2.K.42. (cont'd).

- 2.K. 43. 5CPR. The 5CPR is designed and constructed for use in protected locations where unlighted lateral buoys are required. A typical application would be as a temporary unlighted discrepancy buoy. This buoy is constructed of a hard shell plastic body filled with polyurethane foam. The mooring and lifting eyes are stainless steel. The radar reflector is internal. This buoy is not suitable for use where ice is present. It replaces the old style 5CPR and 6CPR buoys.

a. Standard Buoy Arrangement. 1996 Type 5CPR.



Physical Characteristics. (no mooring)

Buoy Weight	114 lbs.
Buoy Draft	3 ft 6 in.
Freeboard	3 ft.
Minimum Freeboard	2 ft. 1 in.
Pounds-Per-Inch Immersion	15

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1 nm
Radar Range	0.5 nm
Mooring Depth (min.)	7 ft.

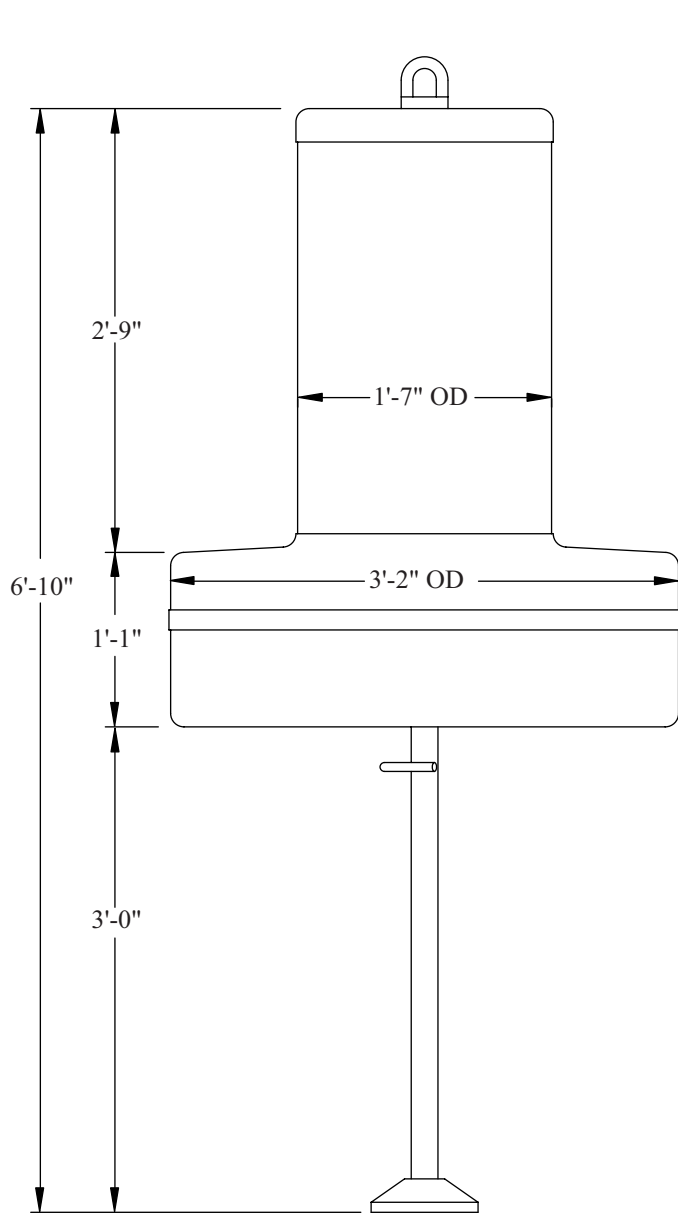
Maximum Mooring Depth.

Chain Size	Max Mooring Depth
1/2"	35'

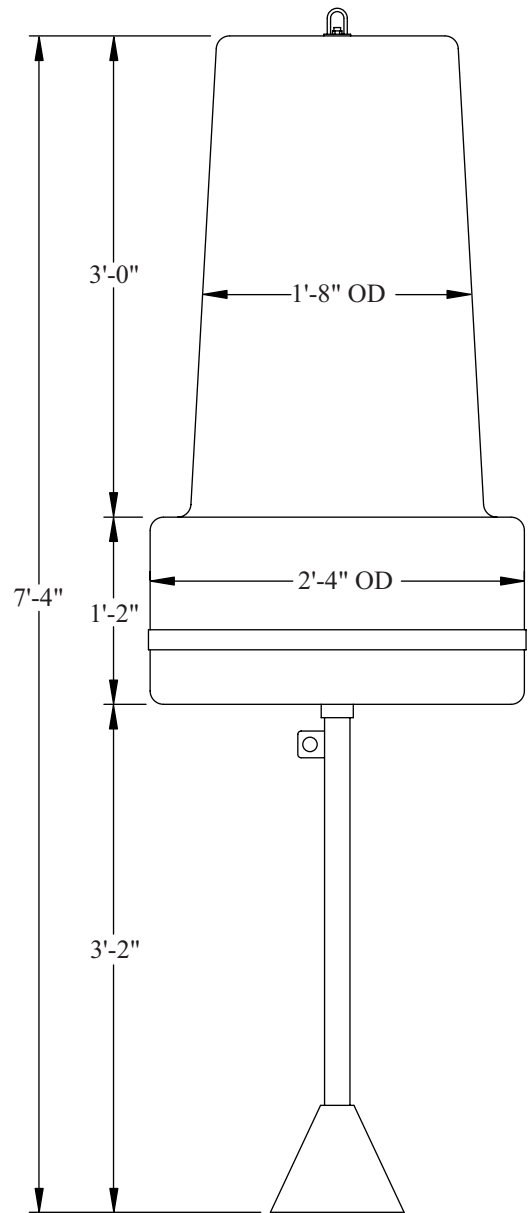
Reference Documents. (use latest rev.)

G-SEC Drawing No. 121172
G-SEC Specification No. 491

2.K.43. b. Non-Standard Buoy (Old style 5CPR).



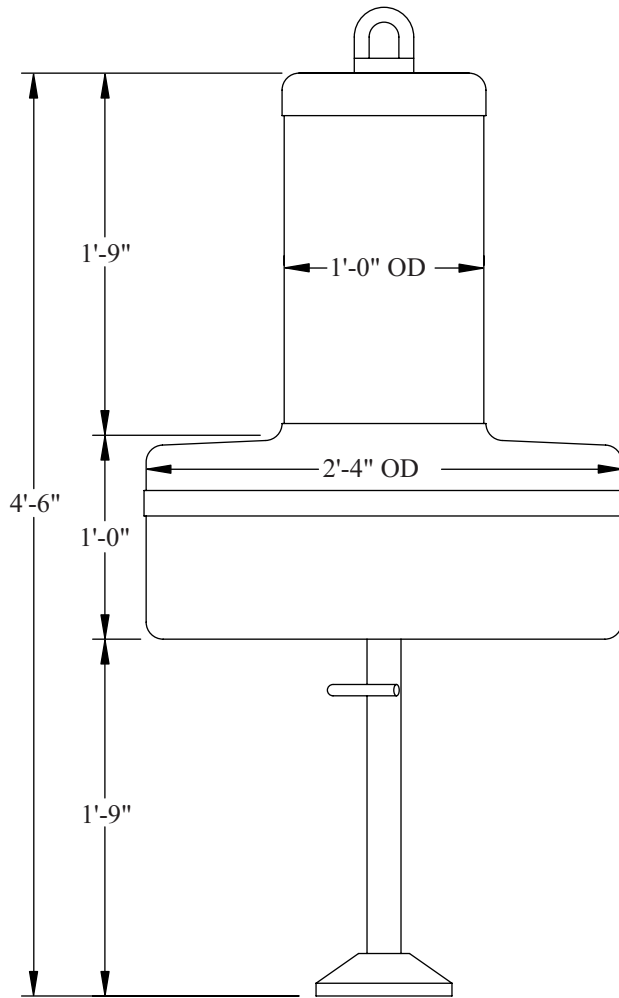
1972 ROLYAN TYPE
5CPR
WEIGHT: 121 LBS
DRAWING NO.: 120330



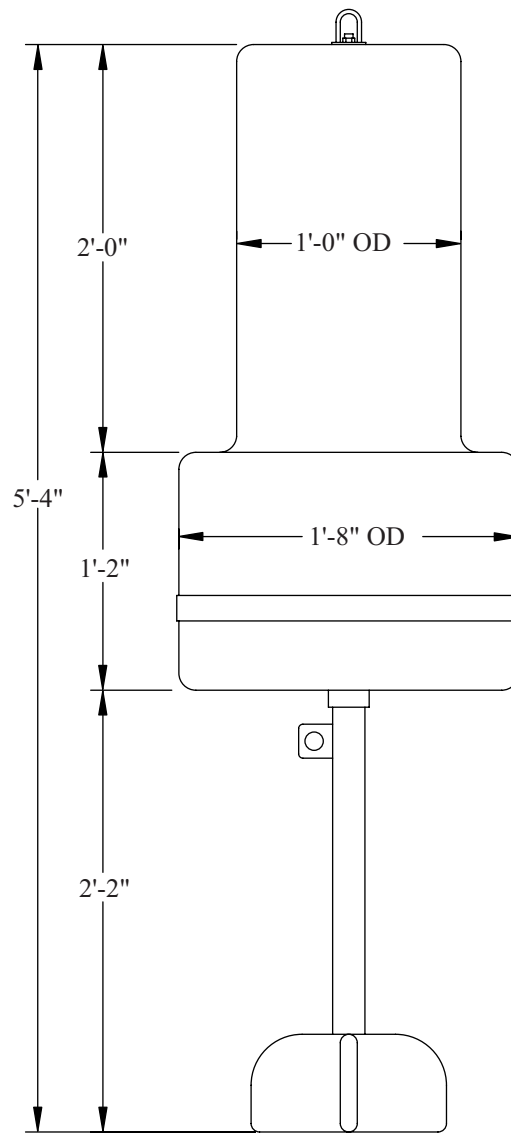
1973 AUTOMATIC POWER TYPE
5CPR
WEIGHT: 140 LBS
DRAWING NO.: 120334

Data Sheet 2.K.43. (cont'd).

2.K.43. c. Non-Standard Buoy (Old style 6CPR).



1972 ROLYAN TYPE
6CPR
WEIGHT: 58 LBS
DRAWING NO.: 120328

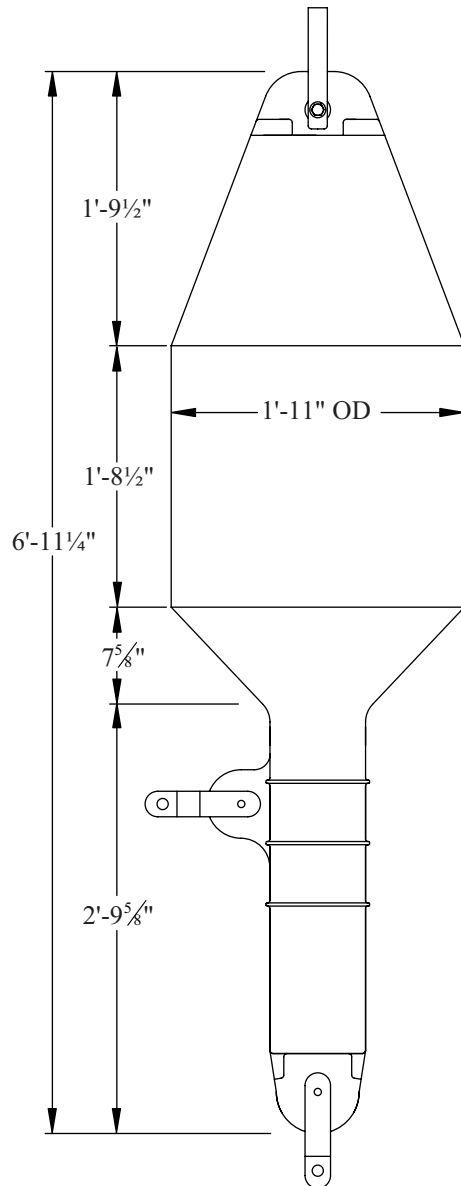


1973 AUTOMATIC POWER TYPE
6CPR
WEIGHT: 76 LBS
DRAWING NO.: 120332

Data Sheet 2.K.43. (cont'd).

2.K. 44. 5NPR. The 5NPR is designed and constructed for use in protected locations where unlighted lateral buoys are required. A typical application would be as a temporary unlighted discrepancy buoy. This buoy is constructed of a hard shell plastic body filled with polyurethane foam. The mooring and lifting eyes are stainless steel. The radar reflector is internal. This buoy is not suitable for use where ice is present. It replaces the old style 5NPR and 6CPR buoys.

a. Standard Buoy Arrangement. 1996 Type 5NPR.



Physical Characteristics. (no mooring)

Buoy Weight	114 lbs.
Buoy Draft	3 ft. 6 in.
Freeboard	3 ft.
Minimum Freeboard	2 ft. 1 in.
Pounds-Per-Inch Immersion	15

Related Equipment.

Mooring Chain	1/2 in.
Sinker (concrete)	500 lbs.

Operational Characteristics. (nominal)

Daymark Visual Range	1 nm
Radar Range	0.5 nm
Mooring Depth (min.)	7 ft.

Maximum Mooring Depth.

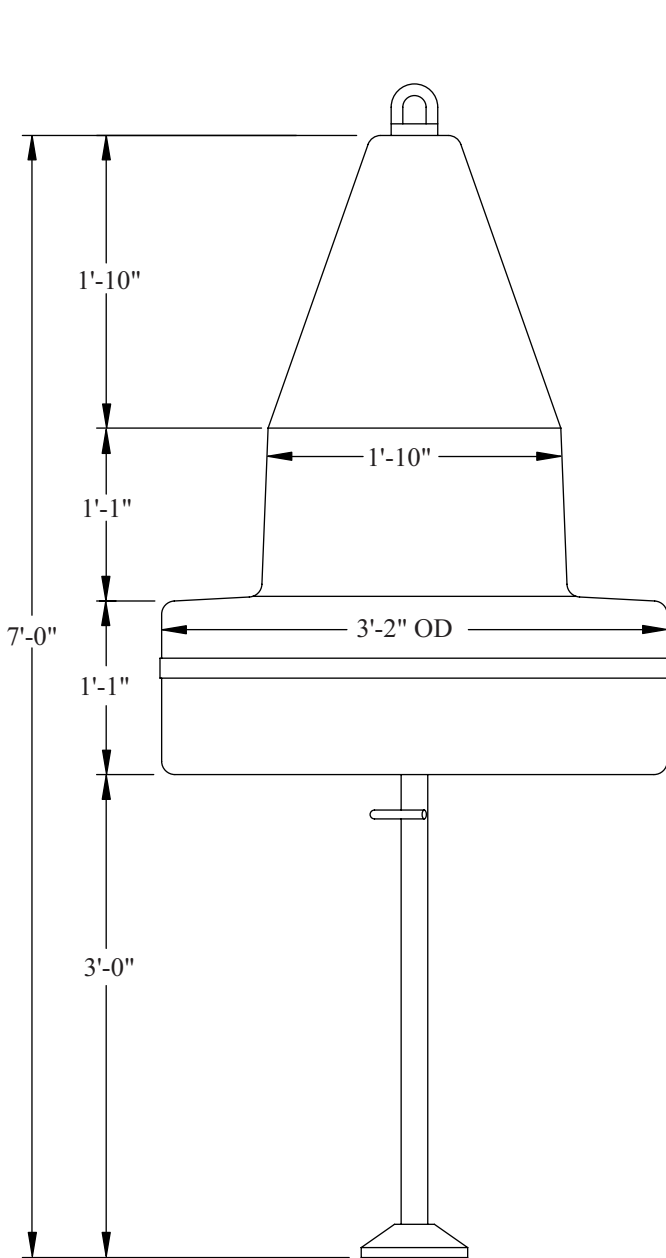
Chain Size	Max Mooring Depth
1/2"	35'

Reference Documents. (use latest rev.)

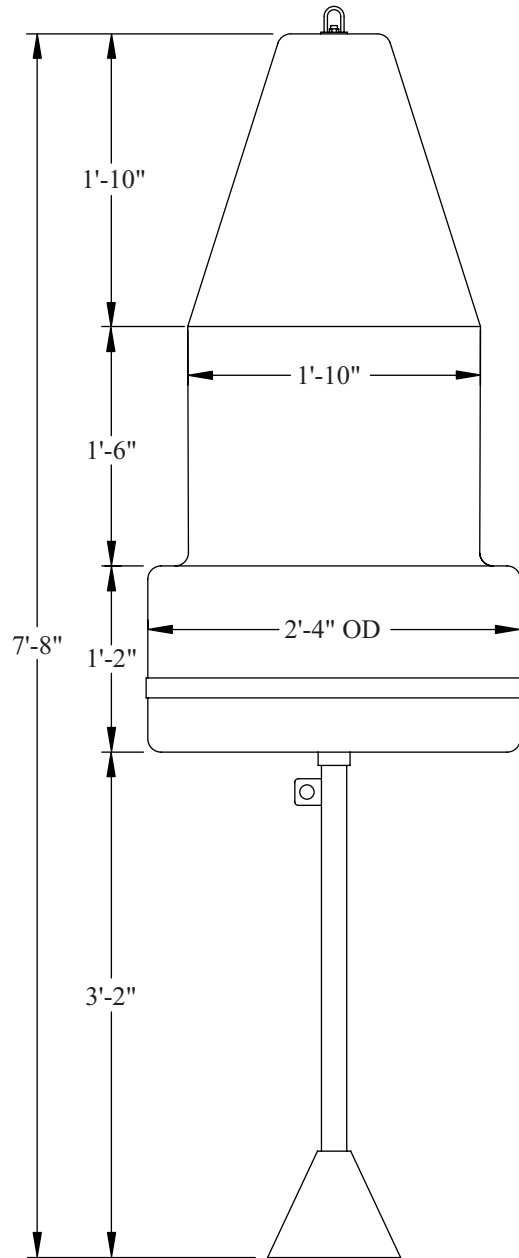
- G-SEC Drawing No. 121173
- G-SEC Specification No. 491

Data Sheet 2.K.44. 5NPR Buoy.

2.K.44. b. Non-Standard Buoy (Old style 5NPR).



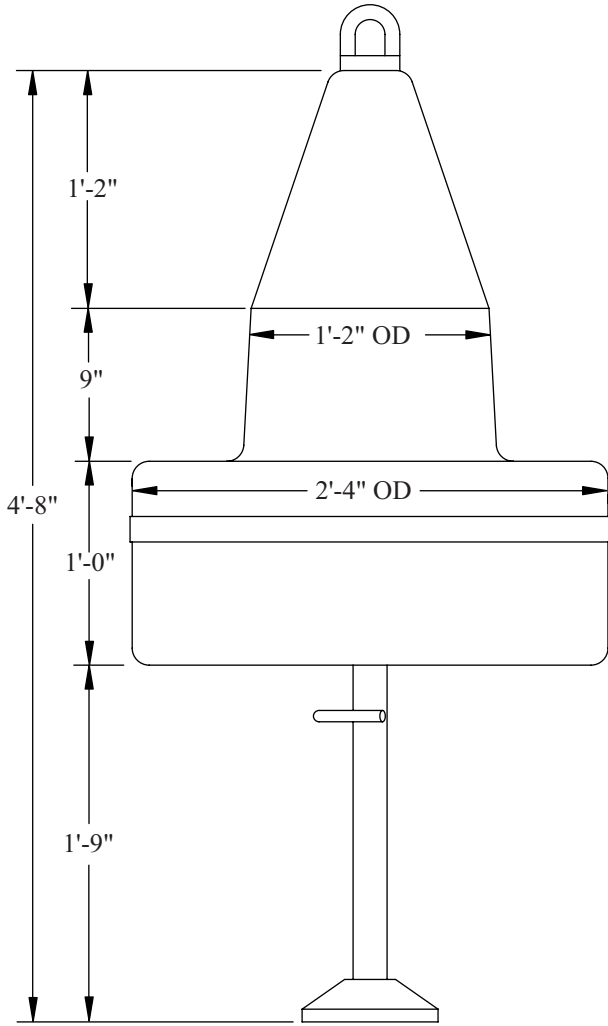
1972 ROLYAN TYPE
5NPR
WEIGHT: 121 LBS
DRAWING NO.: 120329



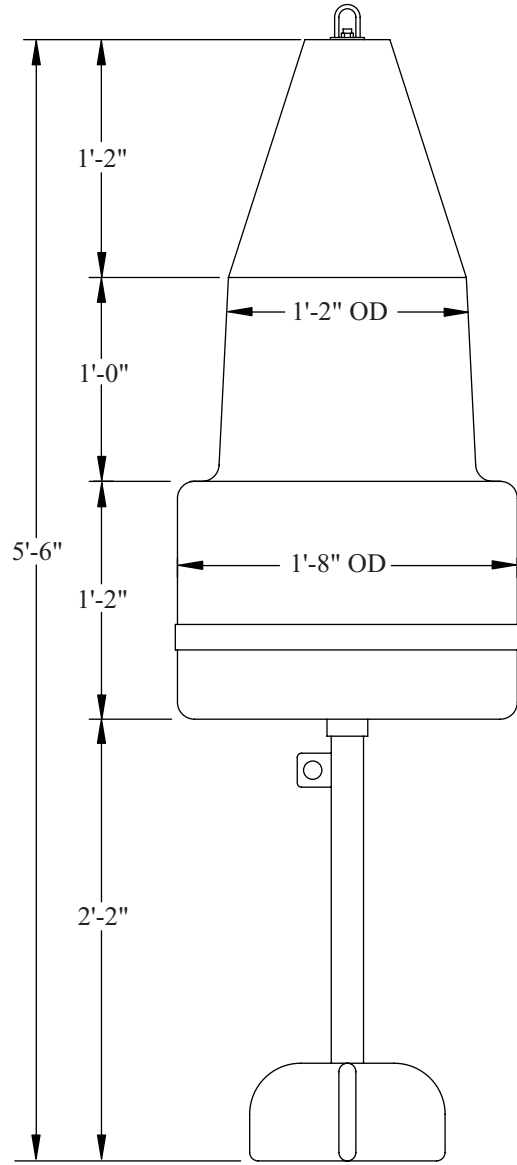
1973 AUTOMATIC POWER TYPE
5NPR
WEIGHT: 138 LBS
DRAWING NO.: 120333

Data Sheet 2.K.44. (cont'd).

2.K.44. c. Non-Standard Buoy (Old style 6NPR).



1972 ROLYAN TYPE
6NPR
WEIGHT: 59 LBS
DRAWING NO.: 120327

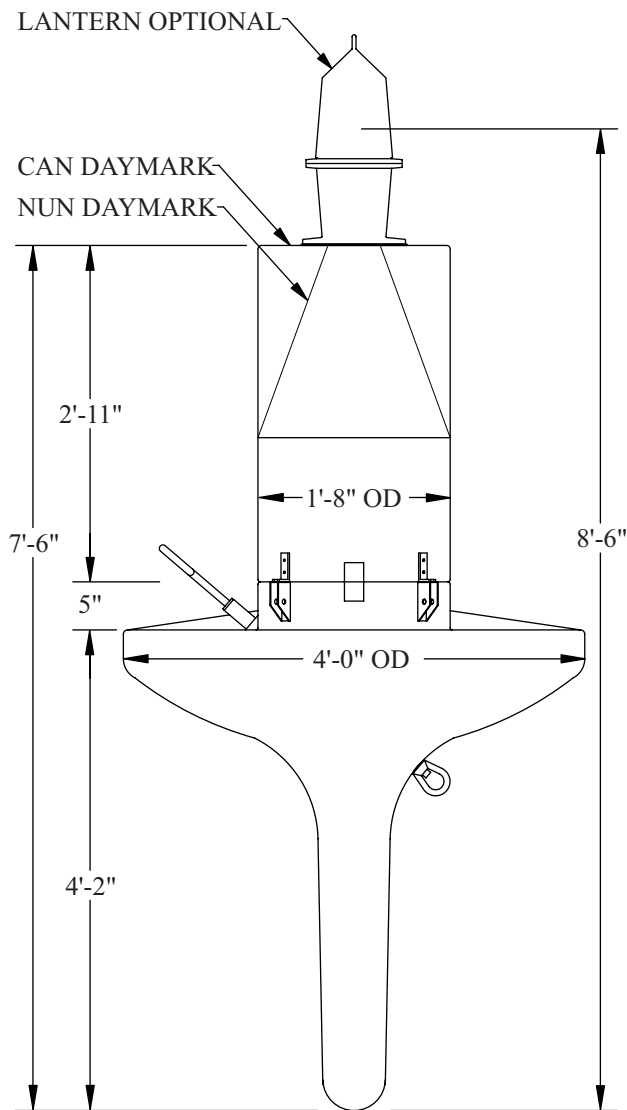


1973 AUTOMATIC POWER TYPE
6NPR
WEIGHT: 76 LBS
DRAWING NO. 120331

Data Sheet 2.K.44. (cont'd).

2.K. 45. Discrepancy Buoy. The discrepancy buoy is designed and constructed for temporary use in the most protected locations where lateral buoys are required. This buoy is constructed of a hard shell plastic body filled with polyurethane foam. The structural members are galvanized steel. The can and nun daymarks can be fitted with an internal radar reflector. A lantern and battery can be fitted to the daymark when lighted temporary marks are needed. This buoy is not suitable for use where ice is present. Although this buoy continues to be approved for use, the design has been discontinued and no new buoys will be manufactured. The authorized replacement is shown on Data Sheets 2.K.37 and 2.K.38.

a. Standard Buoy Arrangement. 1977 Type Discrepancy Buoy.



Physical Characteristics. (no mooring)
 Buoy Weight 220 lbs.
 Buoy Draft 4 ft.

Related Equipment.
 Mooring Chain 3/8-1/2 in.
 Sinker (concrete) 150-250 lbs.

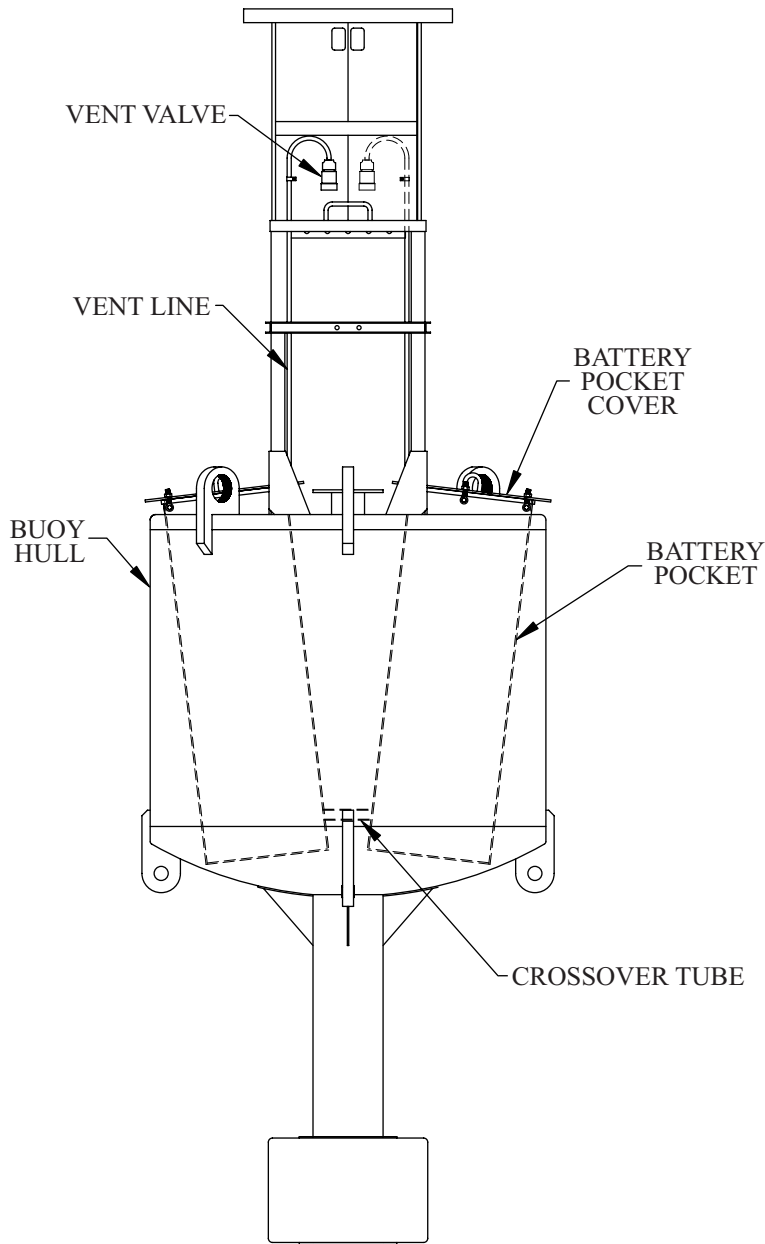
Operational Characteristics. (nominal)
 Daymark Visual Range 1 nm
 Radar Range 1 nm
 Mooring Depth (min.) 6 ft.
 Mooring Depth (max. w/chain) 50 ft.

Reference Documents. (use latest rev.)
 G-SEC Drawing No. 120768
 G-SEC Specification No. 472
 Stock Numbers:
 Hull (gray) NSN 2050-01-225-7276
 Can Daymark NSN 2050-01-222-3938
 Nun Daymark NSN 2050-01-224-6042
 Radar Refelctor NSN 2050-01-225-2779

Data Sheet 2.K.45. Discrepancy Buoy.

2.L. Buoy Outfitting Equipment. Buoy outfitting equipment is presented in this section. Buoy markings, light signals, electronic sound signals, and power systems are presented in later chapters of this manual.

- 2.L. 1. Vent Lines. The batteries used in lighted buoys require a continuous means of airflow. Air-depolarized primary batteries require air to produce energy while secondary (solar) batteries must be provided with a means to vent hydrogen gas. The airflow is provided through 3/4 inch Schedule 40 stainless steel vent lines. The standard two-pocket venting system is shown below. Remove vent lines if battery pockets are welded shut.



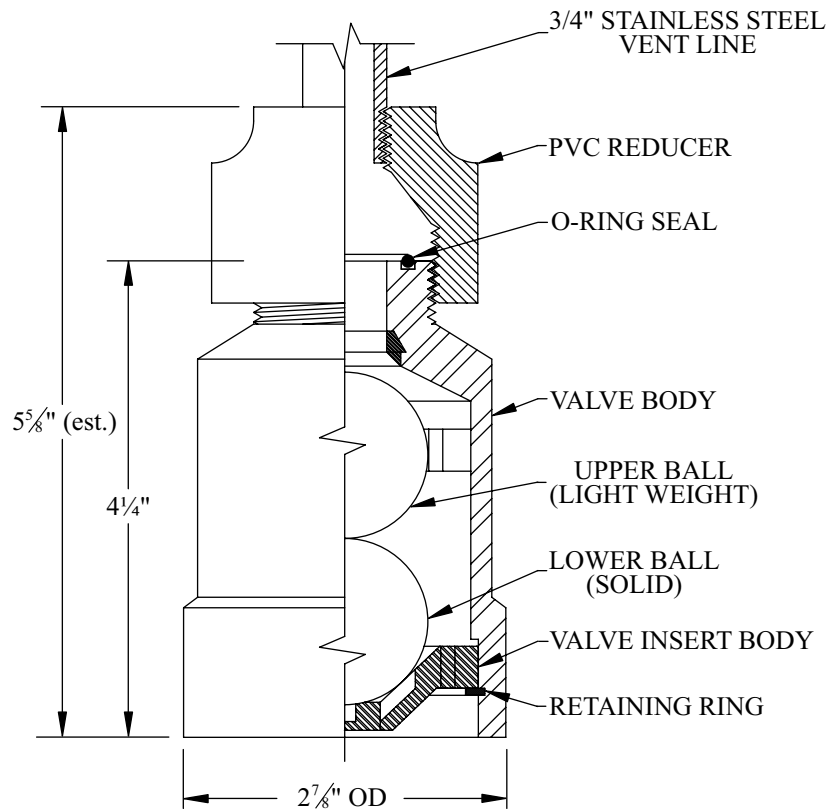
Vent line and crossover tube placement on a two-pocket buoy.

Data Sheet 2.L.1. Vent Lines.

2.L. 2. Vent Valves. Buoy vent valves are specialized versions of check valves. They are designed to seal the vent lines on lighted buoys if the buoy heels beyond 30 degrees or submerges. The PVC valve uses an o-ring to achieve a watertight seal with the PVC vent line reducer. All lighted buoys use vent valves. The standard arrangement is shown below.

Reference Documents. (use latest rev.)
 G-SEC Drawing No. 107334
 G-SEC Specification No. 382

Stock Numbers:
 Vent Valve Overhaul Kit NSN 4820-01-106-5983
 Vent Valve NSN 4820-00-076-6748
 PVC Reducer NSN 4730-01-029-6548

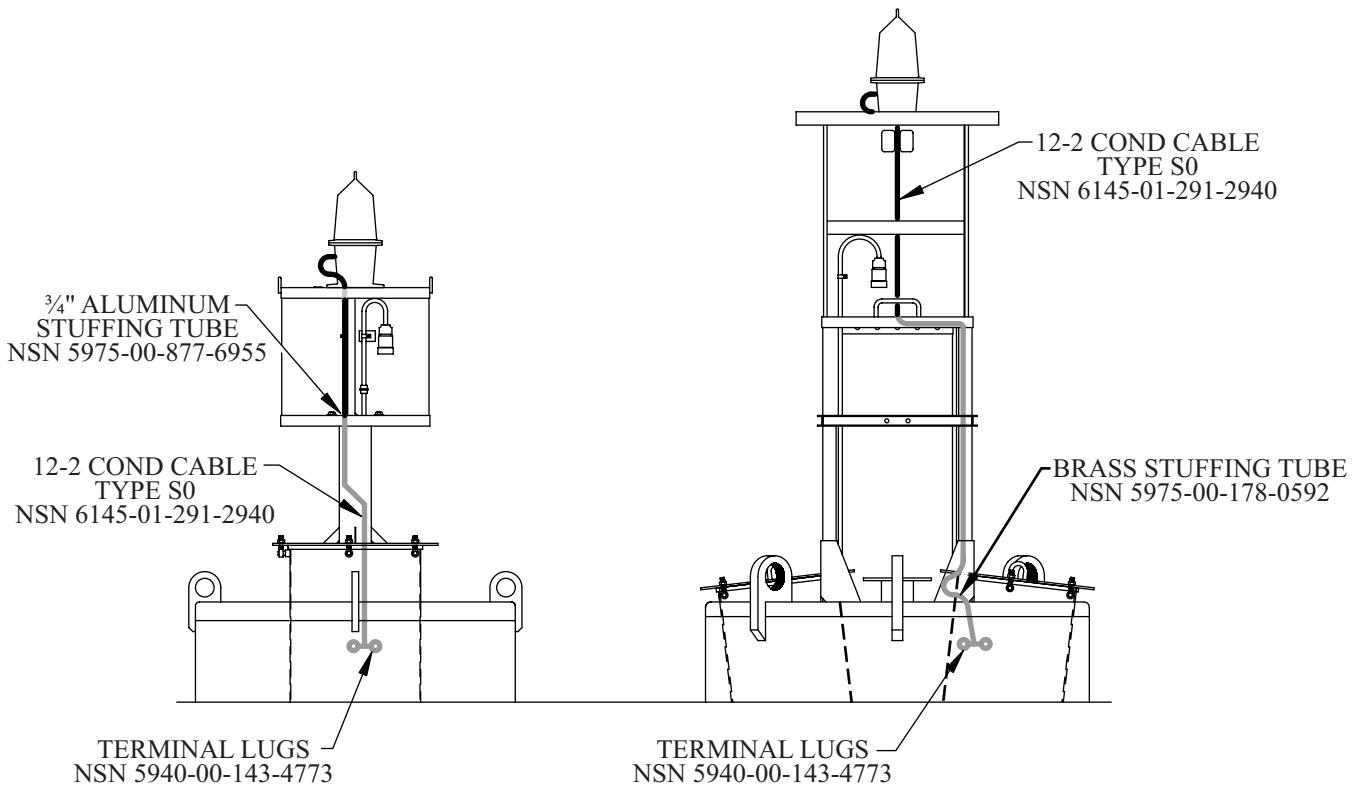


Data Sheet 2.L.2. Vent Valves.

2.L. 3. Wiring. The external wiring of the buoy is used to carry electrical current from the batteries to the lantern. Two-conductor type SO (12/2 or 10/2) is used (see chapter 6 of this manual). The length of cable varies according to the buoy type, power source, and wiring method. For reference purposes, the length of cable required to run from the battery pocket to the lantern is given below:

Buoy	Cable (ft.)
3.5X8	10
5X11	10
6X20	19
7X17	19
8X26	25
9X32	30

Wiring diagrams for various buoy configurations are shown below.

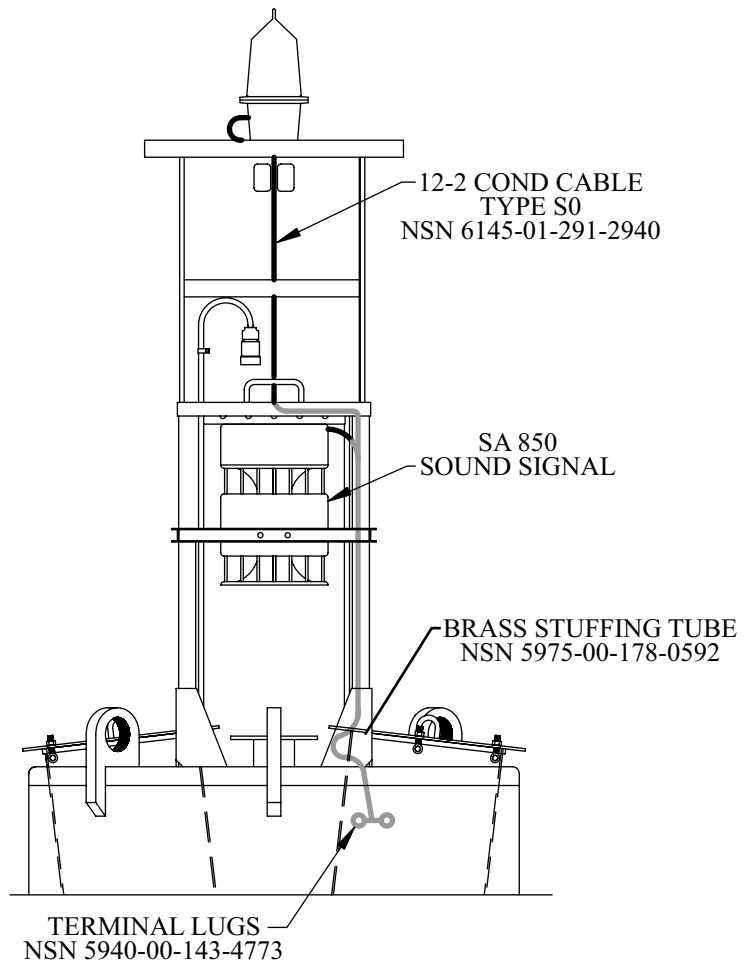


Wiring diagram for single pocket buoy.

Wiring diagram for two-pocket buoy with one power unit.

Data Sheet 2.L.3. Wiring.

2.L.3.



Wiring diagram for two-pocket
buoy with electronic sound signal.

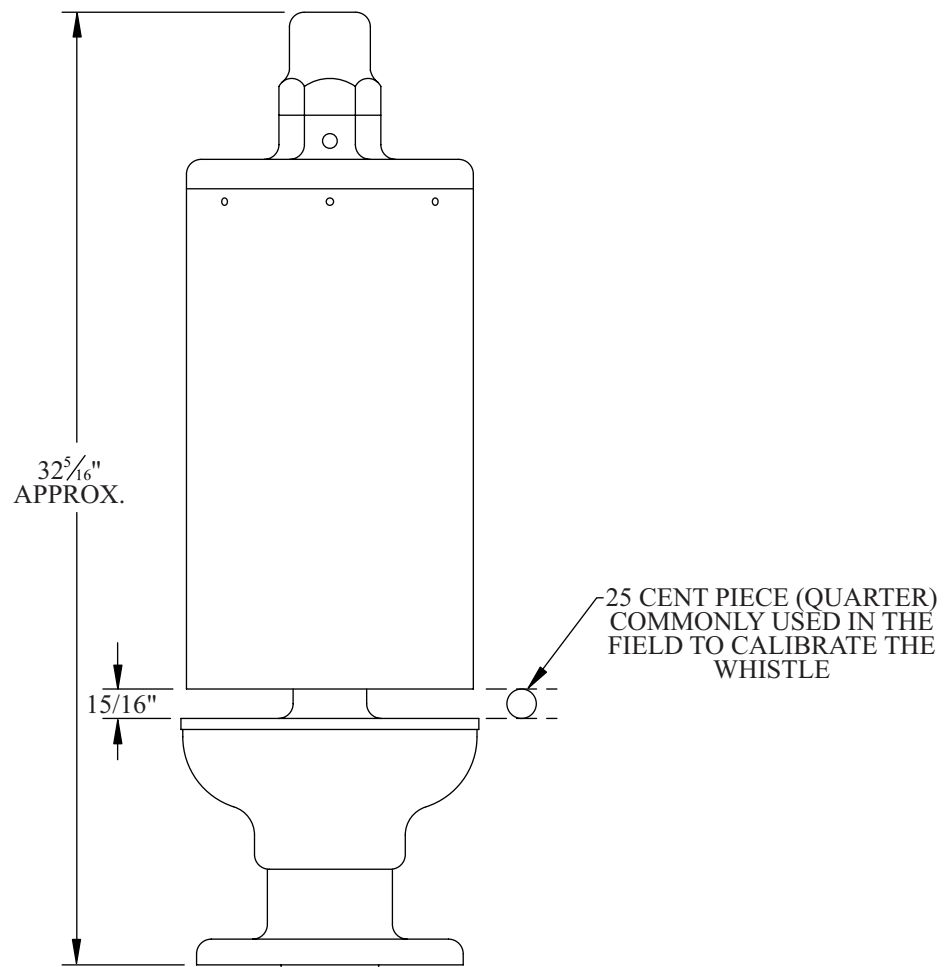
Data Sheet 2.L.3. (cont'd)

- 2.L. 4. Whistle. Whistles are made of a copper-silicon alloy. The air in the open counterweight tube of the buoy rises and falls with wave action. The downward motion of the buoy forces air through the whistle valve to the whistle. The escaping air causes the familiar drone. The standard arrangement is shown below.

Reference Documents. (use latest rev.)
G-SEC Drawing No. 120777
G-SEC Specification No. 381
Weight: 155lbs

Stock Number:

NSN 6350-01-034-1347



Data Sheet 2.L.4. Whistle.

- 2.L. 5. Whistle Valve. Whistle valves are made of a copper-silicon alloy. The valve balls are either cork or rubber. Air is forced up from the buoy counterweight tube during downward motion causing the balls to seal the air ports in the valve, thus forcing the air to flow into the whistle. Upward motion of the buoy causes a suction which lifts the balls, thus allowing air to be drawn back down the counterweight tube. The standard arrangement is shown below.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 120777

G-SEC Specification No. 381

Weight: 265 lbs

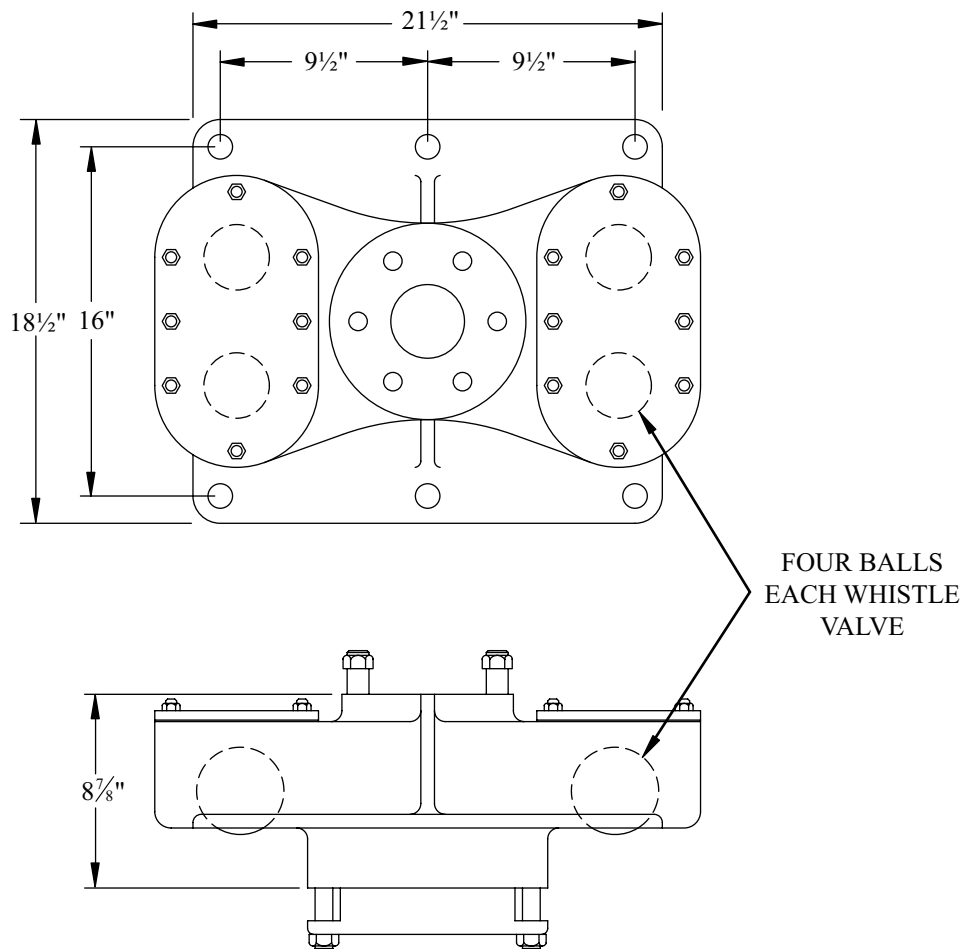
Stock Numbers:

Valve

NSN 4820-01-034-1348

Replacement Balls

NSN 2050-00-301-4067



Data Sheet 2.L.5. Four-Ball Whistle Valve.

- 2.L. 6. Bells. The bells used on lighted and unlighted bell buoys are made of a copper-silicon alloy. External tappers impact the fixed bell when wave motion causes the buoy to roll. The standard bell configurations are shown below.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 120994

G-SEC Specification No. 357

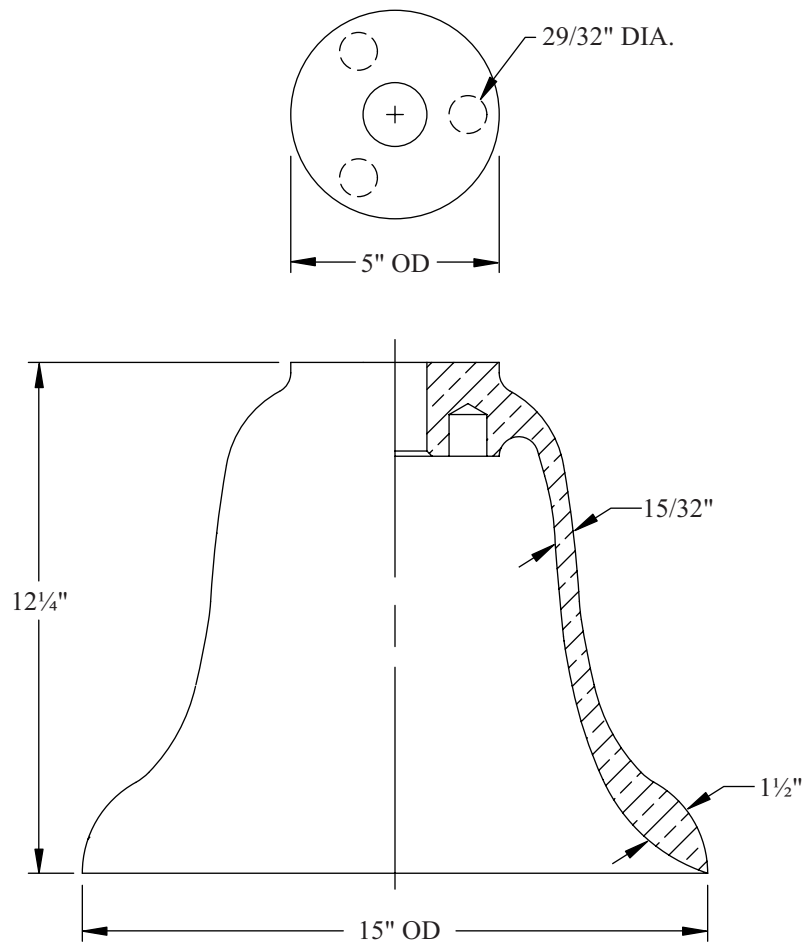
Stock Numbers:

Bell, 85#

NSN 6450-01-034-1349

Bell, 225#

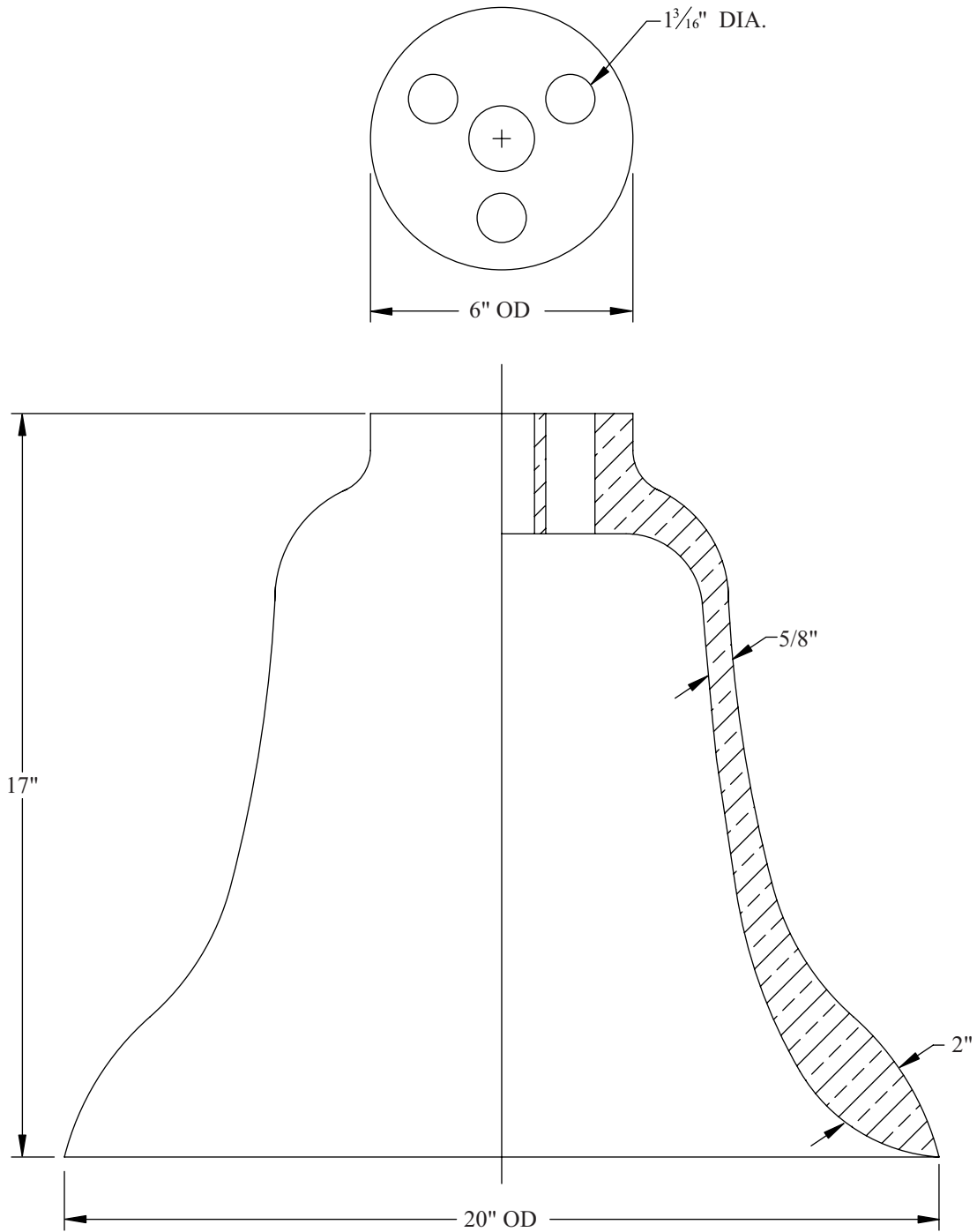
NSN 6450-01-034-1350



85LB. Buoy Bell

Data Sheet 2.L.6. Bells.

2.L.6.



225 LB. Buoy Bell

Data Sheet 2.L.6. (cont'd).

2.L. 7. Bell Stands. The bells used on lighted and unlighted bell buoys are mounted on steel stands which are bolted to the bell/gong mounting flange. Isolation pads (1/8 inch thick rubber) are placed between the bell stand and the bell to prevent vibrations from being transmitted to the buoy and to lessen the shock on the stand. An additional pad is often used between the stand and the buoy flange. Stainless steel mounting hardware is provided with each stand. Bell stands are delivered with a primer coat only.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 120998

G-SEC Specification No. 362

Weight:

85# Bell Stand: 78 lbs

225# Bell Stand: 105 lbs

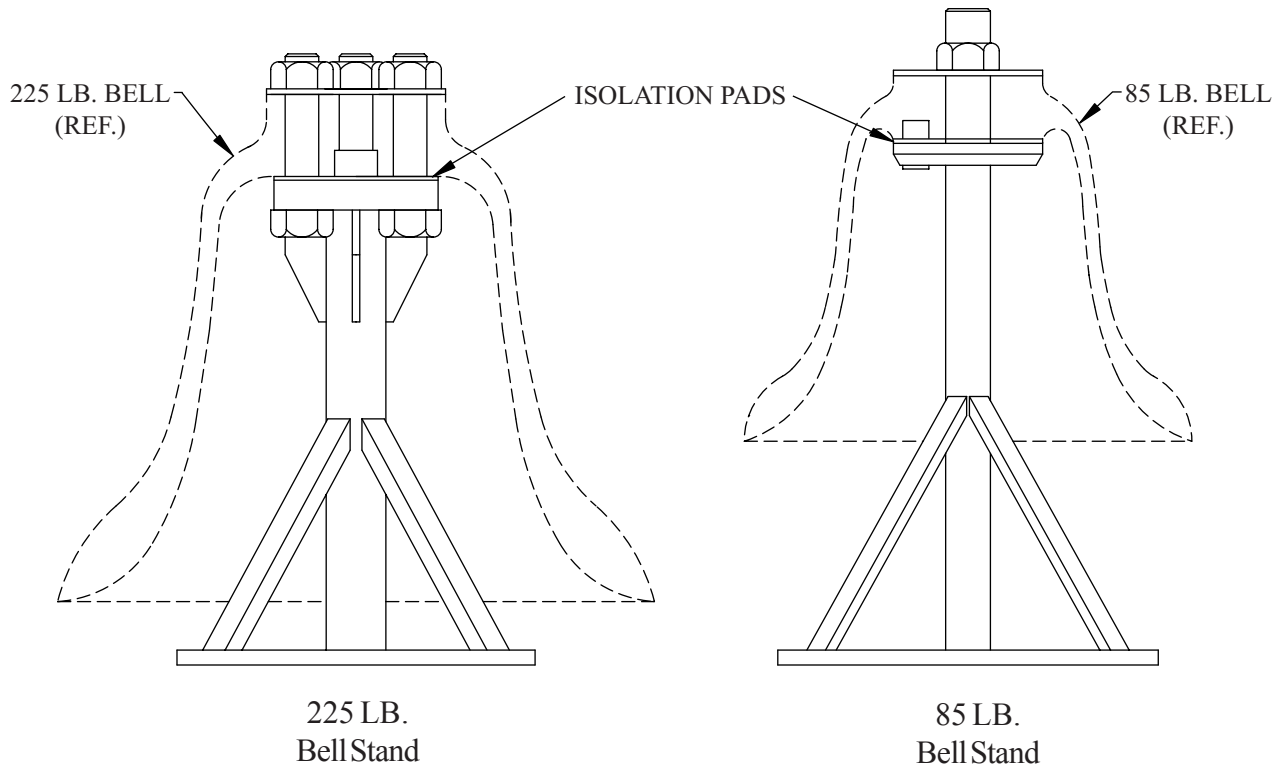
Stock Numbers:

Bell Stand, 85#

NSN 2050-00-856-4618

Bell Stand, 225#

NSN 2050-00-856-4614



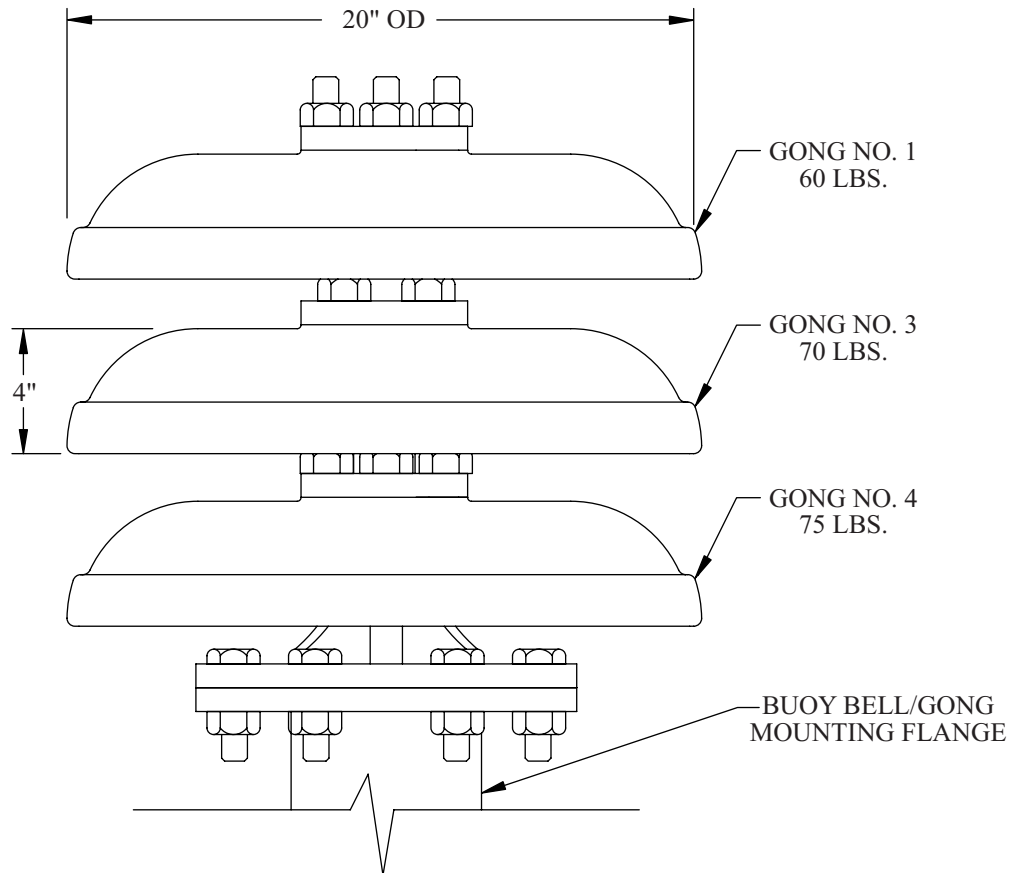
Data Sheet 2.L.7. Bell Stands.

- 2.L. 8. Gongs. The gongs used on lighted and unlighted gong buoys are made of a copper-silicon alloy. External tappers impact the fixed gongs when wave motion causes the buoy to roll. Each gong emits a different tone when struck with the tapper, thus distinguishing the signal from that of a bell. The standard gong configuration is shown below.

Reference Documents. (use latest rev.)
 G-SEC Drawings No. 120994
 G-SEC Specification No. 357

Stock Numbers:

Gong #1, 20"	NSN 6350-01-034-1352
Gong #3, 20"	NSN 6350-01-034-1354
Gong #4, 20"	NSN 6350-01-034-1353



Weight (including stand): 371 lbs

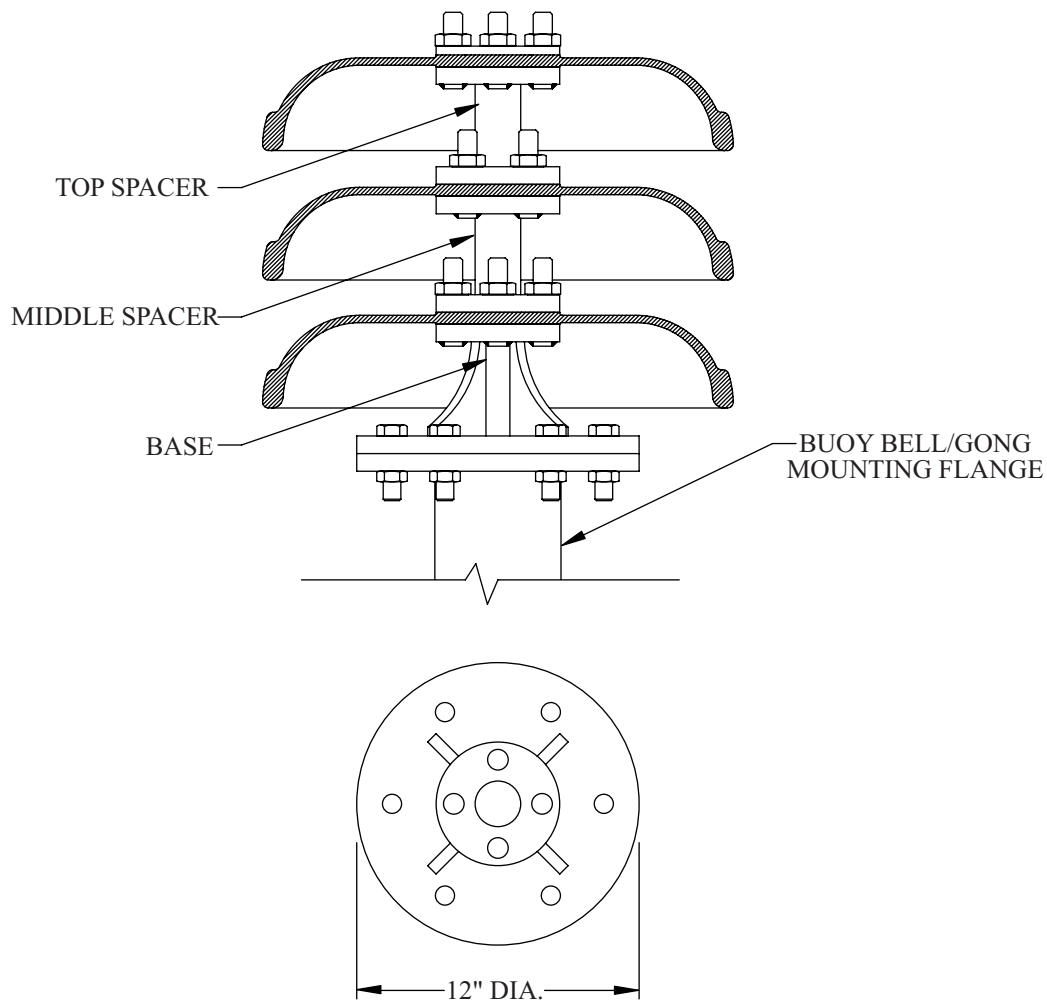
Data Sheet 2.L.8. Gongs.

- 2.L. 9. Gong Stands. The gongs used on lighted and unlighted gong buoys are mounted on steel stands which are bolted to the bell/gong mounting flange. Stainless steel mounting hardware is provided with each stand. Gong stands are delivered with a primer coat only. The gong stands are shown below.

Reference Documents. (use latest rev.)
G-SEC Drawing No. 120998
G-SEC Specification No. 362

Stock Numbers:
Gong Stand

NSN 2050-00-301-4074



20" Gong Assembly

Data Sheet 2.L.9. Gong Stands.

- 2.L. 10. Tappers. Tappers are used to strike wave-actuated sound signals. They swing on hinges and strike a bell or gong with a cylindrical ball to make a characteristic tone. Stainless steel hardware is provided with each tapper assembly. Tapper assemblies are delivered with a primer coat only. Replacement tapper balls may be ordered. The standard tapper configuration is shown below.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121159

G-SEC Specification No. 360

Stock Numbers:

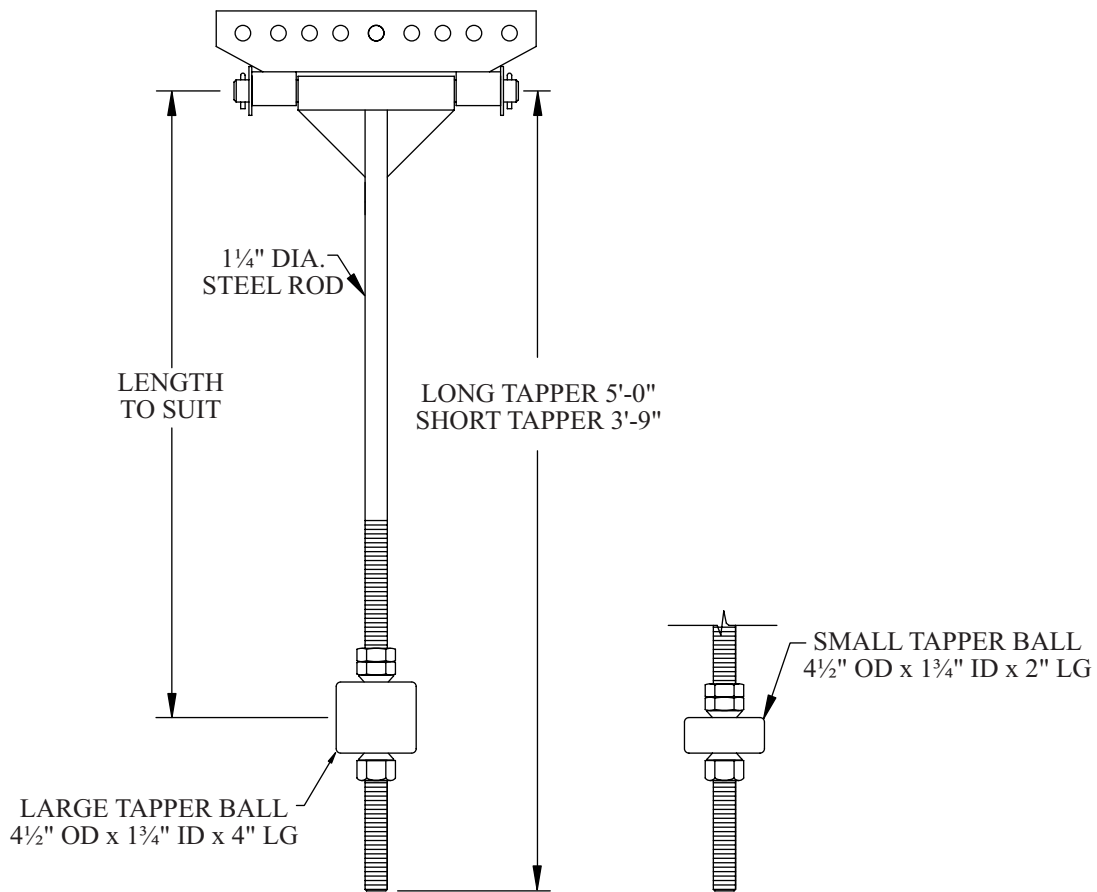
Long Tapper Assembly (Large Ball) NSN 2050-01-025-3527

Short Tapper Assembly (Large Ball) NSN 2050-01-025-3526

Short Tapper Assembly (Small Ball) NSN 2050-01-019-0107

Large Balls NSN 2050-01-392-0939

Small Balls NSN 2050-01-391-6302



Data Sheet 2.L.10. Tappers.

2.L.10. a.

STANDARD TAPPERS FOR VARIOUS BUOY SIZES		
BUOY CLASS	BELL	GONG
9X32	4 LONG	1 SHORT (LG Ball), 2 LONG
9X20	4 LONG	2 SHORT (LG Ball), 1 LONG
8X26	4 LONG	2 SHORT (LG Ball), 1 LONG
8X21	4 LONG	2 SHORT (LG Ball), 1 LONG
7X17	4 SHORT(Small Ball)	N/A
6X20	4 SHORT(Small Ball)	N/A

Data Sheet 2.L.10. (cont'd).

2.L. 11. 24" Pocket Closures. Pocket closures are designed to ensure watertight integrity of the battery pockets on lighted buoys. The 24 inch pocket closure is used on 8X26, 8X21, 9X32, and 9X35 buoys. The standard 24 inch closure uses a swingbolt mount (welded to the buoy pocket), a flat neoprene gasket, a flat cover, and 6 stainless steel swingbolts. Pocket covers are delivered with a primer coat only. They shall be color coated to match the buoy.

a. Standard Arrangement. 24" Swingbolt Closure.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121143

G-SEC Specification No. 484

Stock Numbers:

24" Cover

NSN 6160-01-386-9957

Gasket (Roll)

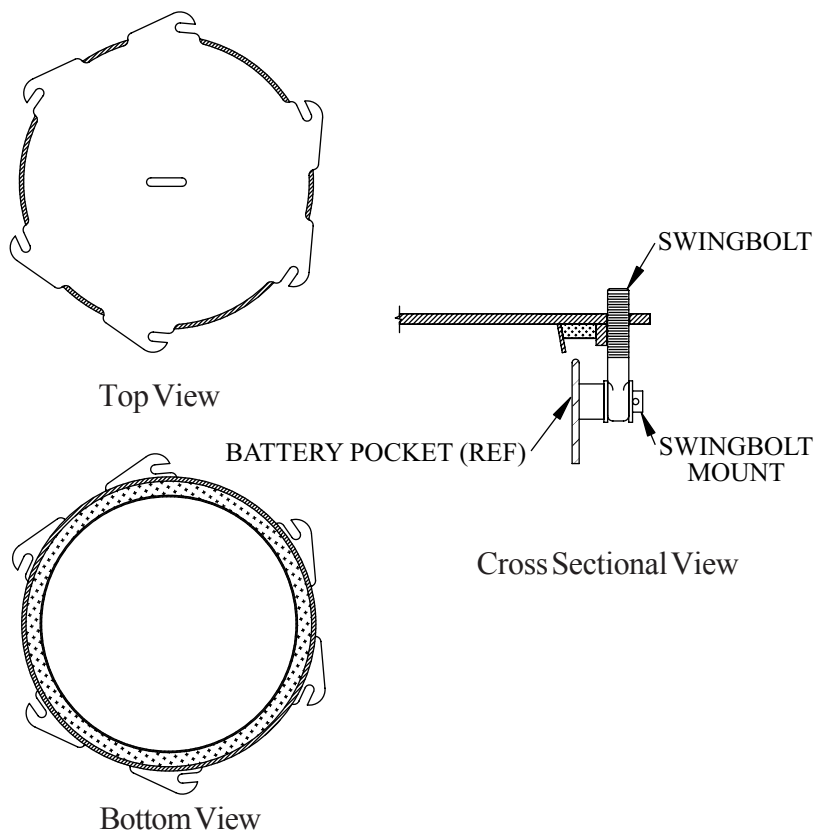
NSN 5330-00-542-1984

Swingbolt & Nut (1)

NSN 5340-01-034-5222

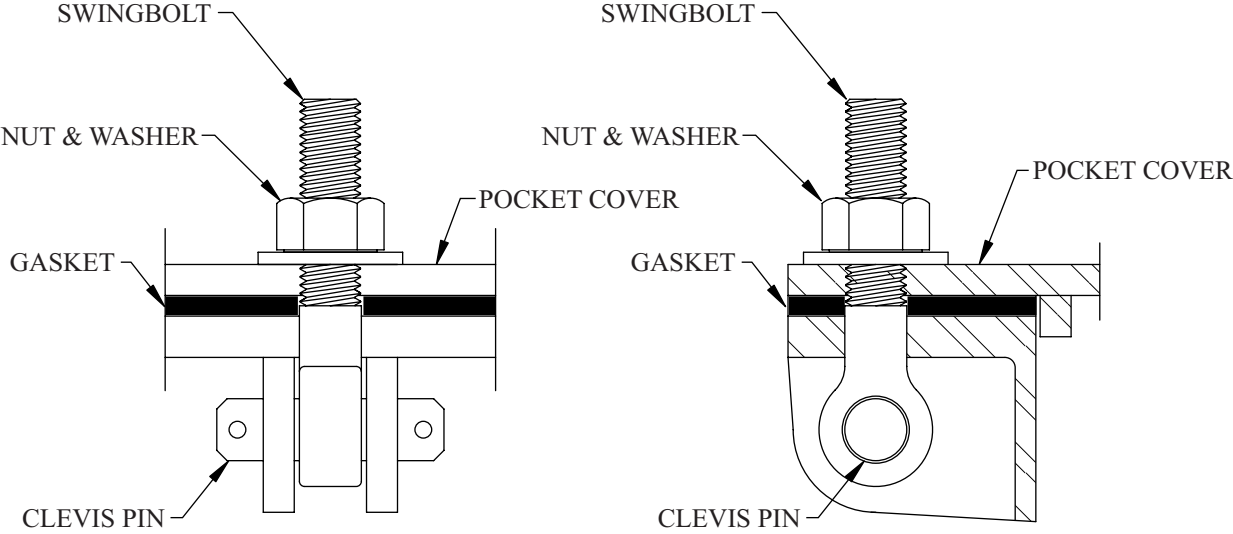
Swingbolt Mount (6)

NSN 5315-01-288-0729

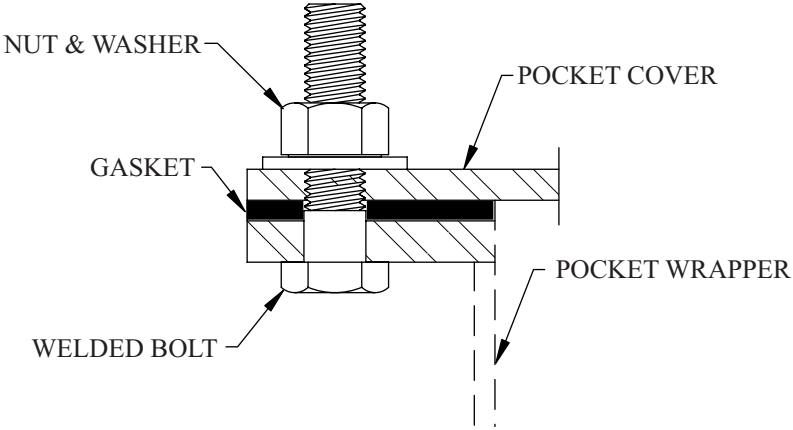


Data Sheet 2.L.11. 24" Pocket Closures.

2.L. 11. b. Authorized Non Standard 24" Pocket Closures. The 12 swing bolt configuration and bolted flange configurations are shown below.



12 Swing Bolt Pocket Closure



1984 Type Bolted Flange Pocket Closure

2.L. 12. 22" Pocket Closures. Pocket closures are designed to ensure watertight integrity of the battery pockets on lighted buoys. The 22 inch pocket closure is used on 6X20 and 7X17 buoys. The standard 22 inch closure uses a swingbolt mount (welded to the buoy pocket), a flat neoprene gasket, a flat cover, and 6 stainless steel swingbolts. Pocket covers are delivered with a primer coat only. They shall be color coated to match the buoy.

a. Standard Arrangement. 22" Side-Swingbolt Closure.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121104

Specification No. 484

Stock Numbers:

22" Cover

NSN 6160-01-290-6897

Gasket (Roll)

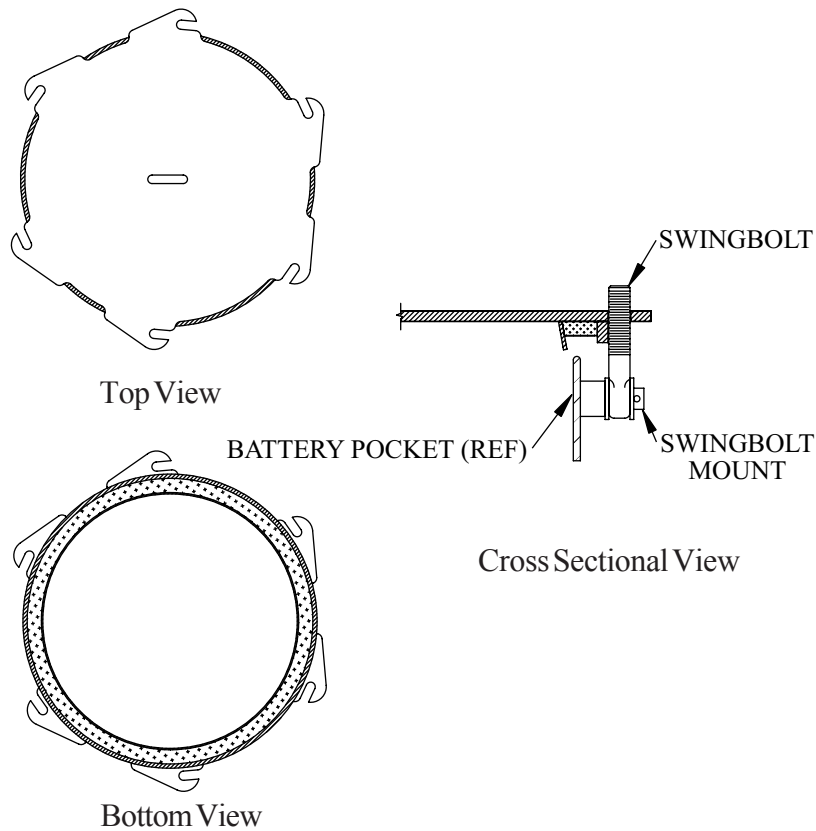
NSN 5330-00-542-1984

Swingbolt & Nut (1)

NSN 5340-01-034-5222

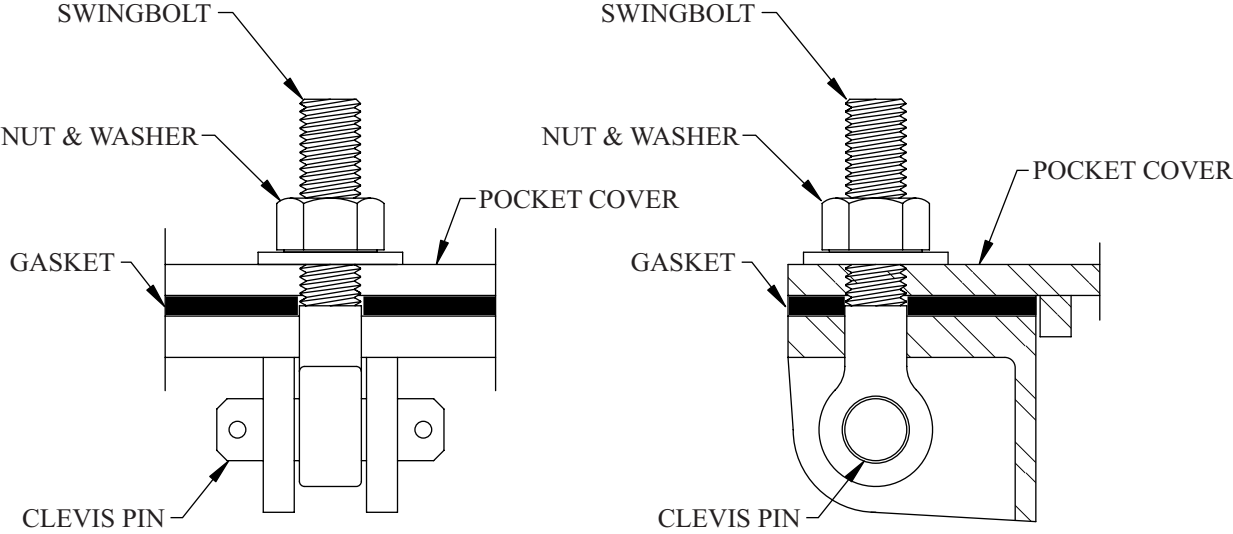
Swingbolt Mount (6)

NSN 5315-01-288-0729

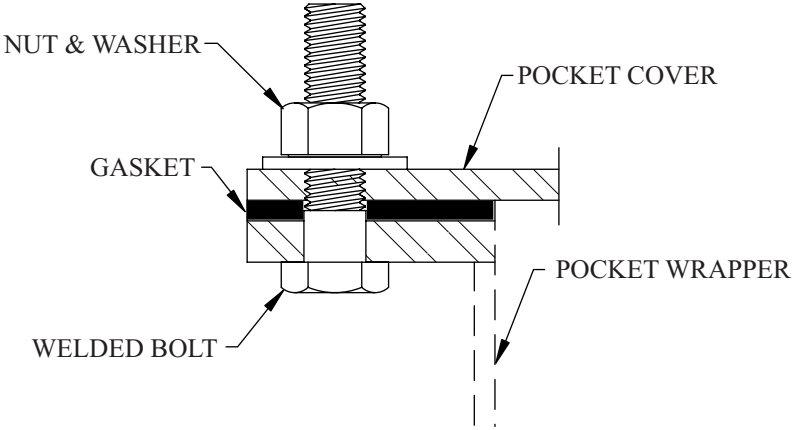


Data Sheet 2.L.12. 22" Pocket Closures.

2.L. 12. b. Authorized Non Standard 22" Pocket Closures. The 12 swing bolt configuration and bolted flange configurations are shown below.



12 Swing Bolt Pocket Closure



1984 Type Bolted Flange Pocket Closure

- 2.L. 13. Pocket Closures for 3.5X8 and 5X11 Buoys. 3.5X8 and 5X11 pocket closures have additional appendages welded on which contain the vent lines and support the buoy radar reflector. Pocket closures are delivered with primer coat only. They shall be color coated to match the buoy.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121160

G-SEC Specification No. 484

Stock Numbers:

3.5X8 Pocket Cover

NSN 6160-01-387-0206

5X11 Pocket Cover

NSN 6160-01-387-1643

Gasket(Roll)

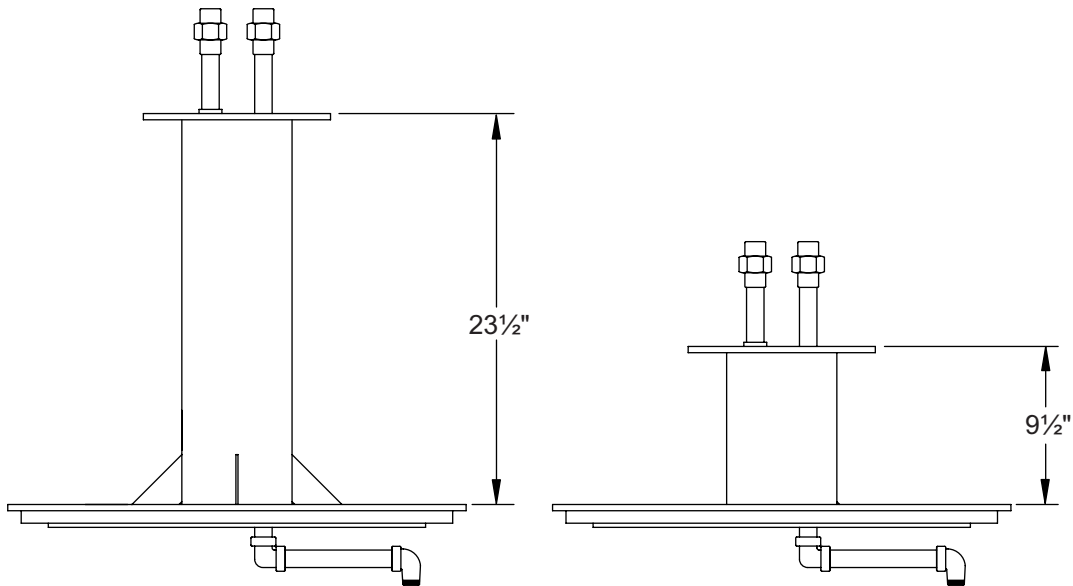
NSN 5330-00-542-1984

Swingbolt & Nut(1)

NSN 5340-01-034-5222

Swingbolt Mount(6)

NSN 5315-01-288-0729

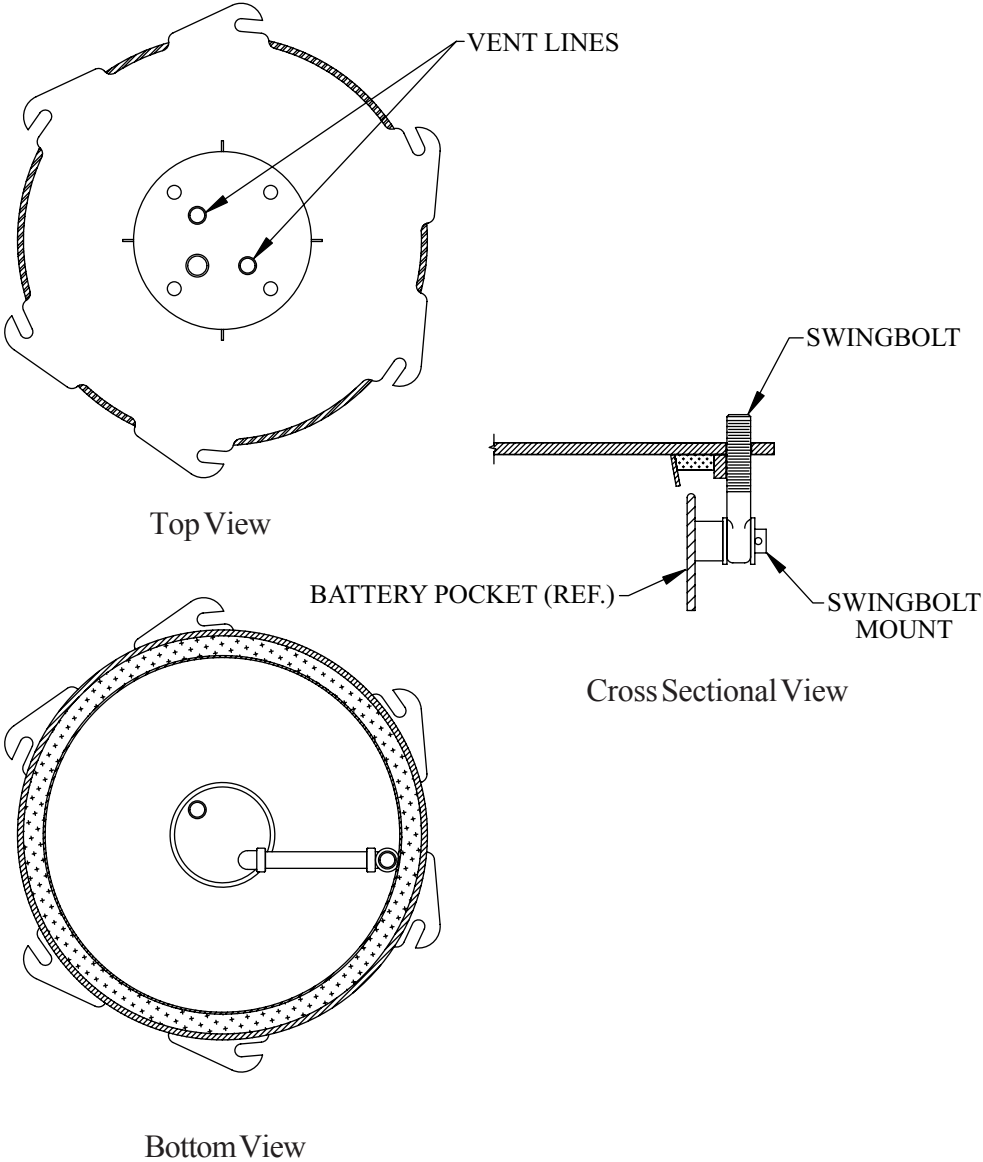


5X11 Pocket Cover

3-1/2x8 Pocket Cover

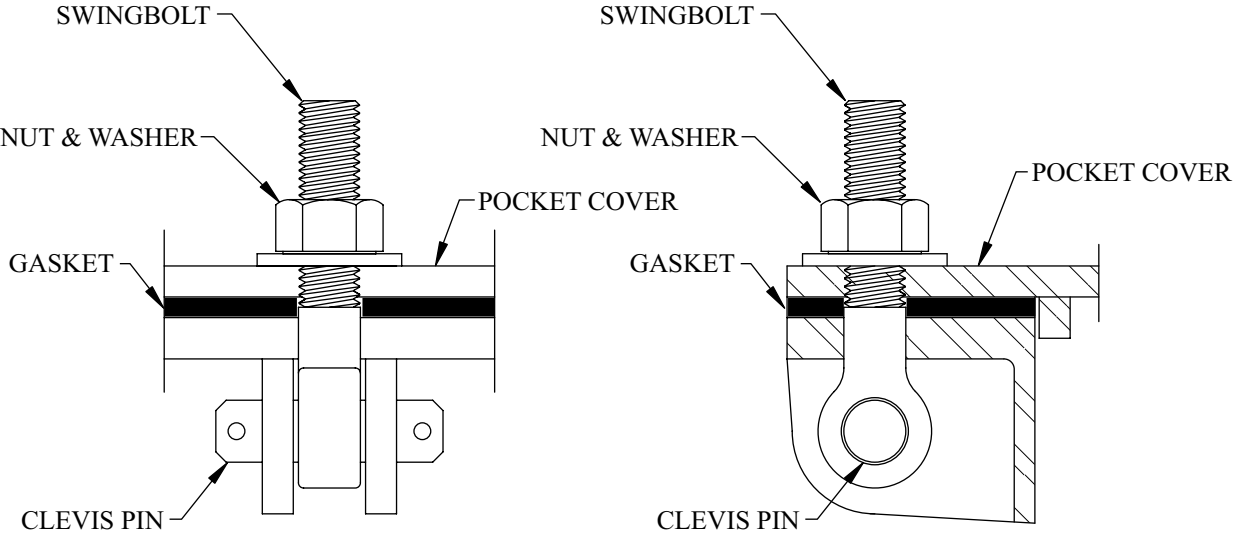
Data Sheet 2.L.13. 3.5X8 and 5X11 Pocket Closures.

2.L. 13. Pocket Closures for 3.5X8 and 5X11 Buoys. (Cont'd).



Data Sheet 2.L.13. (con't).

2.L. 13. b. Authorized Non Standard 3.5X8LR and 5X11LR Pocket Closures. The 12 swing bolt configuration is shown below.



12 Swing Bolt Pocket Closure

- 2.L. 14. Battery Pocket Conversion Kits. Battery pocket conversion kits are designed to replace non-standard pocket closures. Installation is completed by removing the non-standard pocket closure at the buoy top head and welding on the conversion kit. Conversion kits are available for 22 and 24 inch battery pockets. They include swingbolts and mounts, but do not include pocket covers. Battery pocket conversion kits are delivered with primer coat only. They shall be color coated to match the buoy.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121162

G-SEC Specification No. 484

Stock Numbers:

24" Conversion Kit

NSN 2040-01-391-5036

22" Conversion Kit

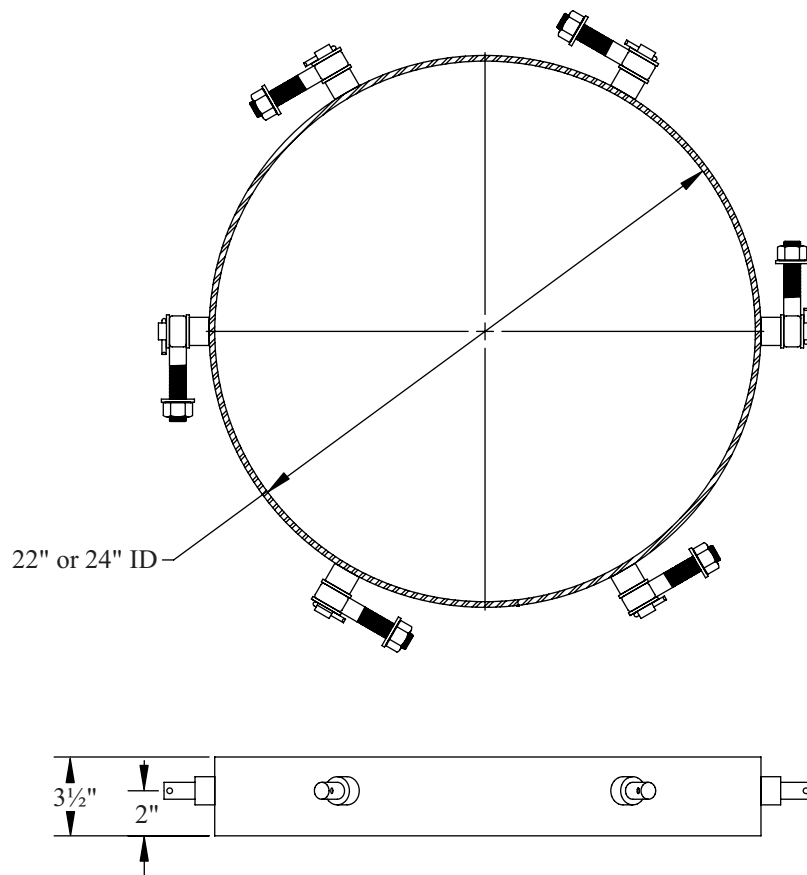
NSN 2040-01-391-5046

24" Pocket Cover

NSN 6160-01-386-9957

22" Pocket Cover

NSN 6160-01-290-6897



Data Sheet 2.L.14. Battery Pocket Conversion Kit.

- 2.L. 15. Buoy Battery Box. Steel battery boxes are intended for use on buoys with bell/gong mounting flanges. Each box requires a vent valve to release hydrogen gas. The valve is attached to a vent line coming out of the back of the box. Stainless steel mounting hardware is provided with each box.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121100

G-SEC Specification No. 460

Stock Numbers:

Double Battery Box

NSN 6160-01-335-3540

Vent Valve

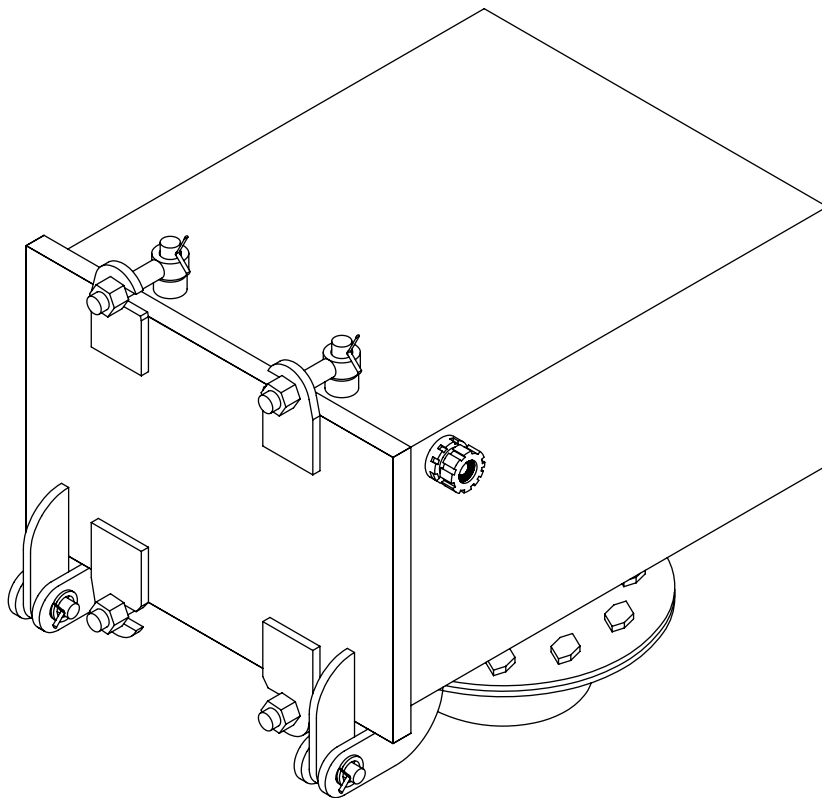
NSN 4820-00-076-6748

PVC Reducer

NSN 4730-01-029-6548

Clevis Pin

NSN 5315-00-857-1453



Data Sheet 2.L.15. Buoy Battery Box.

2.L. 16. Universal Solar Panel Frame. The universal solar panel frame is constructed from aluminum and designed to mount a single solar panel horizontally above the 155mm lantern. It is available in three sizes for use with the standard 10 watt, 20 watt, and 35 watt panels using the solar installation kit described in Chapter 6 of this manual. The larger size frame will accommodate the smaller panels, if necessary. The base of the frame is bolted directly to the lantern support flange on the buoy. The lantern is then installed on the same bolts and sits within the frame. As an option for areas with harsh environmental conditions, the frames may be fabricated locally from steel. Steel frames must be galvanized or painted a neutral color such as gray or silver. Mounting hardware is not provided.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121103

G-SEC Specification No. 461

Stock Numbers:

10 Watt Frame

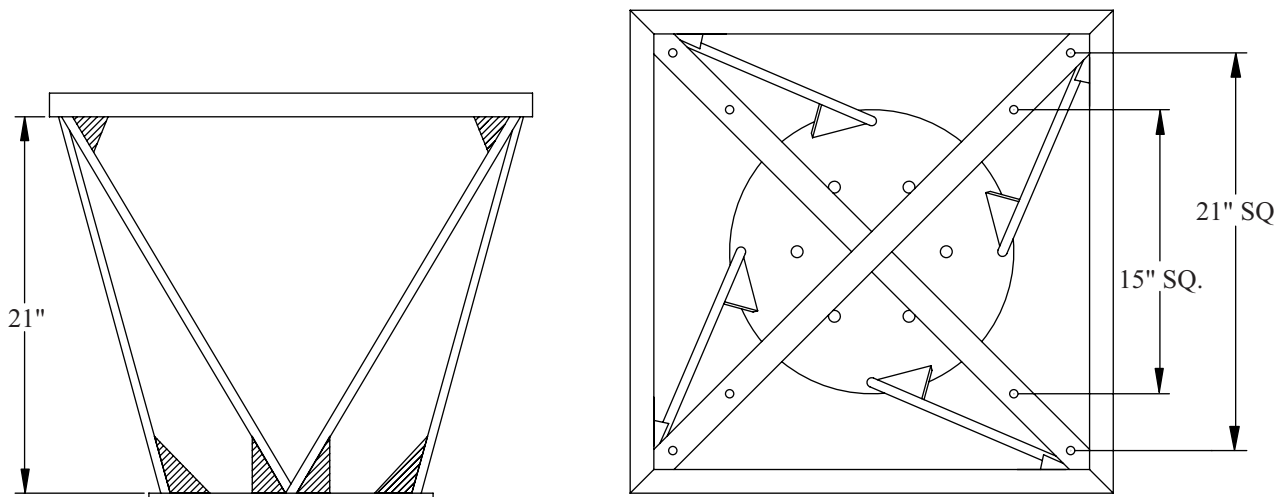
NSN 6117-01-336-9133

20 Watt Frame

NSN 6117-01-336-9132

35 Watt Frame

NSN 6117-01-336-9131



Data Sheet 2.L.16. Universal Solar Panel Frame

- 2.L. 17. Triple Solar Panel Frame. As its name implies, the triple solar panel frame is capable of holding up to three solar panels per frame. Frames for 10, 20, and 35 watt solar panels are available. The 20 watt frame will also accommodate 10 watt panels, and the 35 watt frame will also accommodate 20 watt panels. Mounting hardware is not provided.

Reference Documents: (use latest rev.)

G-SEC Drawing No.: 3X35 WATT 121135

3X20 WATT 121134

3X10 WATT 121133

G-SEC Specification No. 461

Stock Numbers:

3X35 WATT

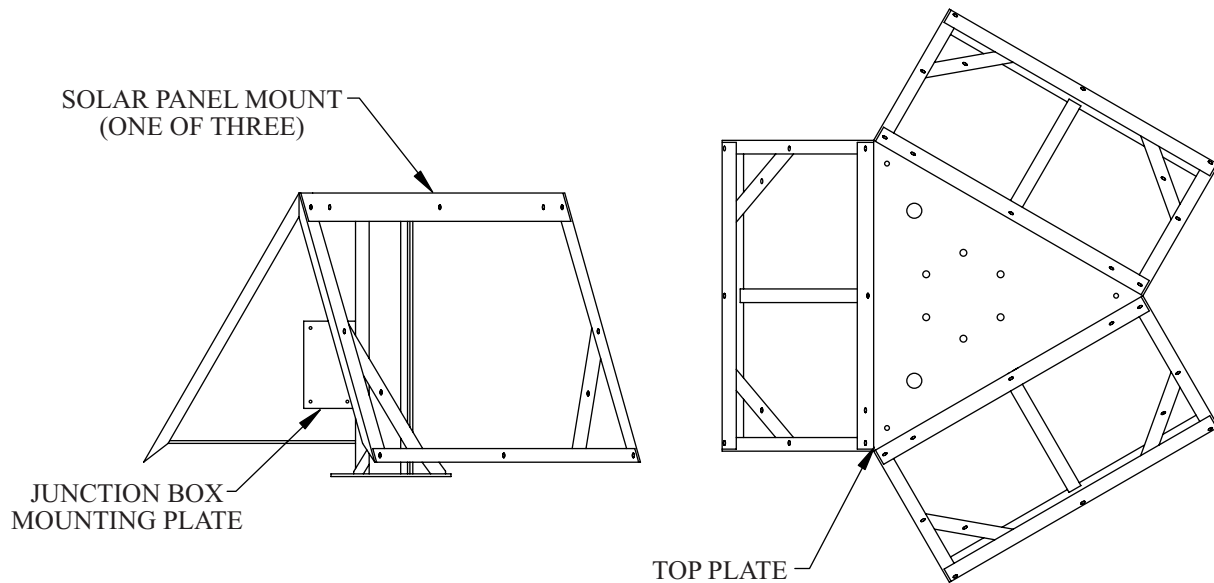
3X20 WATT

3X10 WATT

NSN 6117-01-334-9295

NSN 6117-01-335-7377

NSN 6117-01-334-9292



Data Sheet 2.L.17. Triple Solar Panel Frames.

- 2.L. 18. Lantern Bridge. This is an aluminum stand designed to hold the topmark above the lantern without hindering the lantern's signal. Mounting hardware is not provided.

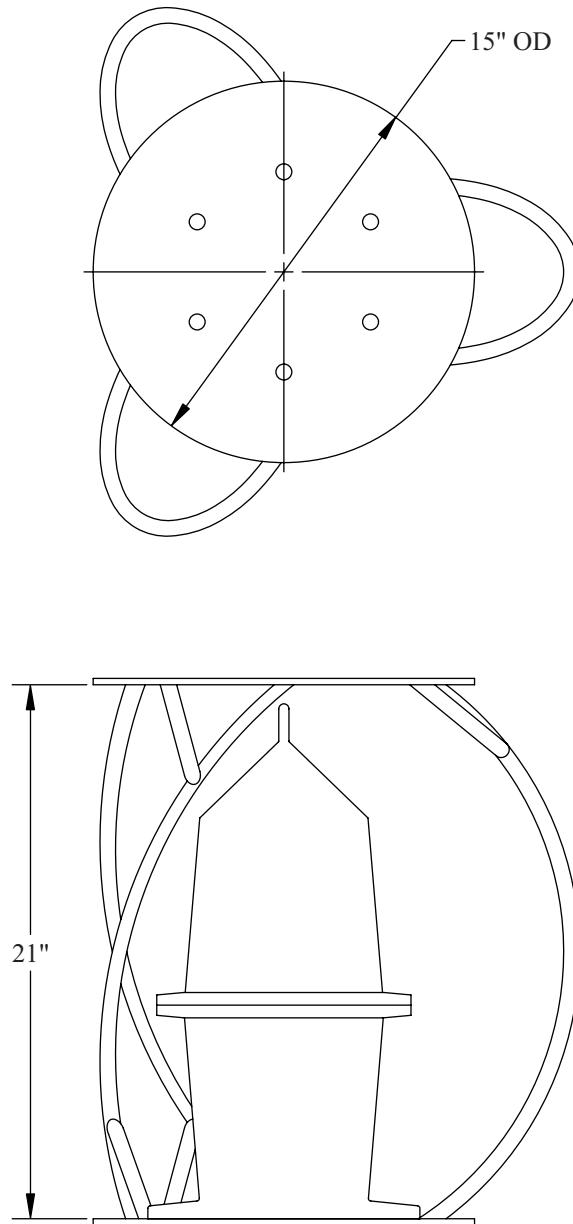
Reference Documents: (use latest rev.)

G-SEC Drawing No. 121101

G-SEC Specification No. 499

Stock Number:

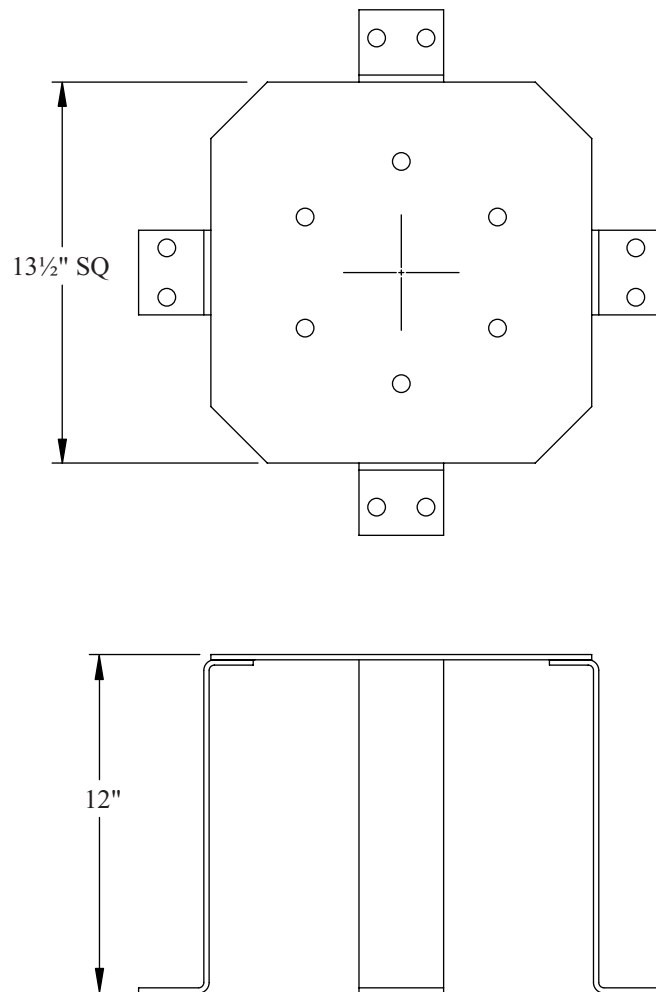
NSN 2050-01-312-9866



Data Sheet 2.L.18. Lantern Bridge.

- 2.L. 19. Topmark Support Flange. This is a steel flange that allows the installation of a topmark on unlighted can buoys by bridging the lifting eye. It is made from galvanized steel. The topmark support flange is mounted on the buoy by drilling eight 5/8 inch diameter holes in the top of the radar reflector and bolting it in place with stainless steel mounting hardware.

Reference Documents: (use latest rev.)
G-SEC Drawing No. 121141



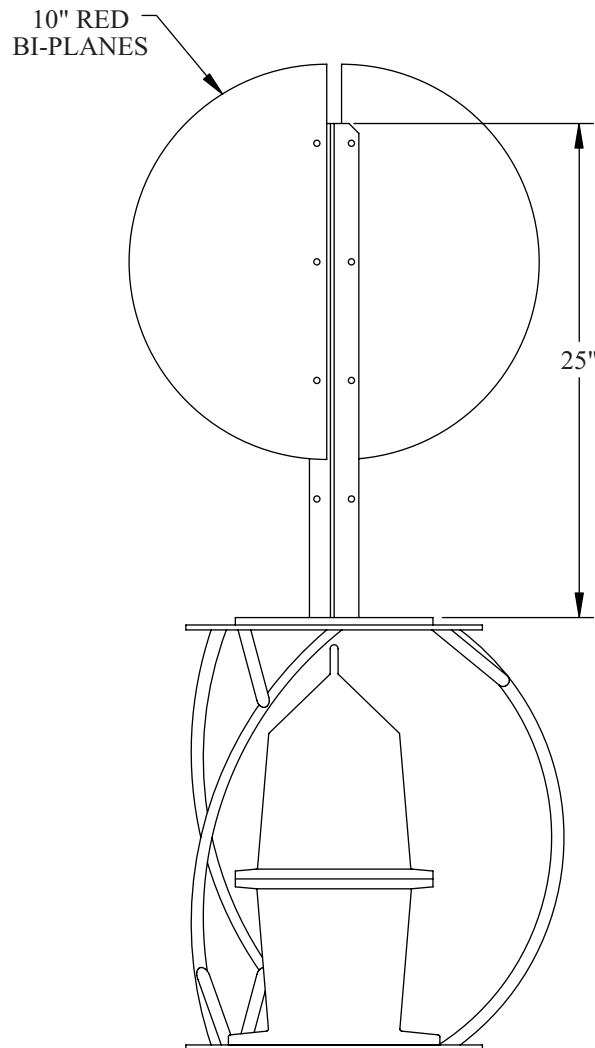
Data Sheet 2.L19. Topmark Support Flange.

2.L. 20. Safe Water Topmark. A single red spherical-shaped topmark is installed on buoys to designate areas of safe water in accordance with IALA requirements. The standard arrangement consists of 4 red (10" radius) bi-plane panels bolted to an aluminum stand.

Reference Documents: (use latest rev.)
G-SEC Drawing No.: Stand: 121138
Bi-Plane: 121144

Stock Numbers:
Short Stand
Lantern Bridge

NSN 2050-01-334-9293
NSN 2050-01-312-9866



Data Sheet 2.L.20. Safe Water Topmark.

2.L.20. Bi-plane Construction. The bi-planes are to be constructed out of either High or Medium Density Overlay (HDO, MDO) plywood.

Source of Supply. These are not available in the supply system. It is the responsibility of the unit to procure them locally or obtain them through their cognizant Industrial Support Command (ISC) or Group Industrial, as applicable.

Signal Coloring. The signal color for the topmarks can be achieved in one of two ways. The preferred alternative is to apply the same elastomeric film that is currently used on dayboards. Either pressure sensitive or heat-activated adhesives are acceptable. After applying the film to both sides of the bi-plane, the edges shall be coated with a sealant to prevent moisture intrusion. Painting the bi-planes is another option. The paints shall be suitable for long-term exposure to the marine environment. For optimal performance, a primer shall be applied to the surface first, followed by a topcoat of the appropriate color. The paints shall be applied to the surfaces and edges of the bi-planes. Whether film or paint is used, the surfaces of the bi-planes shall be lightly sanded first to ensure proper adhesion.

Connecting Bi-planes to Stand. To mount the plywood bi-planes to the aluminum topmark stand use 1/4"-20 X 1-1/4" hex bolts, nuts, and washers.

Data Sheet 2.L.20. (cont'd)

- 2.L. 21. Isolated Danger Topmark. Two black spherical-shaped topmarks are installed on buoys to designate areas of isolated danger in accordance with IALA requirements. The standard arrangement consists of two sets of 4 black (either 5" or 10" radius) bi-plane panels bolted to an aluminum stand.

Reference Documents: (use latest rev.)

G-SEC Drawing No.: Stand: 121138

Bi-Plane: 121144

G-SEC Specification No. 499

Stock Numbers:

Tall Stand

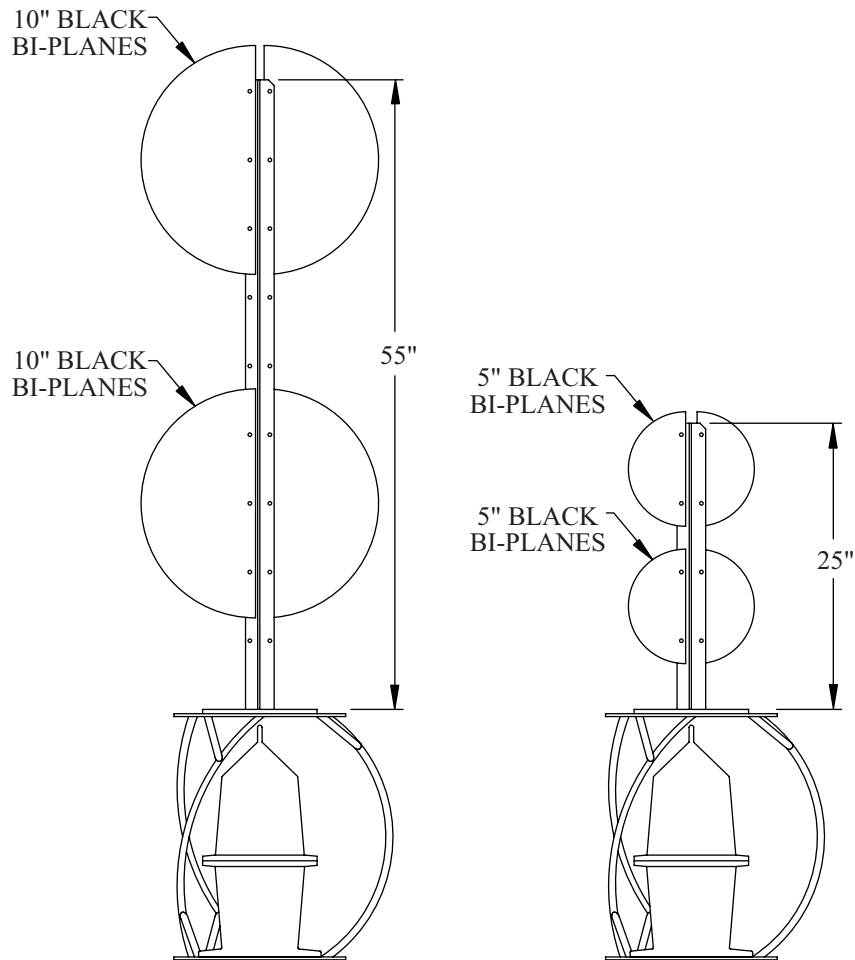
NSN 2050-01-334-8666

Short Stand

NSN 2050-01-334-9293

Lantern Bridge

NSN 2050-01-312-9866



Data Sheet 2.L.21. Isolated Danger Topmark.

2.L.21. Bi-plane Construction. The bi-planes are to be constructed out of either High or Medium Density Overlay (HDO, MDO) plywood.

Source of Supply. These are not available in the supply system. It is the responsibility of the unit to procure them locally or obtain them through their cognizant Industrial Support Command (ISC) or Group Industrial, as applicable.

Signal Coloring. The signal color for the topmarks can be achieved in one of two ways. The preferred alternative is to apply the same elastomeric film that is currently used on dayboards. Either pressure sensitive or heat-activated adhesives are acceptable. After applying the film to both sides of the bi-plane, the edges shall be coated with a sealant to prevent moisture intrusion. Painting the bi-planes is another option. The paints shall be suitable for long-term exposure to the marine environment. For optimal performance, a primer shall be applied to the surface first, followed by a topcoat of the appropriate color. The paints shall be applied to the surfaces and edges of the bi-planes. Whether film or paint is used, the surfaces of the bi-planes shall be lightly sanded first to ensure proper adhesion.

Connecting Bi-planes to Frame. To mount the plywood bi-planes to the aluminum topmark stand use 1/4"-20 X 1-1/4" hex bolts, nuts, and washers.

Data Sheet 2.L.21. (cont'd)

- 2.L. 22. Ice Buoy Domes. Ice buoy domes protect the lanterns on lighted ice buoys. The clear polycarbonate plastic domes are installed with a gasket kit and support ring to provide a watertight seal. A modified 155mm lens is required (see chapter 6 of this manual) as well as the special mounting assembly listed below.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 120981

G-SEC Specification No. 345

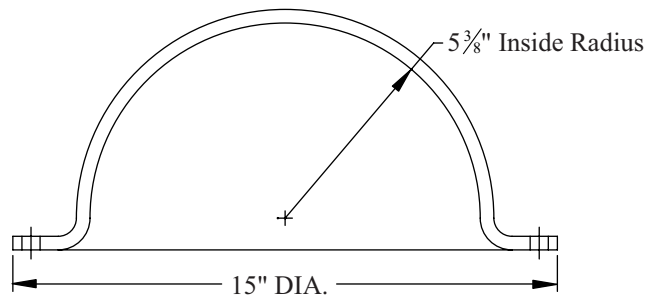
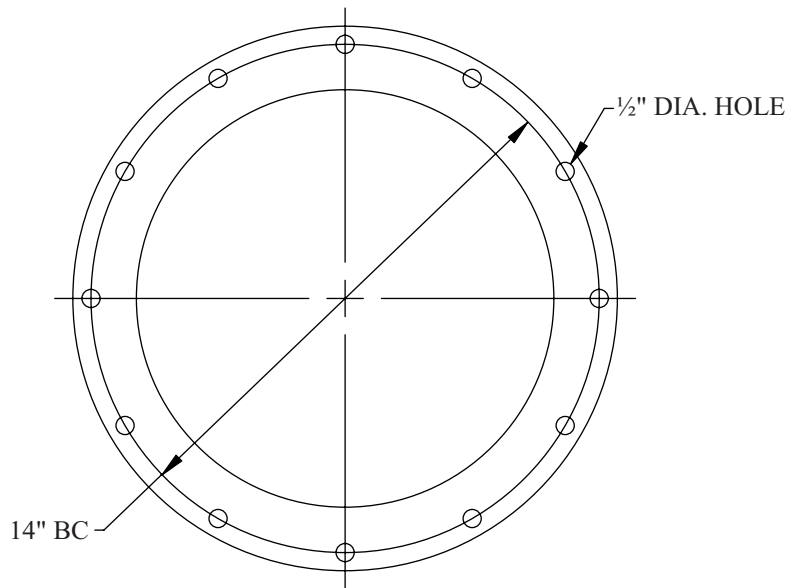
Stock Numbers:

Dome NSN 5340-01-305-5603

Gasket Kit NSN 2050-01-132-2310

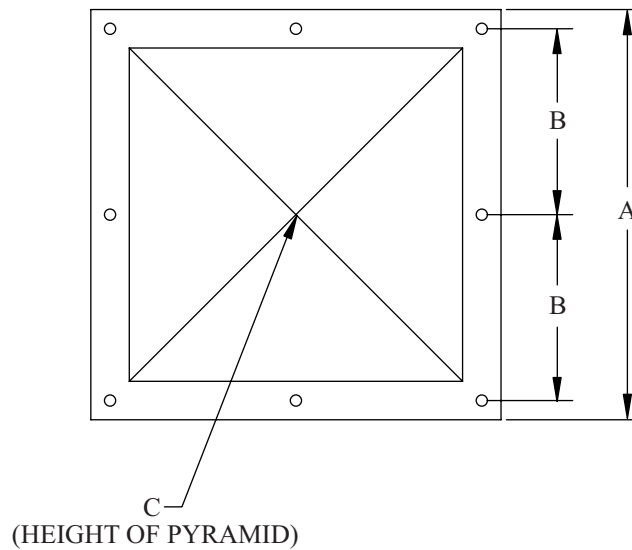
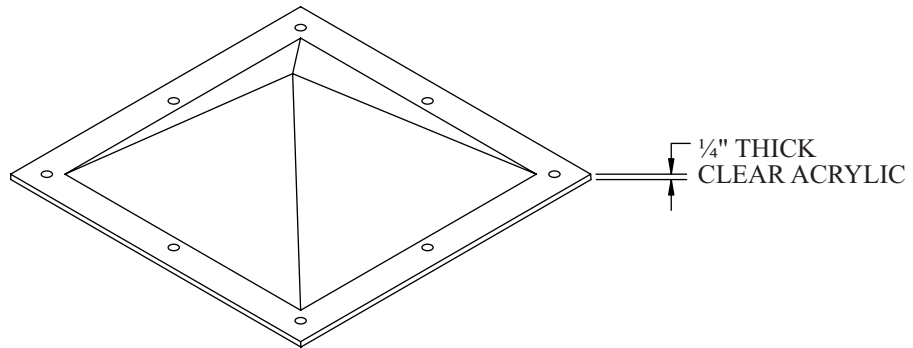
Support Ring NSN 5365-01-137-2432

Bracket Assembly NSN 2050-01-132-5376



Data Sheet 2.L.22. Ice Buoy Domes.

- 2.L. 23. Solar Panel Pyramid. The solar panel pyramid protects the solar panel from bird guano. The pyramids are made from 1/4 inch thick clear acrylic and have a flange for attachment to existing panel mounting bolts. They are available for 10, 20, and 35 watt solar panels. When calculating the solar power requirements, be aware that the pyramid reduces the power output of the solar panel by 35%.



SIZE	A	B	C
10 WATT	16"	7-1/2"	7"
20 WATT	22"	10-1/2"	10"
35 WATT	28"	13-1/2"	13"

Data Sheet 2.L.23. Solar Panel Pyramid.

2.L. 24. Buoy Lift Eyes. Buoy lift eyes are made of steel plate.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121140

G-SEC Specification No. 500

Stock Numbers:

4X7 Lift Eye

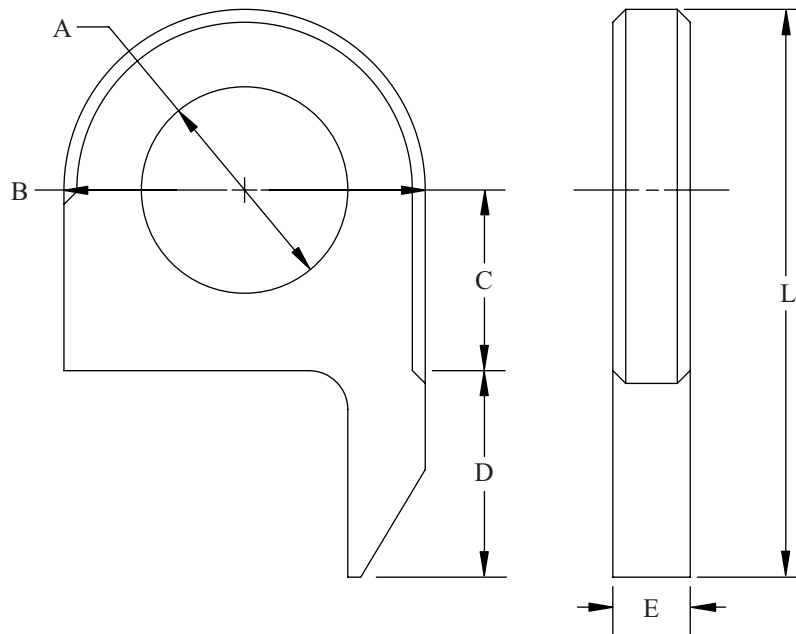
5X9 Lift Eye

5X10 Lift Eye

NSN 2040-01-317-6432

NSN 2040-01-317-6430

NSN 2040-01-317-6431



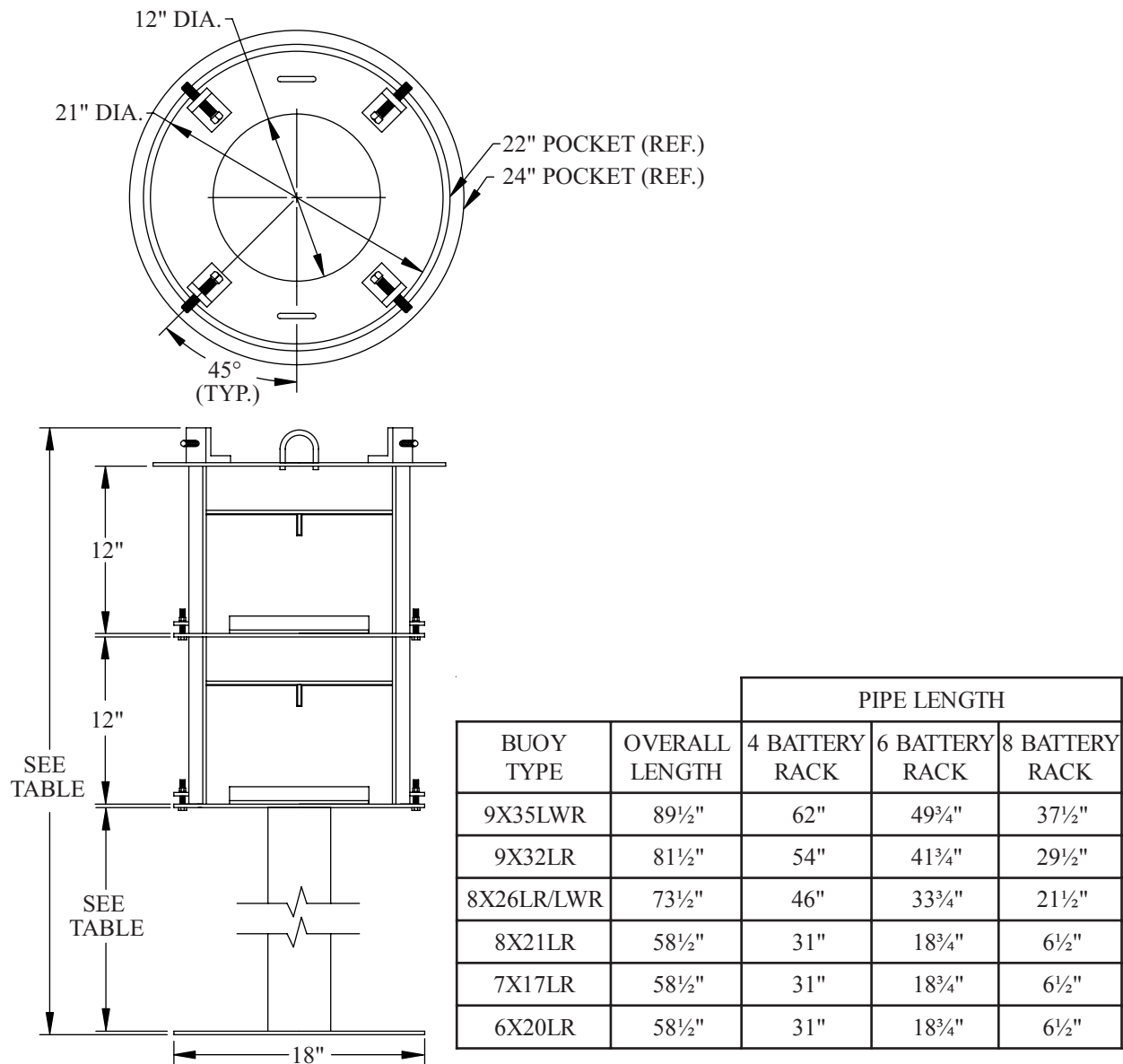
SIZE	A	B	C	D	E	L
4X7	4	7	3.5	5	1.5	12
5X9	5	9	4.75	7.25	2	16.5
5X10	5	10	5	9	2.25	19

Data Sheet 2.L.24. Buoy Lift Eyes.

- 2.L. 25. Buoy Pocket Battery Rack. The buoy pocket battery rack is designed to hold up to 8 batteries. The battery rack is designed to fit in either a 22" buoy pocket or a 24" buoy pocket.

Reference Documents. (use latest rev.)

G-SEC Drawing No. 121178



Data Sheet 2.L.25. Buoy Pocket Battery Rack.

- 2.L. 26. Radar Reflector. Aluminum can and nun radar reflectors are available for 5X9LFR, 5X11LR, and 3 1/2X8LR buoys. Radar reflectors are delivered with a primer coat only. They shall be color coated to match the buoy.

Reference Documents: (use latest rev.)

G-SEC Drawing No.: 121024 (Can Radar Reflector)
120316 (Nun Radar Reflector)

G-SEC Specification No. 374

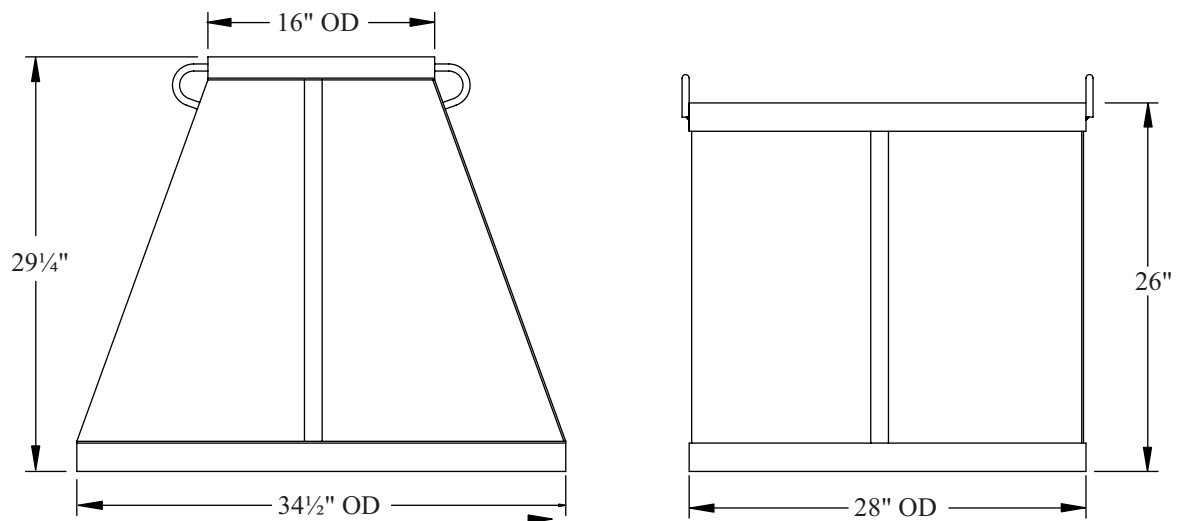
Stock Numbers:

Can Radar Reflector

NSN 5840-01-043-6233

Nun Radar Reflector

NSN 5840-01-261-9882

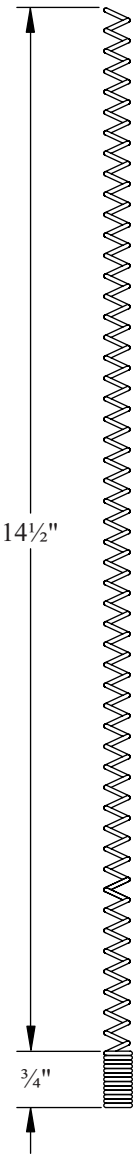


Data Sheet 2.L.26. Radar Reflector.

2.L. 27. Solar Panel Bird Springs. Bird springs are stainless steel springs mounted on the corners of the solar panel. They are designed to keep guano off the solar panel by discouraging birds from roosting on the panel. Bird springs are delivered in lots of 25.

Stock Number

NSN 5360-01-100-3111

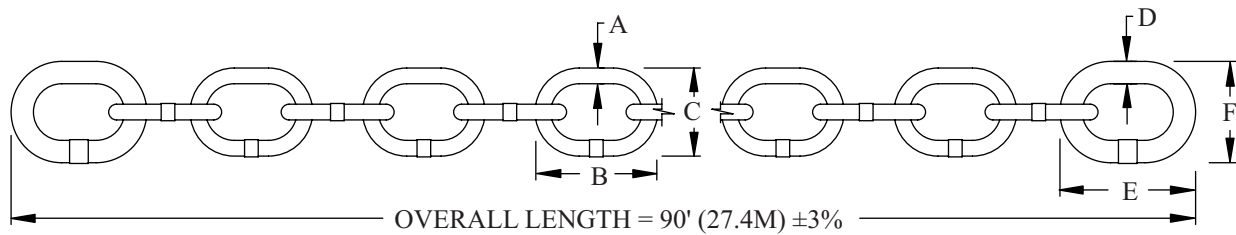


Data Sheet 2.L.27. Solar Panel Bird Springs.

2.M. Buoy Mooring Equipment. Buoy mooring equipment is presented in this section.

2.M. 1. Buoy Chain. Buoy chain connects the buoy to the sinker.

- a. Reference Documents. (use latest rev.)
 G-SEC Drawing No. 121032
 G-SEC Specification No. 377
 MOORSEL (Computer Aided Mooring Selection Guide)



DIMENSIONS (INCHES)						PHYSICAL VALUES				
COMMON LINKS			END LINKS*			PROOF LOAD	BREAK LOAD	WEIGHT		DRY SHOT WEIGHT (LBS)
A	B	C	D	E	F			(LBS/FT)	DRY	
1/2	3	1-7/8	3/4	4-1/2	2-11/16	7,500	15,000	2.33	2.03	210
3/4	4-1/2	2-11/16	7/8	5-1/4	3-1/8	16,000	32,000	4.88	4.24	440
7/8**	5-1/4	3-1/8	1-1/8	6-3/4	4	22,000	44,000	6.61	5.75	595
1	6	3-9/16	1-1/4	7-1/2	4-7/16	29,000	58,000	8.33	7.24	750
1-1/8	6-3/4	4	1-1/4	7-1/2	4-7/16	38,500	77,000	10.55	9.17	950
1-1/4	7-1/2	4-7/16	1-1/2	9	5-5/16	45,500	91,000	13.33	11.59	1,200
1-1/2	9	5-5/16	1-7/8	11-1/4	6-11/16	65,500	131,000	19.33	16.8	1,740
1-5/8**	9-3/4	5-13/16	1-7/8	11-1/4	6-11/16	76,500	163,000	22.52	19.59	2,027
1-3/4	10-1/2	6-1/4	2-1/8	12-3/4	7-7/16	86,500	173,000	26.11	22.70	2,350
1-7/8	11-1/4	6-11/16	2-1/8	12-3/4	7-7/16	100,000	200,000	30.00	26.08	2,700
2	12	7-1/8				116,000	232,000	34.33	29.85	3,090
2-1/8	12-3/4	7-9/16				131,000	262,000	38.66	33.62	3,480
2-1/4	13-1/2	8-1/16				147,000	294,000	43.44	37.78	3,910

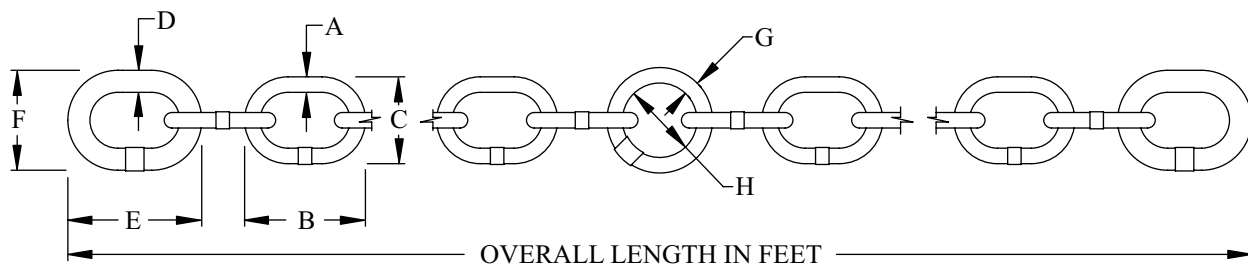
* End links are currently provided on 1/2" chain only. The dimensions for end links on the other chain sizes are shown in this table for reference purposes.

** 7/8" and 1-5/8" chain is no longer being manufactured. The dimensions for these chain sizes are shown in this table for reference purposes.

Data Sheet 2.M.1. Buoy Chain.

2.M. 2. Buoy Bridles. A buoy bridle is used to distribute the mooring load to the buoy mooring eyes. Bridles are fabricated from buoy chain and contain a large round link in the center for the mooring connection.

- a. Reference Documents. (use latest rev.)
 G-SEC Drawing No. 121031
 G-SEC Specification No. 377
 MOORSEL (Computer Aided Mooring Selection Guide)



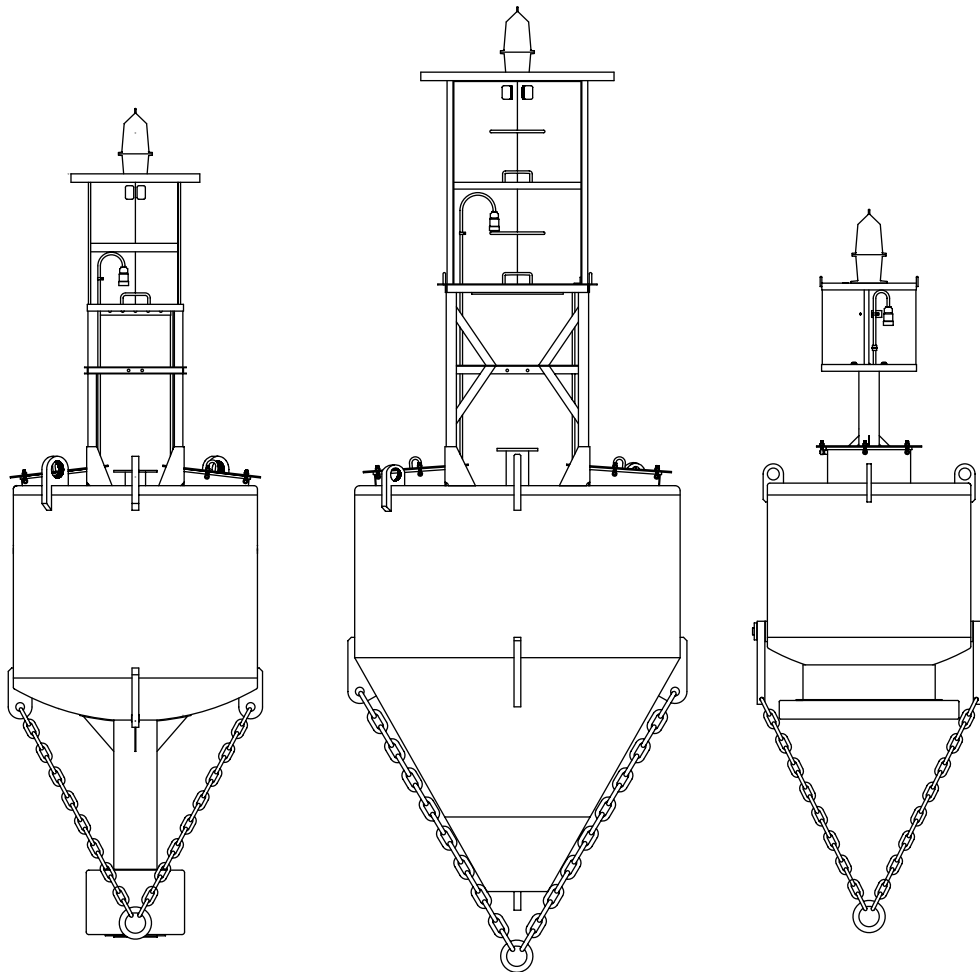
DIMENSIONS (INCHES)									PHYSICAL VALUES			
COMMON LINKS			END LINKS			RING		LENGTH FEET	PROOF LOAD (LBS)	BREAK LOAD (LBS)	WEIGHT (LBS)	
A	B	C	D	E	F	G	H				DRY	WET
7/8	5-1/4	3-1/8	1-1/8	6-3/4	4	1-1/4	6	10	22,000	44,000	70	61
1	6	3-9/16	1-1/4	7-1/2	4-7/16	1-3/4	6	12	29,000	58,000	120	104
1-1/4	7-1/2	4-7/16	1-1/2	9	5-5/16	1-3/4	6	15	45,500	91,000	212	184
1-1/2	9	5-5/16	1-7/8	11-1/4	6-11/16	2-1/4	8	18	65,500	131,000	400	348
1-1/2	9	5-5/16	1-7/8	11-1/4	6-11/16	2-1/4	8	20	65,500	131,000	430	374
1-1/2	9	5-5/16	1-7/8	11-1/4	6-11/16	2-1/4	8	26	65,500	131,000	557	484

Data Sheet 2.M.2. Buoy Bridles.

2.M.2.

Buoy Bridles. (Cont'd). The table and the figures below show the appropriate bridle for each buoy type, and the correct bridle placement for each of the three buoy bottom configurations.

Buoy Type	Bridle Size
9X38LR	1-1/2 x 26
9X35LWR	1-1/2 x 20
9X32LR	1-1/2 x 18
9X20R	1-1/4 x 15
8X26LR	1-1/4 x 15
8X26LWR	1-1/4 x 15
8X21LR	1-1/4 x 15
7X20LI	1-1/4 x 15
7X17LR	1-1/4 x 15
6X20LR	1 x 12
5X11LR	1 x 12
3.5X8LR	7/8 x 10



Data Sheet 2.M.2. (Cont'd).

2.M.3. **Shackles.** Shackles are used to connect lengths of buoy chain, and to attach the chain to bridles, sinkers, and buoys. They are made of forged or die-cast carbon steel. Shackles are of the split-key or rivet-pin type. Split-key shackles are used to connect the bridle to the buoy, the swivel to the bridle, the chain to the swivel, and the sinker to the chain. A split-key shackle assembly includes a stainless steel split-key which is inserted into the pin and bent open to prevent the pin from backing out. Rivet-pin shackles are used for splicing sections of chain together. They are assembled by heating and hammer forging the end of the pin, and are sometimes referred to as “heat and beat” shackles. **Note: Shackles shall not be used in the chafe section of the mooring.**

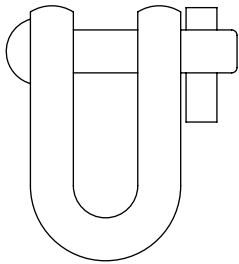
- a. Reference Documents. (use latest rev.)
 G-SEC Drawing No. 121079
 G-SEC Specification No. 417

Stock Numbers:

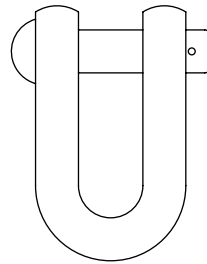
1st Class Split-Key Shackle Assembly	NSN 4030-00-236-8403
2nd Class Split-Key Shackle Assembly	NSN 4030-00-236-8402
3rd Class Split-Key Shackle Assembly	NSN 4030-01-286-6205
4th Class Split-Key Shackle Assembly	NSN 4030-01-286-6204
Special Class Split-Key Shackle Assembly	NSN 4030-00-527-8871
1st Class Rivet Pin-Shackle Assembly	NSN 4030-00-267-7077
2nd Class Rivet Pin-Shackle Assembly	NSN 4030-00-267-7079
3rd Class Rivet Pin-Shackle Assembly	NSN 4030-00-267-7078
4th Class Rivet Pin-Shackle Assembly	NSN 4030-00-729-6093
1st Class Split Key-Shackle Pin	NSN 5315-00-300-0370
2nd Class Split Key-Shackle Pin	NSN 5315-00-300-0369
3rd Class Split Key-Shackle Pin	NSN 5315-00-300-0368
4th Class Split Key-Shackle Pin	NSN 5315-00-300-0367
1st Class Rivet Pin-Shackle Pin	NSN 5315-00-300-0374
2nd Class Rivet Pin-Shackle Pin	NSN 5315-00-300-0373
3rd Class Rivet Pin-Shackle Pin	NSN 5315-00-300-0372
4th Class Rivet Pin-Shackle Pin	NSN 5315-00-300-0371
1st, 2nd, 3rd Class-Split Key	NSN 5315-00-161-4607
4th Class Split-Key	NSN 5315-00-161-4612
Special Class Split-Key	NSN 5315-00-148-2905

Data Sheet 2.M.3. Shackles.

2.M.3



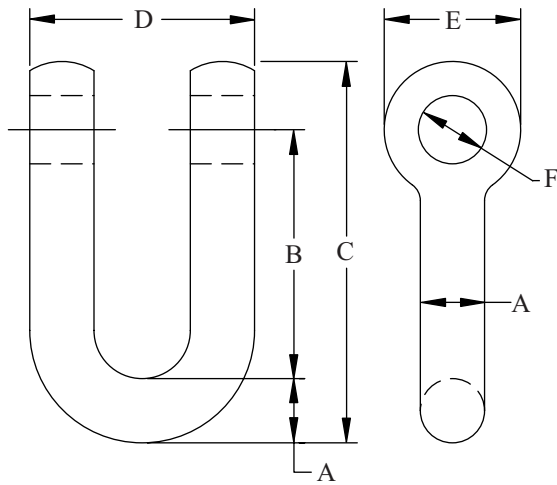
SPLITKEY SHACKLE ASSEMBLY



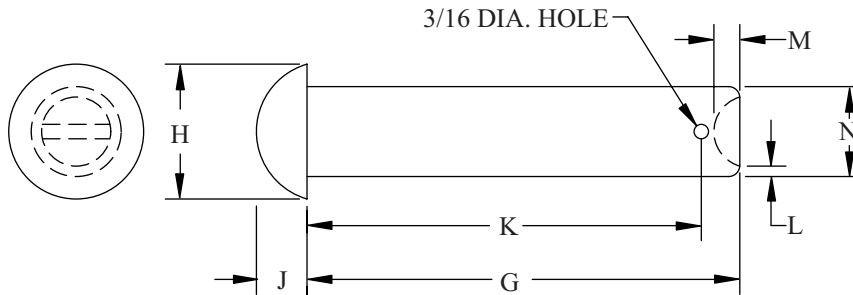
RIVETPIN SHACKLE ASSEMBLY

CLASS	PROOF LOAD	BREAKING LOAD	WEIGHT (APPROX.)	
			DRY	WET
1st	115,000	230,000	40	35
2nd	90,000	180,000	27	23
3rd	65,000	130,000	16	14
4th	30,000	60,000	6	5
SPECIAL*	180,000	360,000	75	65

* SPLIT KEY PIN TYPE ONLY



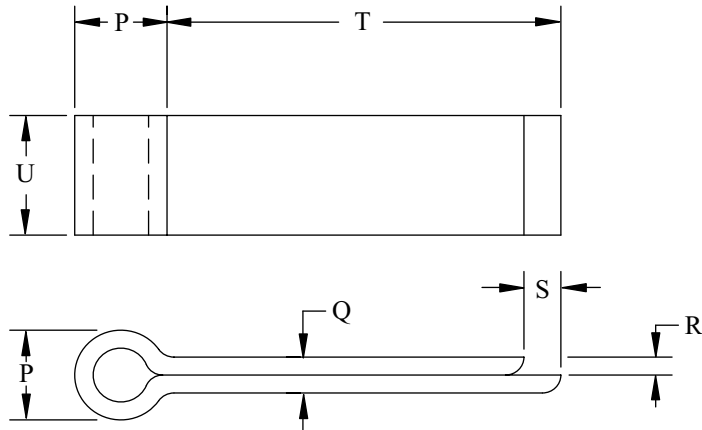
CLASS	A	B	C	D	E	F
1st	2	7-3/4	11-7/8	7	4-1/4	2-1/8
2nd	1-3/4	6-7/8	10-1/2	6-1/4	3-3/4	1-7/8
3rd	1-1/2	5-1/4	8-1/2	5-1/4	3-1/4	1-5/8
4th	1	4-1/8	6-1/2	4-1/4	2-1/2	1-1/8
SPECIAL	2-1/2	9	14-1/4	11	5-1/2	2-5/8
TOLERANCES	±1/16	±1/4	REF.	+3/16 -1/8	+1/4 -1/8	±1/32



CLASS	G	H	J	K	L	M	N
1st	8	3	1-1/8	7-1/4	3/16	3/8	2
2nd	7-1/8	2-3/4	1	6-1/2	3/16	3/8	1-3/4
3rd	6	2-1/2	7/8	5-1/2	3/16	1/4	1-1/2
4th	5	1-5/8	5/8	4-1/2	1/8	1/4	1
TOLERANCES	±1/16	±1/16	±1/64	±1/16	±1/32	±1/32	±1/32

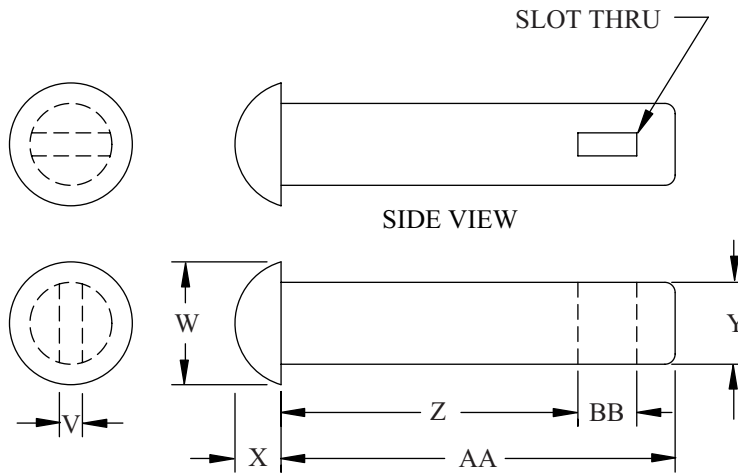
Data Sheet 2.M.3. (cont'd).

2.M.3



SPLIT KEY

CLASS	P	Q	R	S	T	U
1st, 2nd 3rd	15/16	3/8	3/16	3/8	4	1-1/4
4th	13/16	1/4	1/8	3/8	4	7/8
SPECIAL	1-1/16	3/8	3/16	3/8	5	1-1/4
TOLERANCES	±1/16	±1/32	±1/64	±1/16	±1/16	±1/32



SPLIT KEY PIN

CLASS	V	W	X	Y	Z	AA	BB
1st	9/16	3	1-1/8	2	7-1/2	9-5/8	1-7/16
2nd	9/16	2-3/4	1	1-3/4	6-1/2	8-7/8	1-7/16
3rd	9/16	2-1/2	7/8	1-1/2	5-1/2	7-7/8	1-7/16
4th	7/16	1-5/8	5/8	1	4-1/2	6-1/8	1-1/16
SPECIAL	9/16	3-1/2	1-3/8	2-1/2	11-1/4	13-3/4	1-7/16
TOLERANCES	±1/32	±1/16	±1/16	±1/32	±1/16	±1/16	±1/16

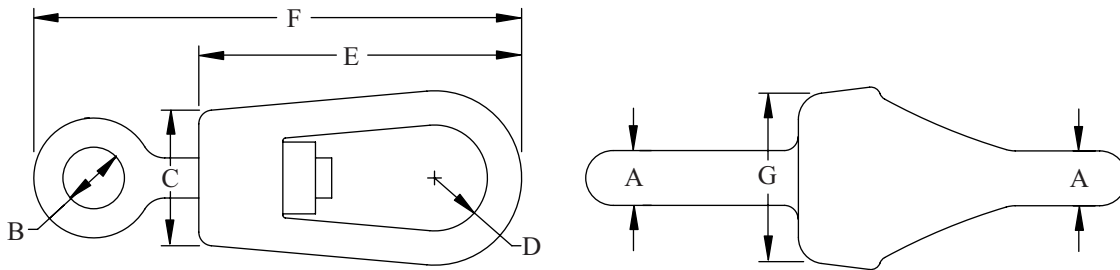
Data Sheet 2.M.3. (cont'd)

2.M.4. Swivels. Buoy swivels are included in the mooring to allow the buoy to twist without causing the chain to kink. They are forged or die-cast from carbon steel. Swivels are normally mounted between the bridle and the riser chain, but can be placed approximately one shot below the bridle depending on the water depth. They are never to be placed in the chafe zone. Swivels are to be installed with the round eye toward the bridle.

- a. Reference Documents. (use latest rev.)
 G-SEC Drawing No. 121081
 G-SEC Specification No. 417

Stock Numbers:

1st Class Swivel	NSN 4030-00-729-6089
2nd Class Swivel	NSN 4030-00-729-6090
3rd Class Swivel	NSN 4030-00-729-6091
4th Class Swivel	NSN 4030-00-729-6094



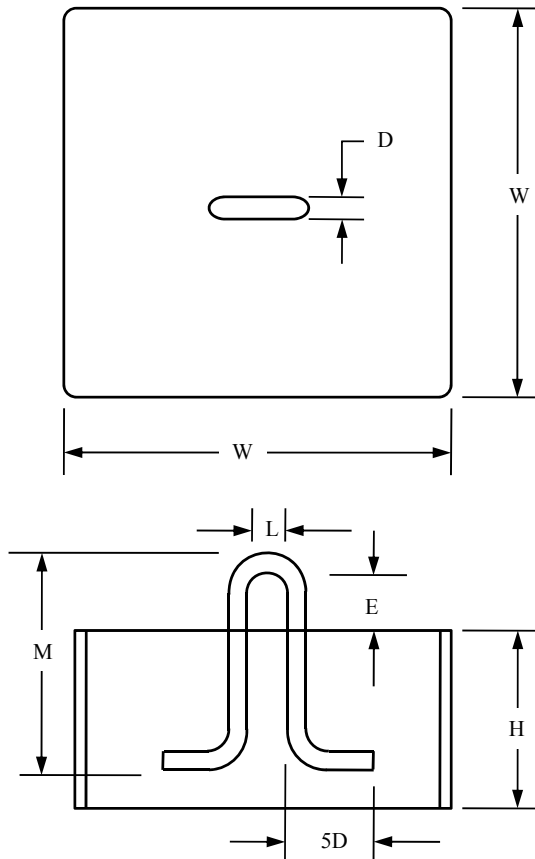
CLASS	DIMENSIONS (INCHES)							PROOF LOAD	BREAK LOAD	WEIGHT (LBS)
	A	B	C	D	E	F	G			
1ST	2	3	6	2-1/4	12	19-3/4	6-3/4	82,000	164,000	78
2nd	1-3/4	2-3/4	5	1-7/8	10-3/4	17-3/4	5-3/4	60,000	120,000	52
3rd	1-1/2	2-1/2	4-1/2	1-5/8	9-1/2	15-3/4	5	45,000	90,000	39
4th	1-1/4	2-1/4	4	1-1/2	7-3/4	13	4-1/2	30,000	60,000	19

Data Sheet 2.M.4. Swivels.

2.M.5.

5. Concrete Sinkers. Sinkers are used to hold the buoy in position. They are cheap, easy to fabricate locally and can be retrieved for inspection. The sinker bail is fabricated from carbon steel and the concrete has a minimum tensile strength of 3000 psi. Concrete sinkers shall be cast in a single pour. **Buoy chain shall not be used for the sinker bail.** Any sinkers currently in use that have a buoy chain bail shall be removed from service as soon as possible. However, scrap buoy chain may be added to the sinker for additional weight. When this is done the actual weight of the sinker must be determined and the sinker must be permanently marked to show the actual weight.

- a. Reference Documents. (use latest rev.)
 G-SEC-Drawing No 121068
 G-SEC Specification No. 407



NOMINAL WEIGHT (LBS)	SINKER DIMENSIONS (IN)					
	W	H	D	L	E	M
20,000	70	51	2	5	5	22
18,000	70	46	2	5	5	22
15,000	70	38	2	5	5	22
12,500	60	43	2	5	5	22
8,500	60	30	2	5	5	22
6,500	60	23	2	5	5	22
5,000	50	25	2	5	5	22
4,000	50	20	2	5	5	22
3,000	50	15	2	5	5	17
2,000	36	20	1-1/2	5	5	22
1,000	36	10	1-1/2	5	5	12
500	22	14	1-1/2	5	5	17
250	22	8	1-1/2	5	5	11

Note: For 500 lbs sinker and 250 lbs sinker, use the dimension 3D.

Data Sheet 2.M.5. Concrete Sinkers.

2.M.6.

6. DOR-MOR Anchor. The DOR-MOR anchor is a cast iron, pyramid-shaped sinker. It is designed for use in areas with mud or sand bottoms. DOR-MORs are available in sizes ranging from 15 pounds to 4,000 pounds. Because cast iron is much denser than concrete, these anchors have significantly more holding power than concrete sinkers of the same weight. This means that sinker weight can be reduced while retaining equivalent holding power on station. For example, field tests have shown that 35 pound DOR-MORs can substitute for 100-pound concrete sinkers, 70-pound DOR-MORs for 500-pound concrete sinkers and 135-pound DOR-MORs for 1,000-pound concrete sinkers. DOR-MORs in these sizes are especially useful for small plastic and foam buoys (4th class and below), which are typically serviced by units with limited weight handling capability. Larger DOR-MORs may also be used for special applications and unique situations where a traditional concrete sinker is not sufficient. Keep in mind, however, that the larger DOR-MOR anchors are significantly more expensive than the equivalent concrete sinkers.

DOR-MOR anchors may be purchased from:

DOR-MOR, Inc.
RR 2, Box 476
Claremont, NH 03743
603-542-7696
www.dor-mor.com



Data Sheet 2.M.6. DOR-MOR Anchor.

- a. Examples. The buoys on the left are new buoys. The buoys in the middle have been in service. The daymark shapes are identifiable, they are stable, and they have adequate freeboard remaining. They should be kept on station. The buoys on the right have significant damage. The nun hull has been damaged enough to cause water intrusion and/or instability. The can daymark shape has been altered, the buoy is listing, and there is insufficient freeboard remaining. Both of these buoys should be relieved..

NEW BUOY



KEEP ON STATION



RELIEVE THE BUOY



NEW BUOY



KEEP ON STATION



RELIEVE THE BUOY



6. Metalwork. The metalwork of a foam buoy will deteriorate over time

CHAPTER 3. BUOY MARKINGS

- A. Introduction. This chapter presents all of the information required to properly mark buoys.
- B. Selection Guide. Select the marking scheme for buoys by referring to the *Aids to Navigation Manual-Administration* (COMDTINST M16500.7).
- C. Preparation and Installation. After the marking scheme selection has been completed, the data sheets in this chapter are the guides for buoy appearance. The actual mechanics of preparing and installing a buoy are outlined in chapter 2 of this volume, where reference is made to both chapter 4 of the *Coatings and Color Manual* (COMDTINST M10360.3) and to this chapter. The *Coatings and Color Manual* provides information on how to apply the markings. This chapter explains where to place the markings by including illustrations of marked buoys on the data sheets, along with notes for clarification of color, sizes, and positions. Note: The U.S. Coast Guard conducts extensive tests to determine what types of films are suitable for use in a marine environment. Qualified films are published on a Qualified Products List (QPL). The QPL is available from G-ECV 202-267-1891.
- D. Inspection, Maintenance and Repair On Station.
 1. Maintenance/Inspection Schedule. Inspect all buoys annually.
 2. Maintenance/Inspection Requirements. Cuts and abrasions over 6 in. in length, or those which penetrate the old coating through to bare metal, shall be repainted. If more than 25 percent of the surface area presented as a visual signal is obscured with bird fouling, marine growth, or physical deterioration (peeling, scaling, etc.), the area should be cleaned or painted to present a "like new" appearance. Painting procedures are specified in the *Coatings and Color Manual*.
 3. Paint Procurement. Buoy paint shall be obtained from GSA. The paint conforms to Federal Specification TT-E-002124B of October 7, 1987. If buoys are purchased from commercial sources, we recommend that buoy paint be Government Furnished Equipment (GFE) or the supplier be authorized to buy from GSA.

3.D.3.

<u>COLOR***</u>	<u>FED STD 595A</u> <u>CHIP #**</u>	<u>NATIONAL STOCK NUMBER</u> <u>FOR ONE GALLON</u>
RED (Munsell 7.5 R 4/16)	31350	8010-01-241-9734
GREEN (Munsell 2.5 G 5/12)	14193	8010-01-136-5240
YELLOW (Munsell 2.5 Y 8/12)	23655	8010-01-186-3082
WHITE	27875	8010-01-185-9688
BLACK	27038	8010-01-078-8665
BLUE	15182	8010-01-036-6344
INTERNATIONAL ORANGE	12197	8010-01-199-1259
GREEN*	14062	NONE

* This green is authorized for use in the Second Coast Guard District only. It is not available from GSA or E/G-ICP and must be procured by the user. The paint shall conform to Federal Specification TT-E-002124B of October 7, 1987.

** The GSA Specification Branch sells 3X5 inch color chips. Phone (202)472-2205 or (202)472-2140 for price and availability. Use Federal Standard 595A chip numbers when ordering.

*** Samples of paint may be sent to the Coast Guard Research and Development Center for color verification. Samples shall be a colored flat, about 2-inches square, without any holes drilled in them. Provide your phone number and a contact for confirmation within 48 hours. Samples may be sent to:

U.S. Coast Guard
 Research & Development Center
 Avery Point
 Groton, CT 06340
 Physics Branch, Paint QA
 Attention: R. E. Stachon

4. Retroreflective Film & Character Procurement. The 3M Company and Reflexite Corporation are the only suppliers on the QPL. Films and letters (F to Z) must be purchased from the supplier that has the annual requirements contract. Letters (A to E) and numbers (0 to 9) must be ordered from the E/G-ICP. Conformable, pressure sensitive film, and characters should be used on buoys.

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LATERAL PORT MARKS

3.E. General Description Data Sheets.

Radar Reflector Type:

Color. Green (Munsell chip number 2.5G 5/12).

Characters. Largest odd white retroreflective NUMERAL, not to exceed 16 in., that will fit in the available area without crowding. Located as far right as possible on each right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. Green panels, one on each left-hand radar reflector, height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

Color: Same as for Radar Reflector Type.

Characters. Largest odd white retroreflective NUMERAL, not to exceed 16 in. or one-quarter of the buoy freeboard, that will fit without crowding. Located under or beside retro panels on each daymark plate (lighted) or in three sets spaced 120 apart (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. Green panels, one sized to fit each daymark plate, with a minimum width of 6 in. (lighted), or three panels spaced 120 apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment (unlighted).

Note. Plastic radar reflecting buoys shall be marked like metal noradar reflecting buoys because they both have similar shapes.

Data sheet 3-E(1). Lateral port marks.

3.E.

Lighted



Unlighted



Figure 3-1. Lateral port marks.

Data Sheet. 3-E(1). (cont'd).

Lateral port marks.

Data Sheet. 3-E(1). (cont'd).

3.E.

LATERAL STARBOARD MARKS

Radar Reflector Type:

Color. Red (Munsell chip number 7.5 R 4/16)

Characters. Largest, even, white retroreflective NUMERAL, not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on each right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels, one of each left-hand radar reflector, height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Largest even white retroreflective NUMERAL, not to exceed 16 in. or one-quarter of the buoy freeboard. Located under or beside retro panels on each daymark plate (lighted) or in three sets spaced 120 apart (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels, one sized to fit each daymark plate, with a minimum width of 6 in. (lighted), or three panels spaced 120 apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment (unlighted).

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

Data Sheet 3-E(2). Lateral starboard marks.

3 . E .

Lighted



Unlighted



Figure 3-2. Lateral starboard marks.

Data Sheet 3-E(2). Lateral starboard marks. (cont'd).

Data Sheet 3-E(2). Lateral starboard marks. (cont'd).

3.E.

SAFEWATER MARKS

Radar Reflector Type:

Color. Alternating red and white vertical stripes. (Munsell chip number 7.5 R 4/16 for red, Federal color number 27875 for white.)*

Characters. Largest, white retroreflective LETTER, not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on the red, right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. White panels, one of each white left-hand radar reflector vane; height to fit in area of reflector and minimum width of 6 in.

*Note: Federal color numbers refer to Federal Standard 595a "Color".

Nonradar Reflector Type:

Color. Six alternating red and white vertical stripes. Same colors as radar reflector type.

Characters. Largest white retroreflective LETTER, not to exceed 16 in. or one-quarter of the buoy freeboard. Located on the red right-hand side of each daymark plate, (lighted) or in three sets centered on each red vertical stripe (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. White panels, one on the white left-hand side of each daymark plate, with a height to fit on the plate and a minimum width of 6 in. (lighted), or three panels, one centered on each white vertical strip (unlighted), with a minimum size of 1 sq ft each.

Data Sheet 3-E(3). Safewater marks.

3 . E .

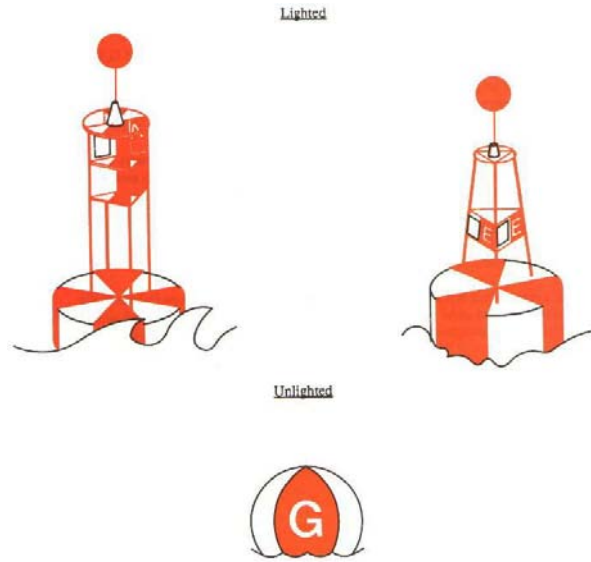


Figure 3-3. Safe water marks.
Data Sheet. 3-E(3). (cont'd).

Data Sheet. 3-E(3). (cont'd).

PREFERRED CHANNEL MARKS

Radar Reflector Type:

Color. Alternating red and green horizontal bands (Munsell chips 7.5 R 4/16 and 2.5 G 5/12).

Characters. Largest white retroreflective LETTER, not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on the right-hand radar reflector. Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels on buoys with a red band uppermost, green panels on buoys with a green band uppermost. One panel of each left-hand radar reflector; height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

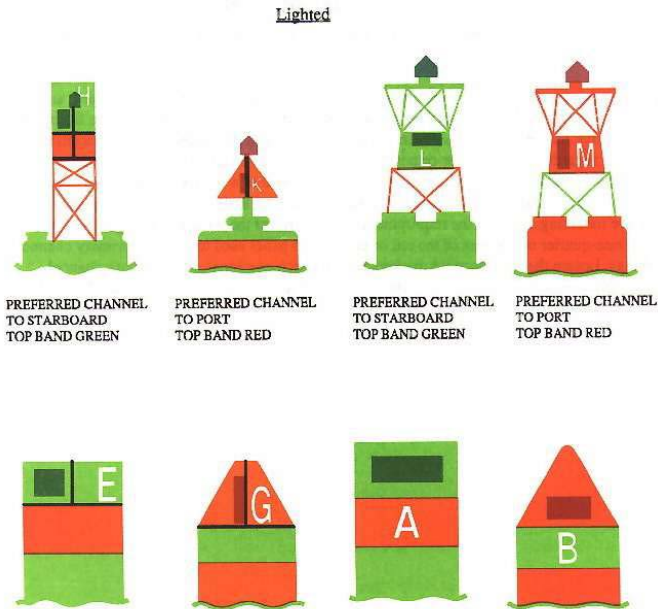
Characters. Largest white retroreflective LETTER, not to exceed 16 in. or one-quarter of the buoy freeboard. Located under or beside retro panels on each daymark plate (lighted) or in three sets spaced 120 apart (unlighted). Multiple characters are displayed horizontally (side by side).

Retro Panels. Red panels on buoys with a red band uppermost, green panels on buoys with a green band uppermost. One panel on each daymark plate, with a height to fit on the plate and a minimum width of 6 in. (lighted), or three panels spaced 120 apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment (unlighted).

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

Data Sheet 3-E(4). Preferred channel marks.

3 . E .



Note. Because of the small surface area available for the alternate color on 1952-, 1942-, or 1928-type lighted buoys, they shall not be installed as junction markers. Existing buoys shall be changed to the 1962-type at the next relief.

Figure 3-4. Preferred channel marks.

Data Sheet 3-E(4). (cont'd).

Note. Because of the small surface area available for the alternate color on 1952-, 1942-, or 1928-type lighted buoys, they shall not be installed as junction markers. Existing buoys shall be changed to the 1962-type at the next relief.

Data Sheet 3-E(4). (cont'd).

3.E.

DUAL-PURPOSE PORT, STARBOARD,
PREFERRED CHANNEL MARKS

Marking: Radar and Nonradar Reflector Types

Color. Identical to port, starboard, and preferred channel marks (Data Sheets 3-D(1), 3-D(2), and 3-D(4)).

Retro Panels. In addition to the red and green retro panels outlined for port, starboard, and preferred channel marks, dual-purpose marks shall have squares and triangles made from yellow retroreflective material. The squares indicate that the aid is a port mark for the intracoastal waterway, regardless of the color or number of the aid. Conversely, triangles indicate a starboard side mark for the intracoastal waterway. The size of a square should be between 3 and 6 in. on a side and the size of a triangle should be between 4 and 6 in. on a side, depending on available mounting area and the requirement that the area of the square or triangle shall not exceed one-quarter of the area of the red or green retro panel used to note the primary channel markings. Locate the dual-purpose markers beneath each combination of primary channel characters/retro-panel markings using the available space on radar reflector vanes, daymark plates, or the buoy body, as shown in Figures 3-5 and 3-6.

Data Sheet 3-E(5). Dual-purpose port,
starboard, and preferred channel marks.

3 . E .

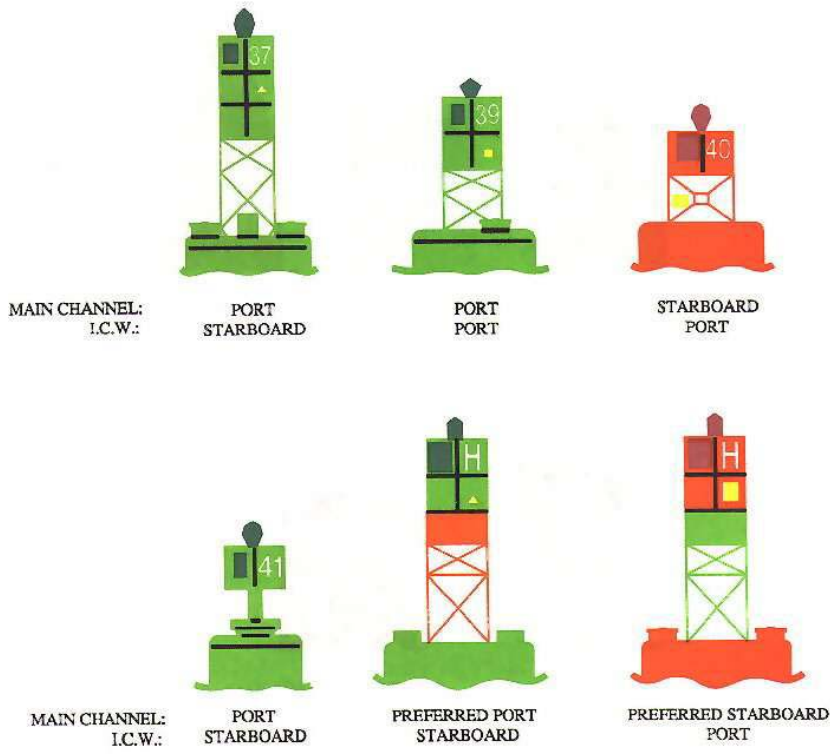


Figure 3-5. Dual-purpose port, starboard, and preferred channel marks.

Data Sheet. 3-E(5). (cont'd).

Data Sheet. 3-E(5). (cont'd).

3 . E .

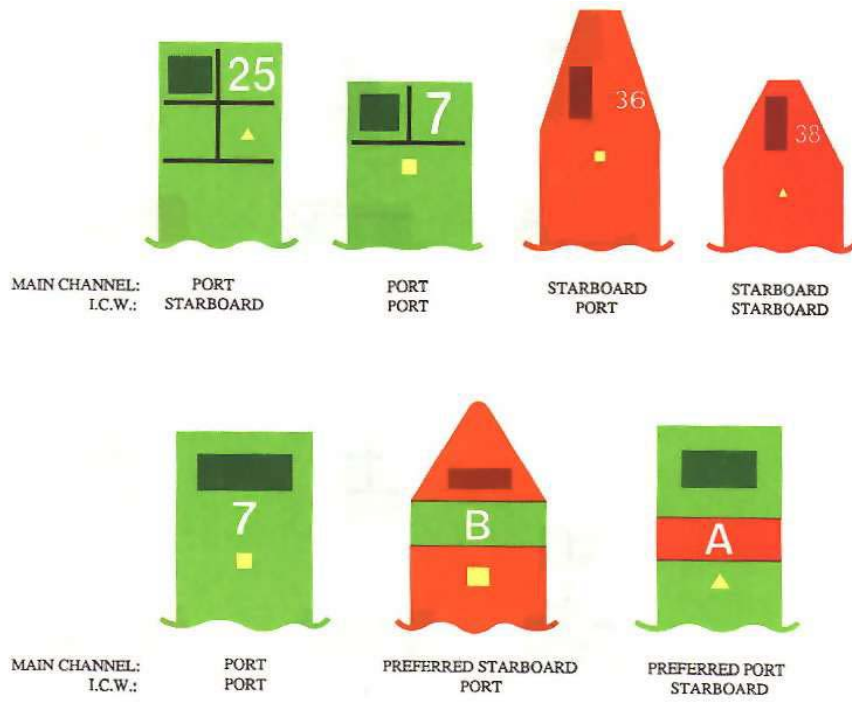


Figure 3-6. Dual-purpose port, starboard, and preferred channel marks.

Data Sheet. 3-E(5). (cont'd).

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CH-1

SPECIAL AID MARKS

Radar Reflector Type:

Color. Yellow Munsell chip number 2.5 Y 8/12.

Characters. Largest black nonretroreflective LETTER, (Federal color no. 27038) not to exceed 16 in., that will fit in the available area without crowding. Located offset to the right, on the right-hand radar reflector. Multiple characters are displayed horizontally (side by side). Mount the black letter on a yellow retro panel.

Retro Panels. Yellow panels, one on each left-hand radar reflector, height to fit in area of reflector and minimum width of 6 in.

Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Largest black nonretroreflective LETTER, not to exceed 16 in. or one-quarter of the buoy freeboard, that will fit without crowding. For buoys with daymark plates, install the letters to the right of or under the retro panels. For buoys without daymark plates, install 3 letters spaced 120 apart. Mount the letters on yellow retro panels.

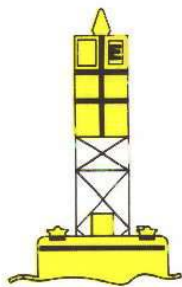
Retro Panels. Yellow panels, one sized to fit each daymark plate, with a minimum width of 6 in. or three panels spaced 120 apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.

Data Sheet 3-E(6). Special aid marks.

3. E.

Lighted



Unlighted

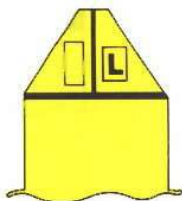
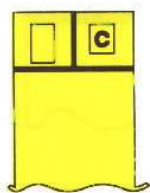


Figure 3-8. Special aid marks.

Data Sheet 3-E(6). (cont'd).

3.E.

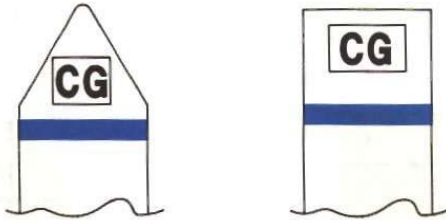
COAST GUARD MOORING BUOYS

Color. White with a blue band (Federal Color Nos. 27875 and 15182).

Appearance. The buoy body shall be white with a narrow blue band located midway between the buoy top and the waterline.

Characters. The buoy shall display three sets of black nonreflective, "CG" characters, sized to fit onto the white retroreflective panels. Multiple characters are displayed horizontally (side by side).

Retro Panels. Three white panels spaced 120 apart, with minimum height of 6 in. and a minimum width of two-thirds of the buoy diameter at the point of attachment.



Coast Guard mooring buoys.

Data Sheet 3-E(7). Coast Guard mooring buoys.

3.E.

WESTERN RIVERS LEFT DESCENDING BANK MARKS

Radar Reflector Type:

Color. Solid red (Munsell chip 7.5 R 4/16).

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Red panels, one on each left-hand radar reflector vane; height to fit in available area and width up to 12 in.

Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Same as for Radar Reflector Type.

Retro Panels. Three red panels spaced 120 apart, with a minimum height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.



File: West 3-E(8). Western rivers left descending bank marks.

Western rivers left descending bank marks

Data Sheet 3-E(8). Western rivers left descending bank marks.

3.E.

WESTERN RIVERS RIGHT DESCENDING BANK MARKS

Radar Reflector Type:

Color. Green (Munsell chip 2.5 G 5/12).

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Green panels, one on each left-hand radar reflector vane; height to fit in available area and width up to 12 in.

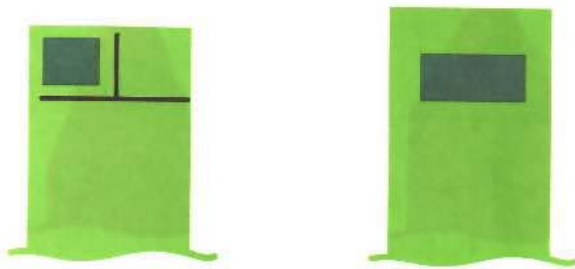
Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Same as for Radar Reflector Type.

Retro Panels. Three green panels spaced 120 apart, with a minimum height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.



Western rivers right descending bank marks

Data Sheet 3-E(9). Western rivers right descending bank marks.

3.E.

WESTERN RIVERS PREFERRED CHANNEL MARKS

Radar Reflector Type:

Color. Red and green horizontal bands (Munsell chips 7.5 R 4/16 and 2.5 G 5/12.)

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Red or green panels to match top band color, one on each left-hand radar reflector vane; height to fit in available area and width up to 12 in.

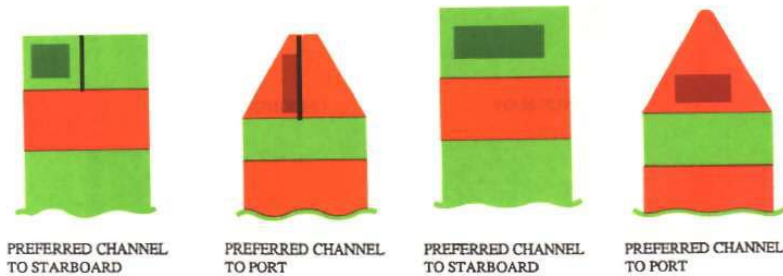
Nonradar Reflector Type:

Color. Same as for Radar Reflector Type.

Characters. Same as for Radar Reflector Type.

Retro Panels. Three red or green panels to match top band color located on top band spaced 120 apart, with a height of 6 in. and a width of two-thirds of the buoy diameter at the point of attachment.

Note: Plastic radar reflecting buoys shall be marked like metal nonradar reflecting buoys because they both have similar shapes.



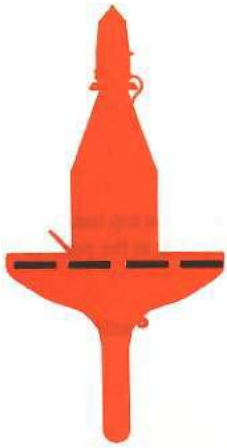
NOTE. Buoys used to mark both coinciding Main and I.C.W. channels.

Data Sheet 3-E(10). Western rivers preferred channel marks.

3.E.

TEMPORARY MARKS

Markings: The purpose of a temporary mark is to provide an interim mark when an operational aid is damaged, missing, or unrepairable. It shall have markings as similar as possible to the markings of the aid that it replaces.



LIGHTED NUN BUOY



UNLIGHTED CAN BUOY

Data Sheet 3-E(11). Temporary marks.

3.E.

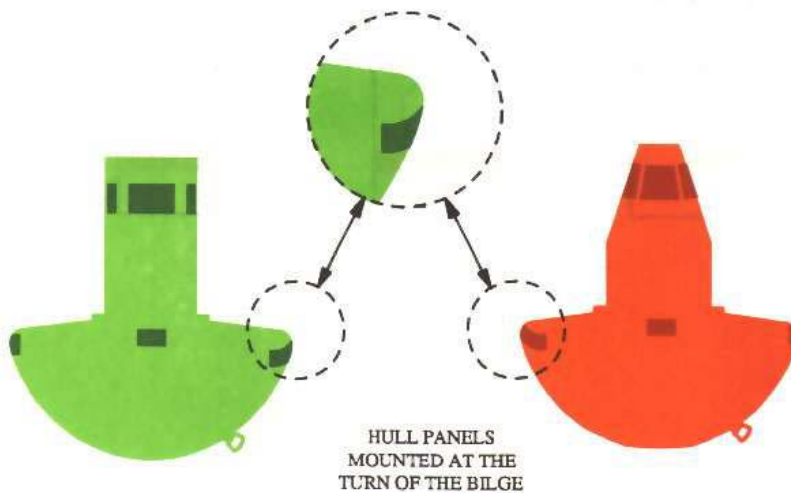
WESTERN RIVERS FAST WATER PORT AND STARBOARD MARKS

Color. Solid green or solid red (Munsell chips 2.5 G 5/12 and 7.5 R 4/16) for port or starboard markers, respectively.

Characters. No LETTERS or NUMERALS shall be used.

Retro Panels. Four green (port) or red (starboard) panels mounted on each daymark, space 90° apart, with a minimum height of 6 in. and a width equal to one-half of the buoy diameter at the point of attachment. To provide for the possible loss of a daymark, four additional strips, 3 in. by 6 in., of the same color as the daymark panels, shall be mounted on the hull directly below the daymark panels.

Note: Occasionally, fast water buoys may be used in places other than the western river system. In these cases, the buoys shall also include the appropriate number for port or starboard buoys. The numeral shall be the largest odd or even white retroreflective numeral, not to exceed 16 in., that will fit in the available area below the topmost retro panels without crowding.



Data Sheet 3-E(12). Western rivers fast water port and starboard marks.

3.E.

INFORMATION AND REGULATORY MARKS

Markings: The vast majority of these marks are can buoys. They shall be white (Federal color number 27875) with orange (Federal color number 12197) retroreflective bands and buoy warning symbols. The warning symbols shall be placed 180 apart. An open diamond indicates a "Danger" area. A cross centered in the diamond shape indicates an "Exclusion" area. An open circle indicates a "Controlled" area. Typical information and regulatory marks are pictured below.

Occasionally, there may be need to light an information and regulatory mark. If lighted, the mark shall display a white light.



Data Sheet 3-E(13). Information and regulatory marks.

CHAPTER 5. DAYBOARDS

A. Introduction. Dayboards differ in size and markings depending on the marking system and specific function. There are three marking systems used in the U.S.: General Use; Intercoastal Waterway (ICW); and Western Rivers. All three are based on a Lateral System, wherein marks are used to define the edges of a channel. Not all marks within a lateral system will have lateral significance. Safe-water marks and special marks, for example, do not provide the mariner with guidance on which side the mark should be passed. This chapter describes dayboard characteristics and provides guidance for selecting, preparing, inspecting and maintaining dayboards.

B. Selection Guide.

1. Designations. Prior to selecting a dayboard, it is helpful to understand the standard designations and operational parameters. Every daymark, with the exception of information and regulatory marks, has a designator-composed of a numeral followed by a group of letters-which indicates its dimension, shape and color. The designator is constructed as follows:

- a. A NUMERAL gives the width of the dayboard in feet.
- b. The first LETTER refers to the shape or purpose of the dayboard.

S – square;
T – triangle;
J – preferred channel;
M – safe water;
N – no lateral significance;
K – range; and
C – crossing.

- c. The second LETTER represents the key color:

R – red;
G – green;
W – white; and
B – black.

5.B.1.

d. The third LETTER indicates the color of stripe (range dayboards only):

- R – red;
- G – green;
- W – white; and
- B – black.

e. Additional information is shown by LETTERS placed after the dash (-):

- I – intracoastal waterway;
- SY – yellow square on dayboard (dual purpose); and
- TY – yellow triangle on dayboard (dual purpose).

As shown in Figure 5-1, a 6KRW-I designator indicates a 6 ft wide, red range dayboard with a white center stripe and a yellow, reflective strip along the bottom edge, which shows that it is used on the intracoastal waterway. The yellow strip is placed on the front dayboard only.

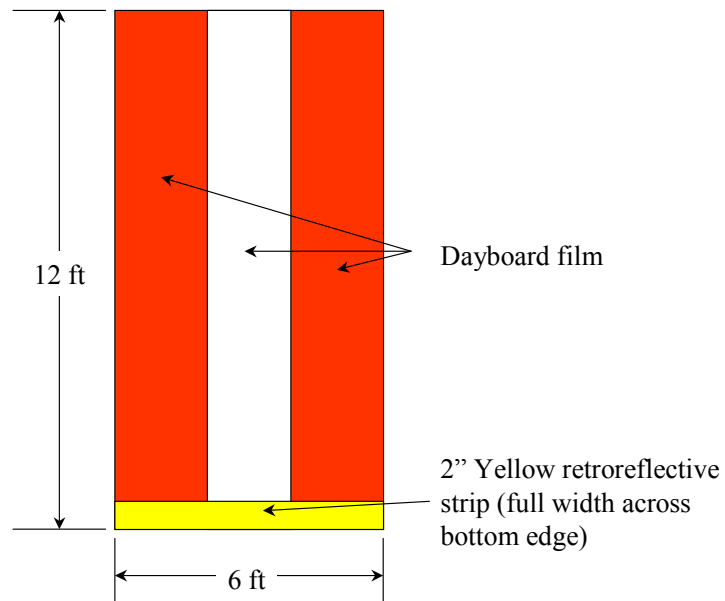


Figure 5-1. Sample 6KRW-I dayboard designator.

5.B.1.e (cont)

A 4JR-SY designator indicates a 4-ft wide, red and green, triangular dual-purpose preferred channel dayboard with a yellow square, as shown in Figure 5-2. The dayboard marks a junction between the intracoastal waterway (ICW) and another waterway, with the dayboard position denoting the port side of the ICW and the starboard side of the other waterway.

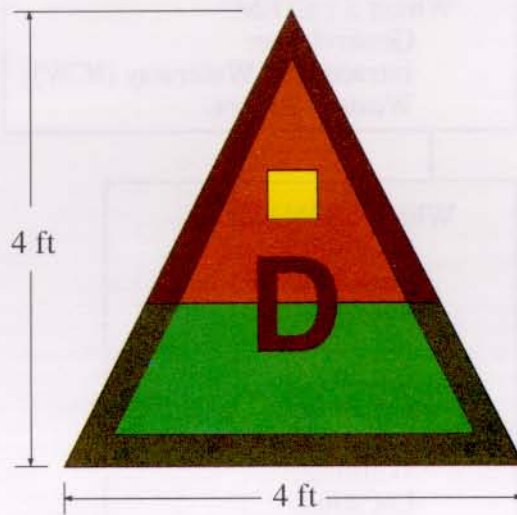


Figure 5-2. Sample 4JR-SY dayboard designator.

2. Nominal Ranges. As a mariner approaches a dayboard from a distance, it is first *detected* as an object apart from its surroundings (detection range). Upon coming closer to the dayboard, it can be *recognized* as an aid to navigation with color and shape (recognition range). Finally, the particular aid can be *identified* when the mariner is close enough to read the numbers and letters on the dayboard (identification range).

The values for these three ranges will depend on the mariner's vision and the viewing conditions. The nominal range rating used in the classification of dayboards will generally fall between the detection and recognition ranges, for days when the visibility is 10 nm or more. The identification range (in feet) for viewing dayboard characters is approximately 40 times the character height (in inches)—i.e., a 16-in. character can be identified at 640 ft or just over 200 yd—in clear visibility.

5.B.

3. Selection. Figure 5-3 is a functional diagram of the dayboard selection process.

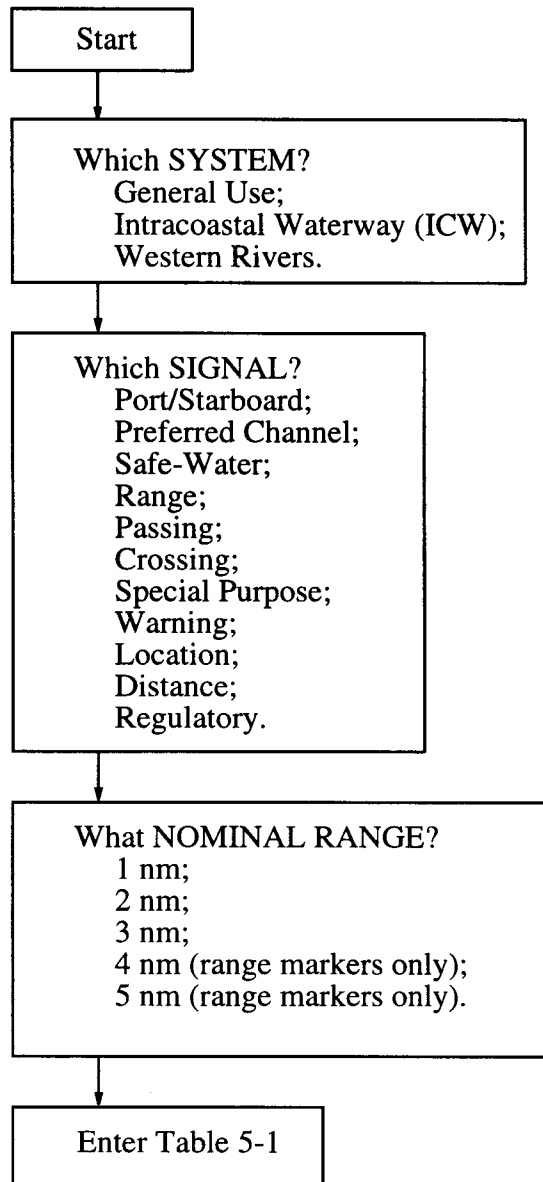


Figure 5-3. Selection procedure for dayboards.

Table 5-1
Reference Table for Dayboard Selection
(Numbers refer to data sheets in Section E of this Chapter)

<u>Function (Nominal Range-nm)</u>	<u>General Use</u>	<u>W. Rivers</u>	<u>ICW</u>
Port and starboard (1)	5-E(1)	—	5-E(12)
Port and starboard (2)	5-E(2)	—	5-E(12)
Port and starboard (3)	5-E(3)	—	5-E(12)
Preferred channel (1,2,3)	5-E(4)	5-E(20)	5-E(13)
Safe-water (1,3)	5-E(5)	—	5-E(16)
Range (1,2,3,4,5)	5-E(6)	5-E(6)	5-E(17)
Non-Lateral (1,2,3)	5-E(7)	5-E(7)*	5-E(7)
Warning (1,2,3)	5-E(8)	5-E(8)	5-E(8)
Information & regulatory	5-E(9)	5-E(9)	5-E(9)
Special (1,2,3)	5-E(10)	5-E(10)	5-E(10)
Location (1,2,3)	5-E(11)	5-E(11)	5-E(11)
Dual-purpose port and starboard (1,2,3)	5-E(14)	—	5-E(14)
Dual-purpose preferred channel (1,2,3)	5-E(15)	—	5-E(15)
Distance	—	5-E(21)	5-E(18)
Passing (1,2,3)	—	5-E(19)	—

* Non-lateral marks have replaced crossing marks in the Western Rivers.

5.C. Preparation and Installation.

1. Preparation. Data Sheet 5-E(22) provides cutting patterns for dayboard backings. Application of dayboard film(s) and retroreflective characters shall be conducted in accordance with the manufacturers' instruction. Preparation of dayboards by units subsequent to the manufacturing stage should be limited to the selection and application of identifying marks, such as letters, numerals, and dual purpose and intracoastal waterway markings. Data Sheets 5-E(1) through 5-E-(21) provide guidance on the size, color, and placement of dayboard films and identifying markings.
2. Installation. Dayboards shall be fastened to their support structures in such a way as to meet or exceed a lifetime of 5 years. Common fasteners acceptable for this purpose are listed in Table 5-2.

Table 5-2

Dayboard Support Structure Fasteners

<u>Structure</u>	<u>Fastener</u>	<u>Notes</u>
Wood	Nails	Minimum size 8d galvanized Minimum number, 4 per 8-sq ft board area
	Lag screw	Minimum size 3/8 in. galvanized Minimum number, 2 per 8-sq ft board area
Concrete or steel (with platform)	Through bolts Carriage bolts	1/2 in. X 13 in. NC galvanized 1/2 in. X 13 in. NC aluminum Minimum number, 2 per 8-sq ft board area
	U bolts or J bolts	3/8 in. X 3 in. galvanized Minimum number, 2 per 8-sq ft board area

5.C.

3. Dayboard Backings. Acceptable materials for dayboard construction are either 3/8-in. or 1/2-in. Medium Density Overlay (single-sided) plywood or 1/8-in. commercial grade aluminum sheet. When Medium Density Overlay plywood is used, place the film on the wood facing and treat the exposed edges with a sealer, such as paint or polyurethane. Data Sheet 5-E(22) provides cutting patterns for dayboard backings. Knockdown rates and other special considerations may justify the use of less expensive backings.
4. Films and Characters. The surface of a dayboard is covered with a colored vinyl film and retroreflective tape, and may also have identifying characters (letters and numbers). Commandant (G-SEC) maintains separate Qualified Products Lists (QPLs) for red and green dayboard films and retroreflective materials. (White and black dayboard films are commercial items.) Identification of qualified suppliers of dayboard film and retroreflective materials will be promulgated by Commandant (G-SEC) annually. Retroreflective numbers and letters (A through E, R, T, and W) should be purchased from the Engineering Logistics Center (ELC). Remaining letters should be purchased from a qualified vendor.

D. Inspection, Maintenance, and Repair on Station.

1. Inspection. Dayboards shall be inspected at least biennially. The dayboard surface and backing materials will deteriorate due to the effects of weathering—wind, rain, freezing temperatures, and sunlight cause delamination (separation), cracking, peeling, and fading. Attention shall be given to these conditions when inspecting according to the following guidelines.
 - a. Backing Material. Delamination of the plies on a plywood backing should not affect more than 25 percent of the surface area. Any warpage should not visibly detract from the signal presented to the mariner. The backing should not be softened or otherwise deteriorated around the mounting points to a degree that the board could come loose in a storm typical for the area.
 - b. Elastomeric Films, Retroreflective Numerals, Letters, and Borders. Delamination of films and retroreflective markings should not affect more than 10 percent of the surface area of the material. The film and markings should not be cracked, checked, or abraded so as to provide a dull or roughened top surface. Peeling of the film and markings from the dayboard should not affect more than 10 percent of the surface area.

5.D.

2. Replacement or Repair. The dayboard shall be replaced if any of the deterioration noted above is observed, or if for any reason it cannot function as intended (including significant fading or other discoloration) until the next regularly scheduled visit. Onsite repairs are permitted if they do not detract from the intended signal function of the dayboard.

5.E. General Description Data Sheets.

GENERAL USE PORT AND STARBOARD MARKS

System: General Use.

Function: Laterally significant port and starboard marks.

Nominal Range: 1 nm.

Additional Data: For three numerals on a 3SG, use 8-inch characters at a height of 14 inches from the base. For three numerals on a 4TR, use 8-inch characters at a height of 12 inches.

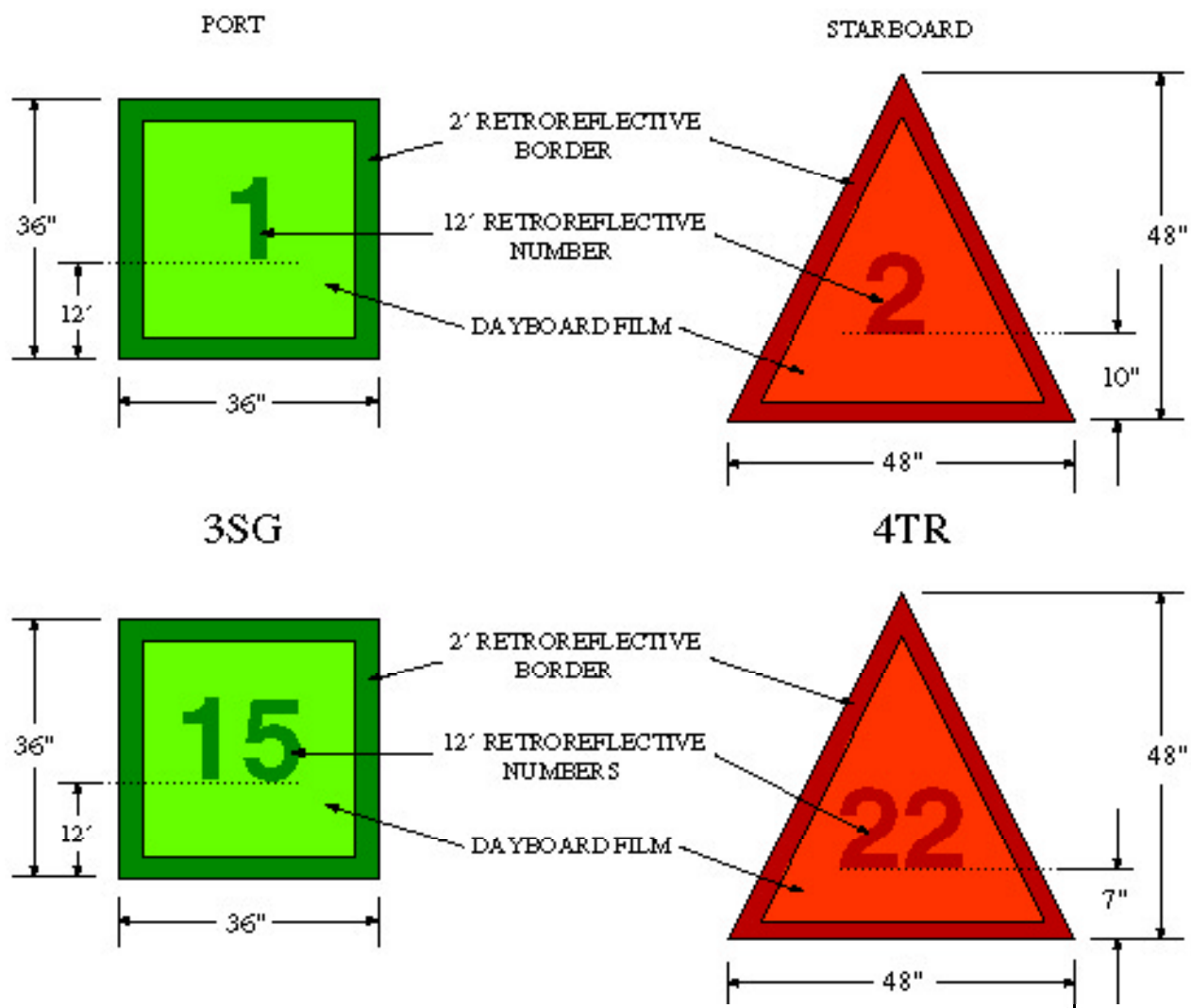


Figure 5-4. General Use port and starboard marks.

Data Sheet 5-E(1). General Use port and starboard marks (nominal range, 1 nm).

5.E.

GENERAL USE PORT AND STARBOARD MARKS

System: General Use.

Function: Laterally significant port and starboard marks.

Nominal Range: 2 nm.

Additional Data: For three numerals on a 4SG, use 12-inch characters at a height of 18 inches from the base. For three numerals on a 6TR, use 12-inch characters at a height of 12 inches.

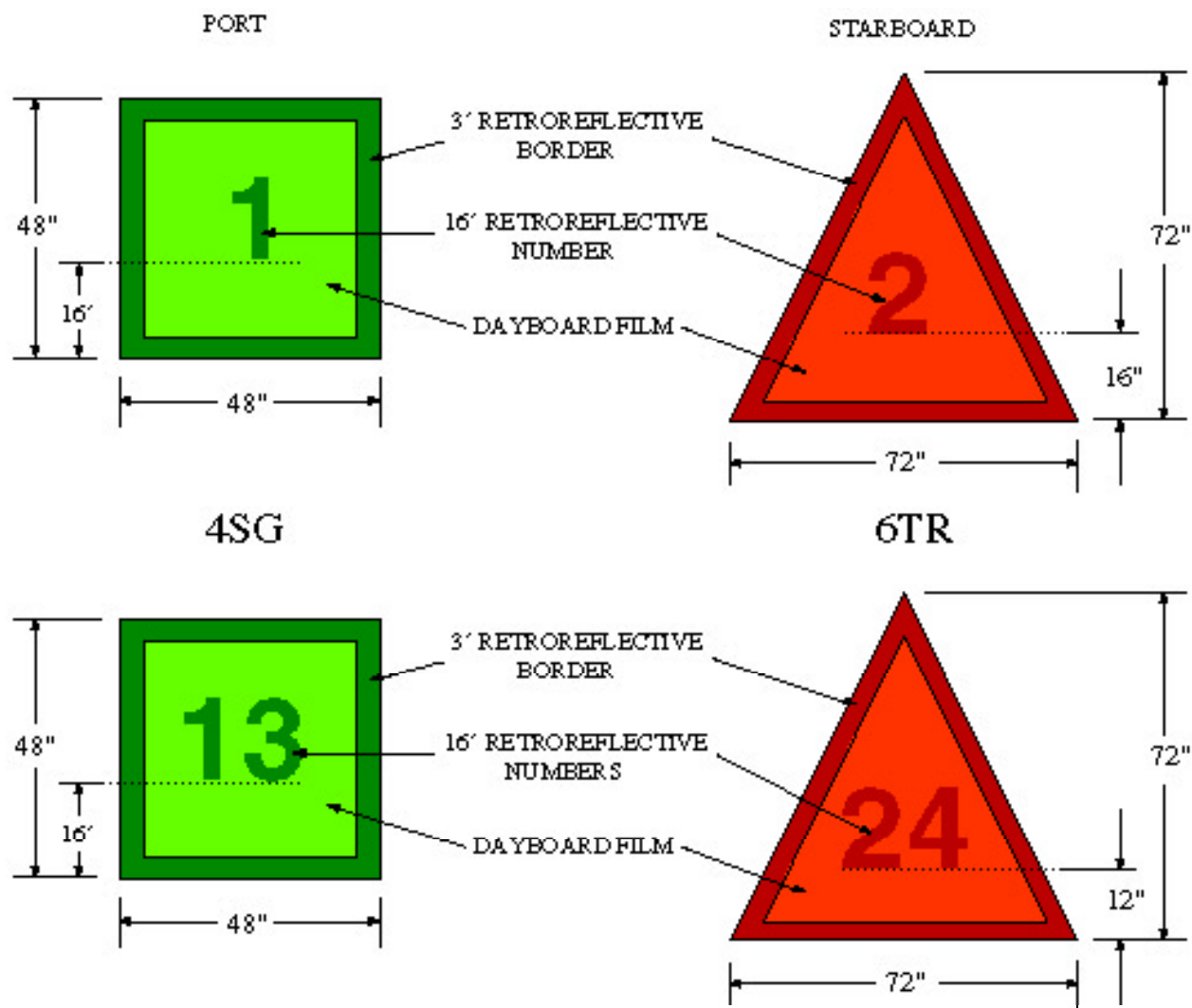


Figure 5-5. General Use port and starboard marks.

Data Sheet 5-E(2). General Use port and starboard marks (nominal range—2 nm).

5.E.

GENERAL USE PORT AND STARBOARD MARKS

System: General Use.

Function: Laterally significant port and starboard marks.

Nominal Range: 3 nm.

Additional Data: For three numerals on a 6SG, use 16-inch characters at a height of 28 inches from the base. For three numerals on an 8TR, use 16-inch characters at a height of 14 inches.

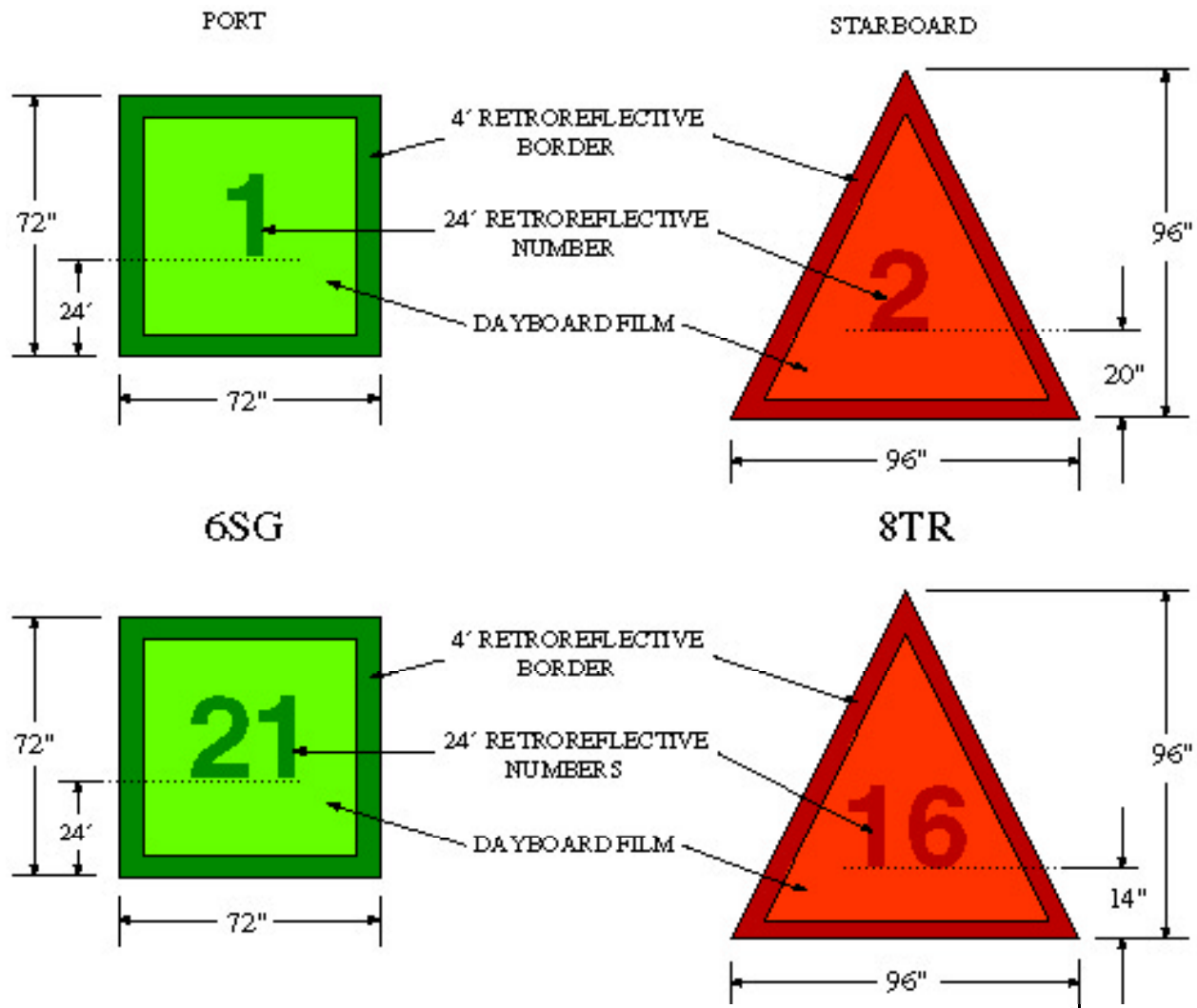


Figure 5-6. General Use port and starboard marks.

Data Sheet 5-E(3). General Use port and starboard marks (nominal range—3 nm).

5.E.

GENERAL USE PREFERRED CHANNEL MARKS

System: General Use.

Function: Laterally significant preferred channel marks.

Nominal Range: 1 nm (*as designated in Figure 5-7, below—use Table 5-3 for dimensions of preferred channel marks with nominal ranges of 1-, 2-, and 3-nm).

Additional Data: For both JG and JR markers, letters are vertically centered on the dividing line of the dayboard film. The letters on a JG dayboard are green, while those on a JRs are red.

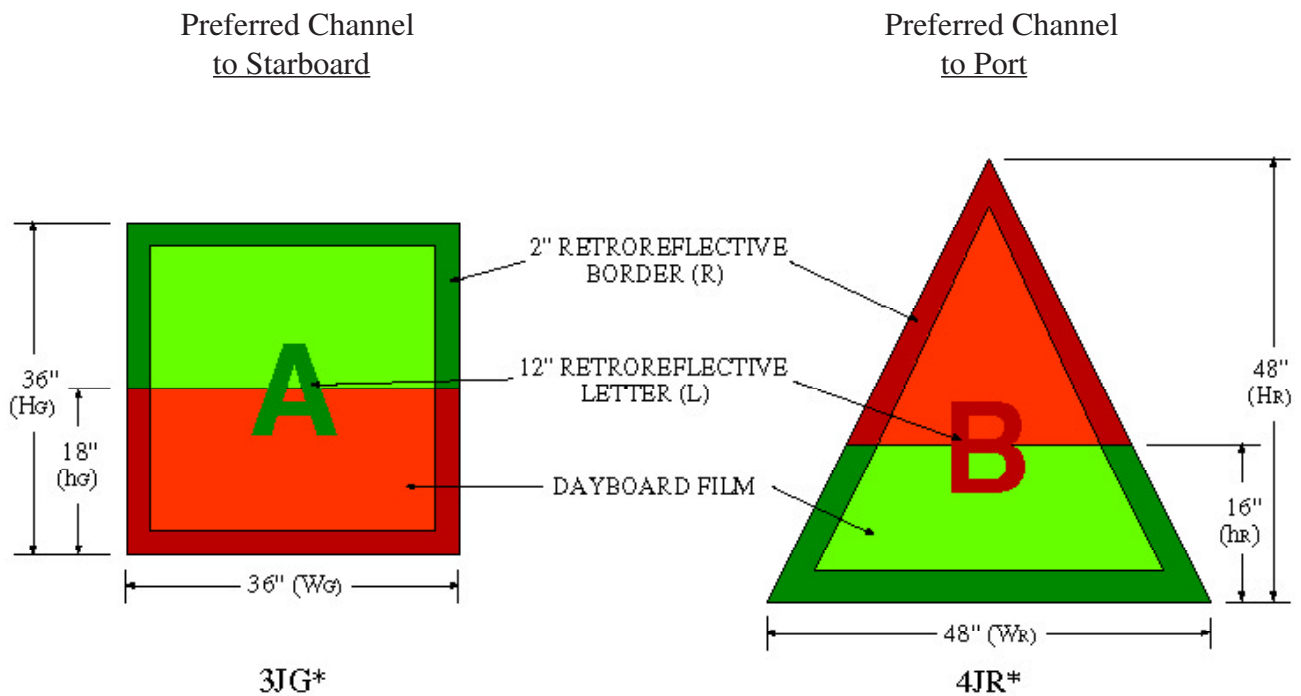


Figure 5-7. General Use preferred channel marks.

Data Sheet 5-E(4). General Use preferred channel marks (nominal ranges, 1, 2, and 3 nm).
5.E.

5.E.

Table 5-3

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for General Use Preferred Channel Marks

Preferred Channel to Starboard

Mark	Nominal Range (nm)	$H_G \times W_G$ (in)	h_G (in)	R (in)	L (in) (1 letter)	L (in) (2 letters)	L(in) (3 letters)
3JG	1	36 x 36	18	2	12	12	8
4JG	2	48 x 48	24	3	16	16	12
6JG	3	72 x 72	36	4	24	24	16

Preferred Channel to Port

Mark	Nominal Range (nm)	$H_R \times W_R$ (in)	h_R (in)	R (in)	L (in) (1 letter)	L (in) (2 letters)	L(in) (3 letters)
4JR	1	48 x 48	16	2	12	12	8
6JR	2	72 x 72	24	3	16	12	12
8JR	3	96 x 96	32	4	24	16	16

Data Sheet 5-E(4). (cont'd).

5.E.

GENERAL USE SAFE-WATER MARKS

System: General Use.

Function: Safe-water markers.

Nominal Range: 1 nm and 3 nm.

Additional Data: The 4MR daymark, illustrated in Figure 5-8a, is a 4-ft octagon. The 8MR, shown in Figure 5-8b, is an 8-ft octagon. Borders and letters on safe-water marks are white retroreflective material. Letters are centered on the red portion of the daymark. When displaying two characters on a 4MR, use 8-in letters. For a single character on an 8MR, use a 16-in letter.

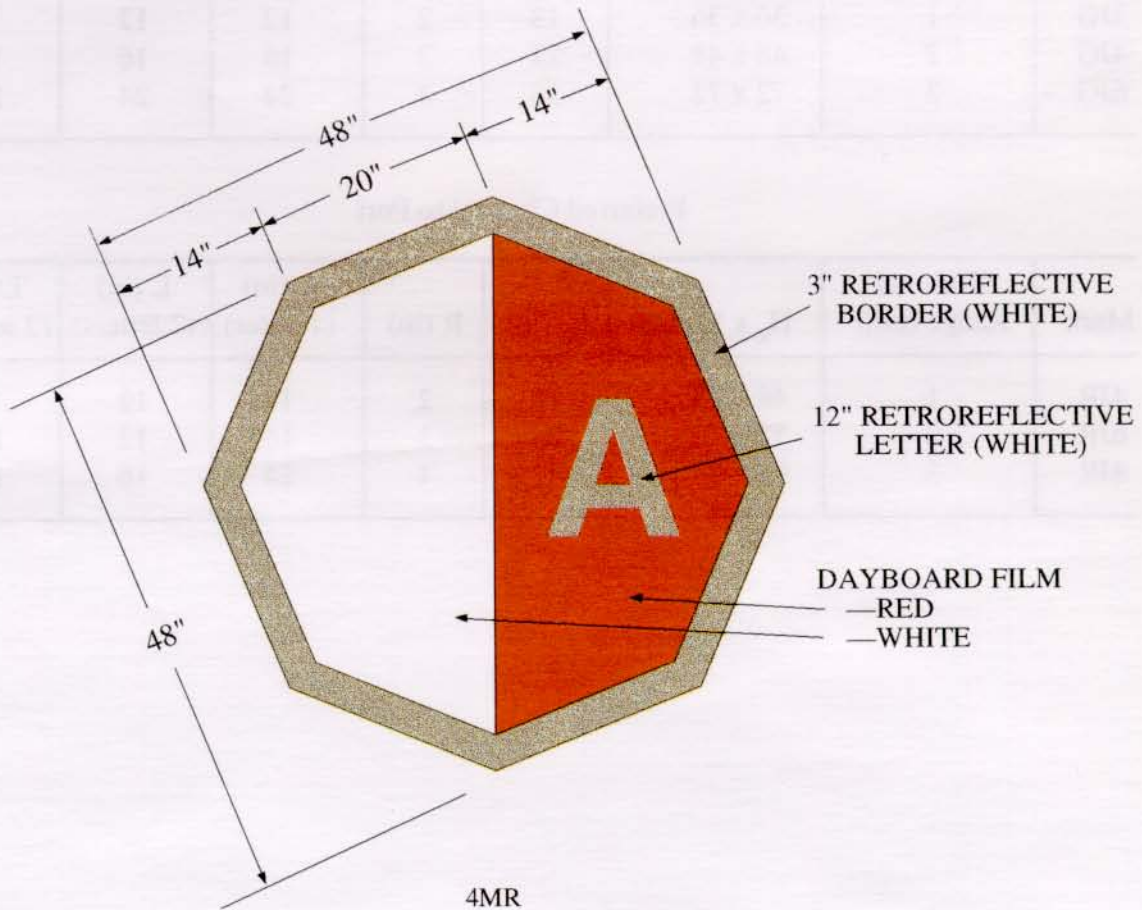


Figure 5-8a. General Use safe-water marks (nominal range—1 nm).

Data Sheet 5-E(5). General Use safe-water marks.

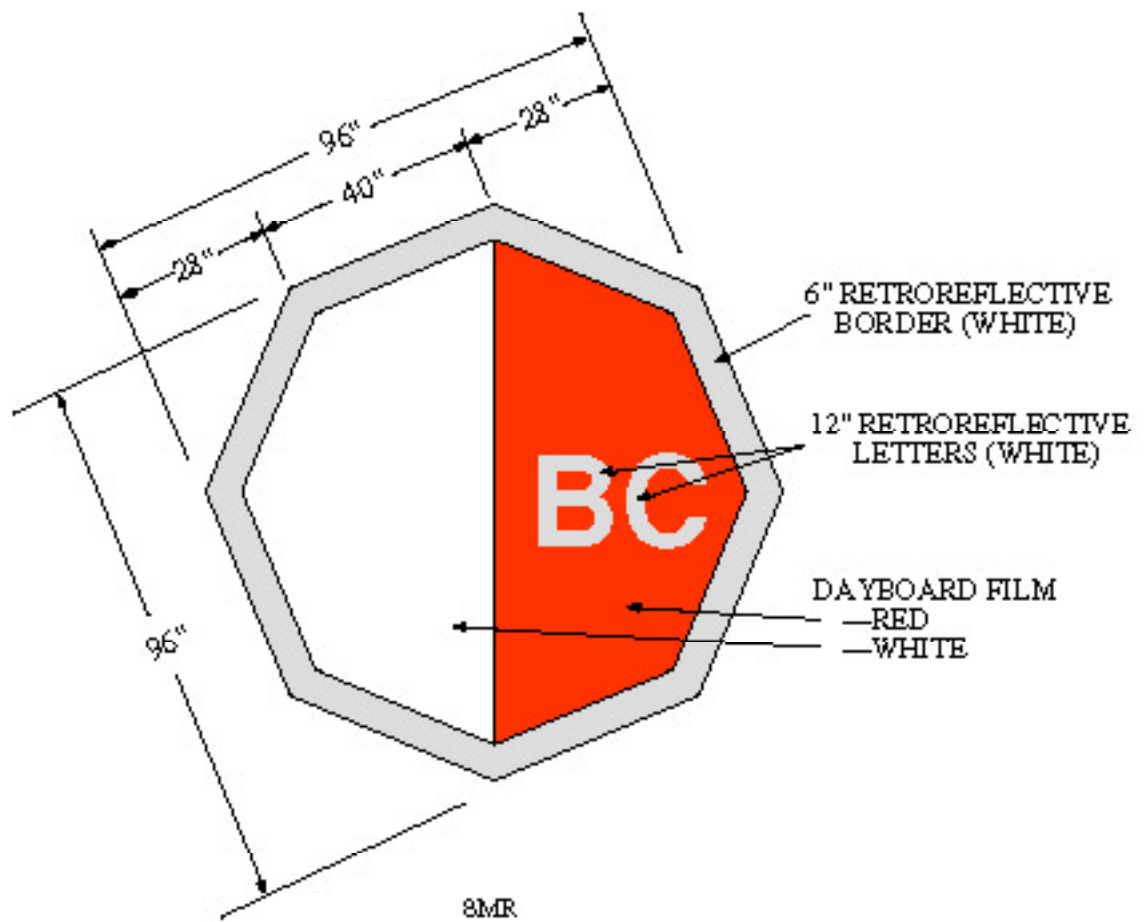


Figure 5-8b. General Use safe water marks (nominal range—3 nm).

Data Sheet 5-E(5). (cont'd).

5.E.

GENERAL USE OR WESTERN RIVERS RANGE MARKS

System: General Use or Western Rivers.

Function: Range marks.

Nominal Range: 1 to 5 nm. See Table 5-4 for the dimensions of range boards required to achieve the various stated nominal ranges.

Additional Data: Front and rear daymarks for a given range will be the same colors, although the sizes may vary. The front range board may be marked with a contrasting colored letter. Use a white retroreflective character on range boards with a black stripe (KWB, KRB and KGB), and a black vinyl film character on all other type range boards. Letters shall be centered on the range board. Use the largest letter which will fit on the center stripe.

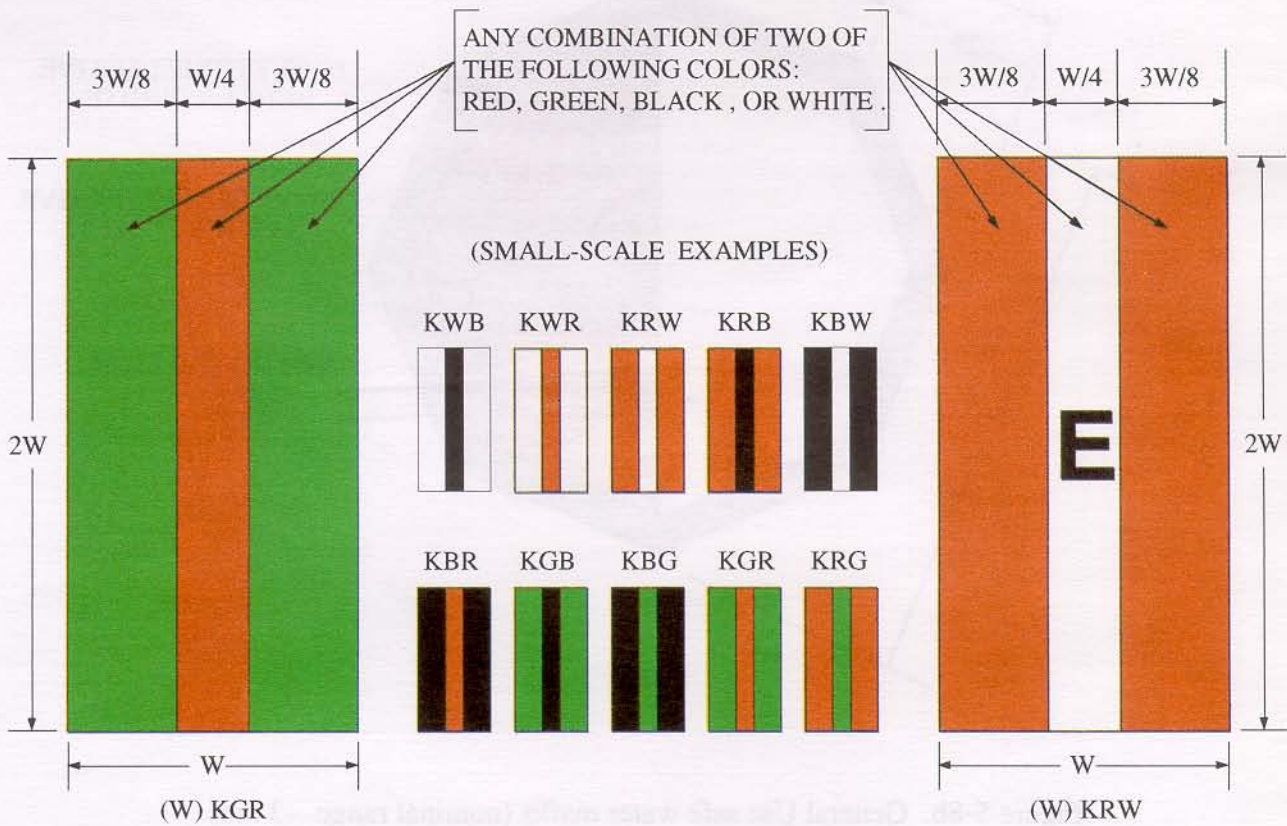


Figure 5-9. General Use or Western Rivers range marks.

Data Sheet 5-E(6). General Use or Western Rivers range marks

5.E.

Table 5-4

Dimensions for 1- to 5-nm Nominal Range Dayboards for
General Use, or Western Rivers Range Marks

Nominal Range (nm)	Range Board Designation	Width—W (ft)	Width of Side Panels— $3W/8$ (in.)	Width of Center Stripe— $W/4$ (in.)
1	3K__	3	13.5	9
2	4K__	4	18	12
3	6K__	6	27	18
4	8K__	8	36	24
5	12K__	12	54	36

Data Sheet 5-E(6). (cont'd).

ALL WATERWAYS NON-LATERAL MARKS
(WESTERN RIVERS CROSSING MARKS)

System: All waterways.

Function: No lateral significance marks.

Nominal Range: 1 nm (*as designated in Figure 5-10, below—use Table 5-5 for dimensions of non-lateral marks with nominal ranges of 1-, 2-, and 3-nm).

Additional Data: Use red retroreflective letters on NR marks, green retroreflective letters on NG marks, and white retroreflective letters on NB marks. These marks are used in the ICW without addition of the yellow strip.

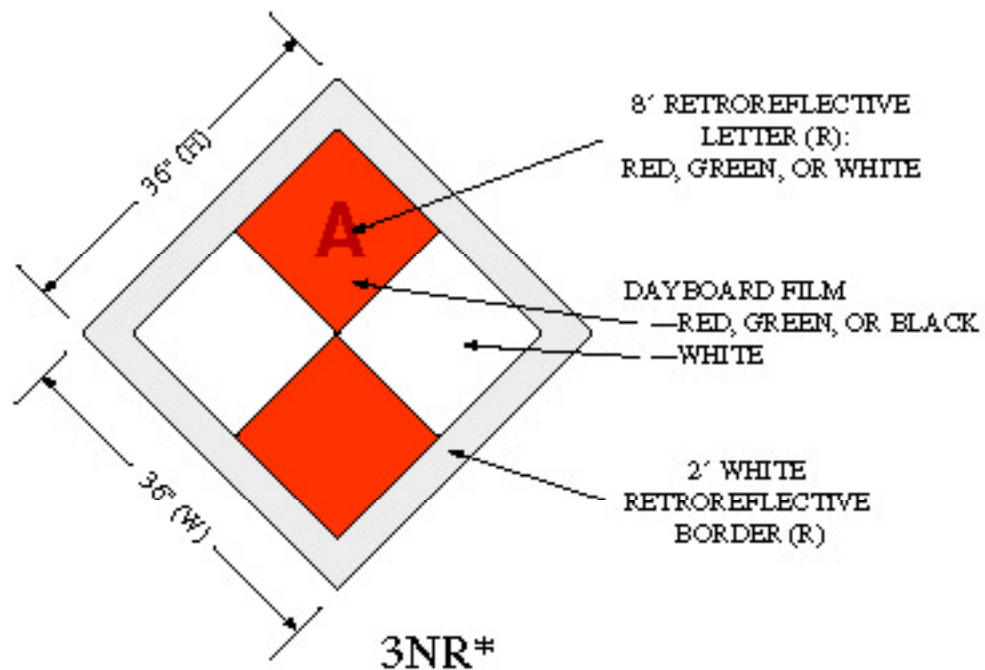


Figure 5-10a. All waterways non-lateral marks.
(Western Rivers crossing marks.)

Data Sheet 5-E(7), All Waterways Non-Lateral Marks.

5.E

5.E.

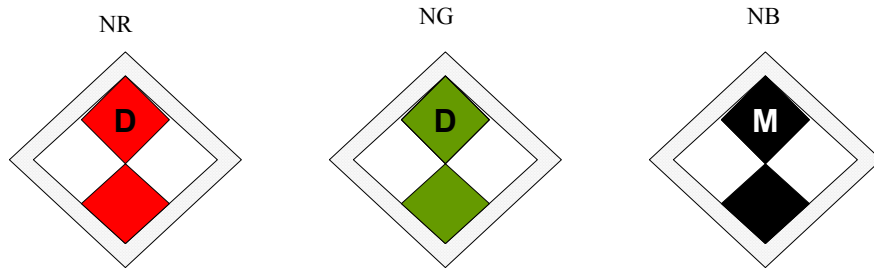


Figure 5-10b. Non-lateral marks
(except Western Rivers)

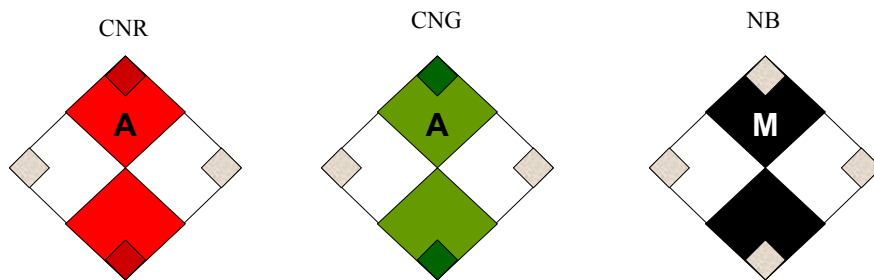


Figure 5-10c. Crossing marks (optional)
(Western Rivers)

Table 5-5

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for all Waterways Special Marks

Mark	Nominal Range (nm)	H x W (in)	Retro* (R) (in)	Letter (L) (in)
3N_	1	36 x 36	2	8
4N_	2	48 x 48	3	12
6N_	3	72 x 72	4	16

*For Western Rivers, the square retroreflective patch should be 6" for the 3N_, 8" for the 4N_ and 12" for the 6N_.

Data Sheet 5-E(7), cont'd

5.E.

ALL WATERWAYS WARNING MARKS

System: All waterways.

Function: No lateral significance warning marks.

Nominal Range: 1nm (*as designated in Figure 5-11, below-use Table 5-5 for dimensions of warning marks with nominal ranges of 1-, 2- and 3-nm: except that the letter sizes for the word “DANGER” will be 6-in for a 3NW, 8-in for a 4NW and 10-in for a 6NW. Other wording will have 3-in letters on a 3NW, 4-in on a 4NW and 5-in on a 6NW).

Additional Data: The word “DANGER” will be centered on the daymark. Informational words may be placed above and/or below, as necessary (see examples below). Warning marks are used in the ICW without addition of the yellow strip.

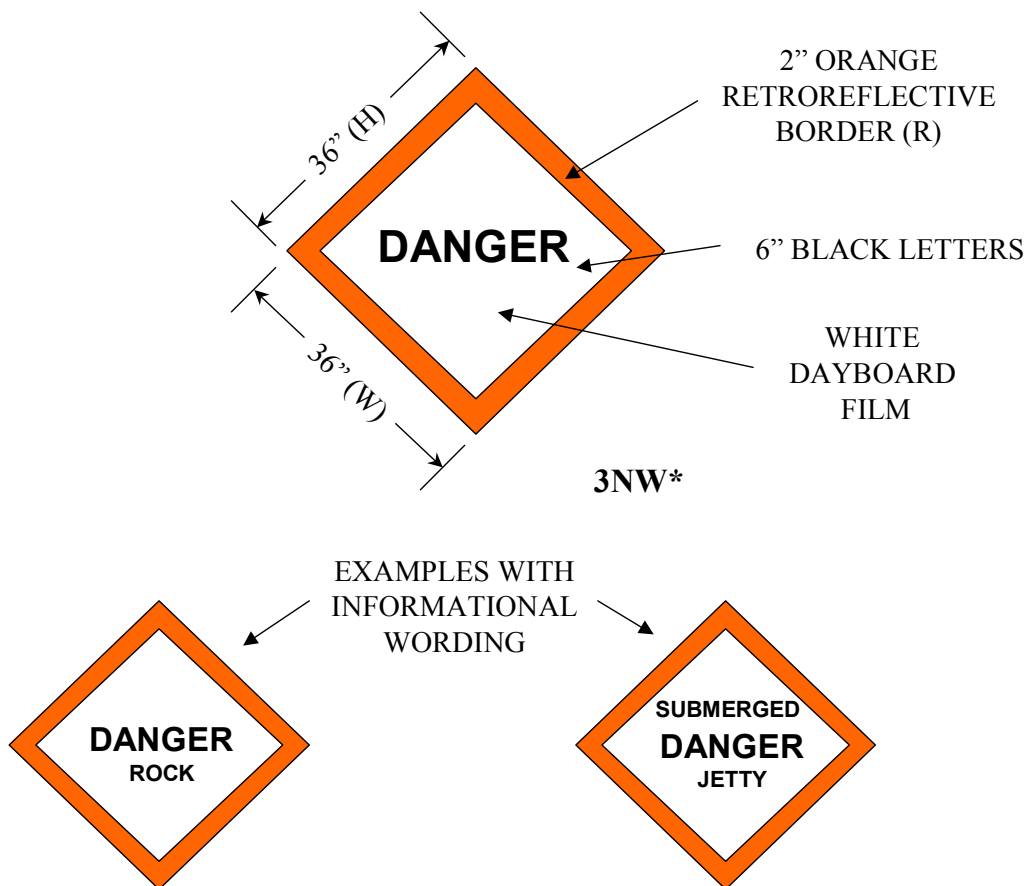


Figure 5-11. All waterways warning marks.

Data Sheet 5-E(8). All waterways warning marks (nominal ranges 1, 2 and 3 nm).

ALL WATERWAYS INFORMATION & REGULATORY MARKS

System: All waterways.

Function: No lateral significance information & regulatory marks.

Nominal Range: 1 nm (typical).

Additional Data: Information and regulatory marks do not have designators, as described in section B of this chapter. The border and center mark are orange retroreflective material. The remainder of the daymark is white dayboard film. Use black vinyl characters for informational wording, as necessary. Figure 5-12 illustrates the three types of information and regulatory marks, with typical wording. Information and regulatory marks are used in the ICW without addition of the yellow strip. Note—the warning mark, described in Data Sheet 5-E(8) is preferred to the "danger" version of the information and regulatory marks.

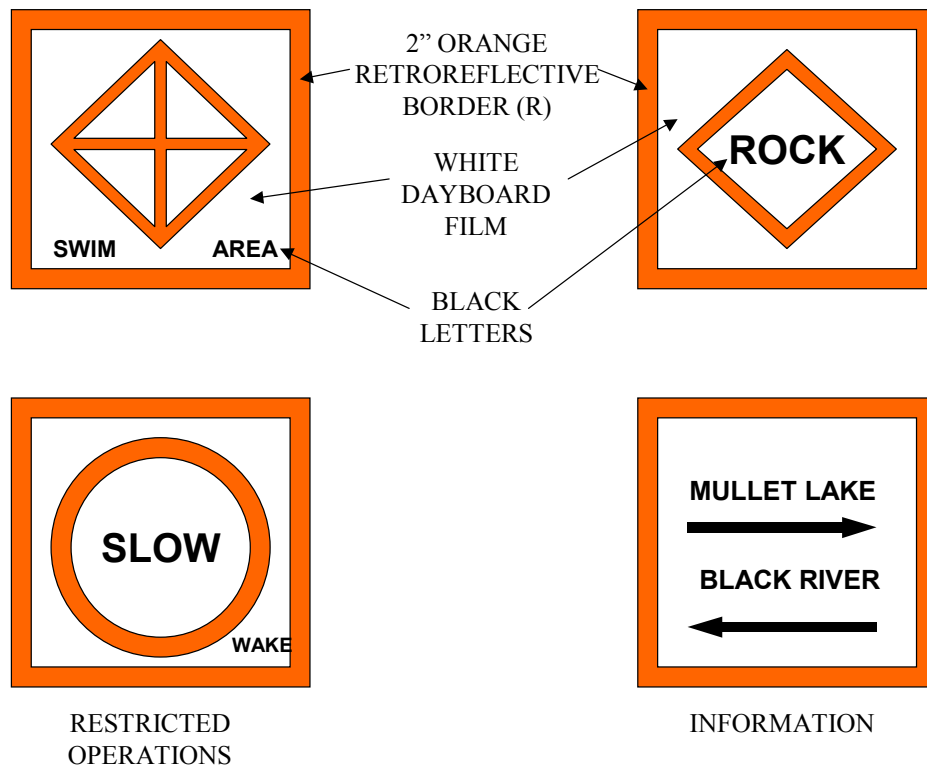


Figure 5-12. All waterways information & regulatory marks.

Data Sheet 5-E(9). All waterways information & regulatory marks

5.E.

ALL WATERWAYS SPECIAL MARKS

System: All waterways.

Function: No lateral significance special marks.

Nominal Range: 1 nm (*as designated in Figure 5-13, below—use Table 5-6 for dimensions of special marks with nominal ranges of 1-, 2-, and 3-nm).

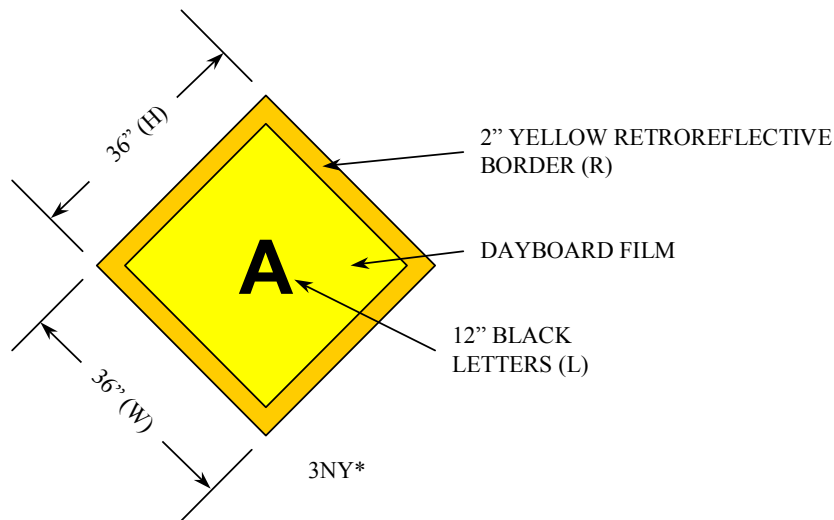


Figure 5-13. All waterways special mark.

Table 5-6

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for All Waterways Special Marks

Mark	Nominal Range (nm)	H x W (in)	R (in)	L (in)
3NY	1	36 x 36	2	12
4NY	2	48 x 48	3	16
6NY	3	72 x 72	4	24

Data Sheet 5-E(10). General Use special marks (nominal ranges, 1, 2, and 3 nm).

5.E.

ALL WATERWAYS LOCATION MARKERS

System: All waterways.

Function: No lateral significance location marks.

Nominal Range: 1 nm, 2 nm, and 3 nm. See Table 5-7 for dimensions.

Additional Data: Location marks are used to indicate the approach or entrance to a harbor. Location marks are placed on structures, directly below the existing daymark. Lettering on location marks should be vertically and horizontally centered on the dayboard.

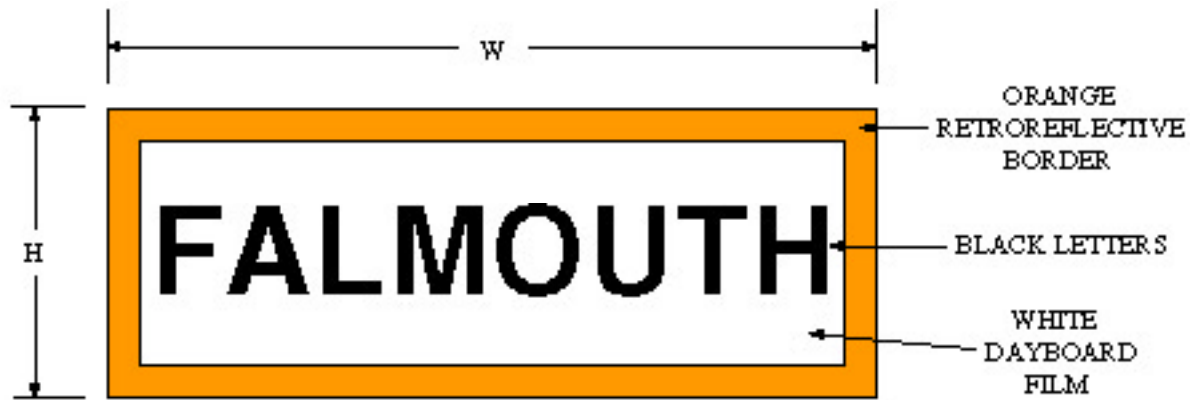


Figure 5-14. All waterways location mark.

Table 5-7

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards for All Waterways Location Marks

Nominal Range (nm)	H x W (in)	Border Width (in.)	Maximum Letter Size (in.)
1	18 x 48	2	6
2	24 x 72	3	8
3	30 x 96	4	10

Data Sheet 5-E(11). All waterways location marks (nominal ranges, 1, 2, and 3 nm).

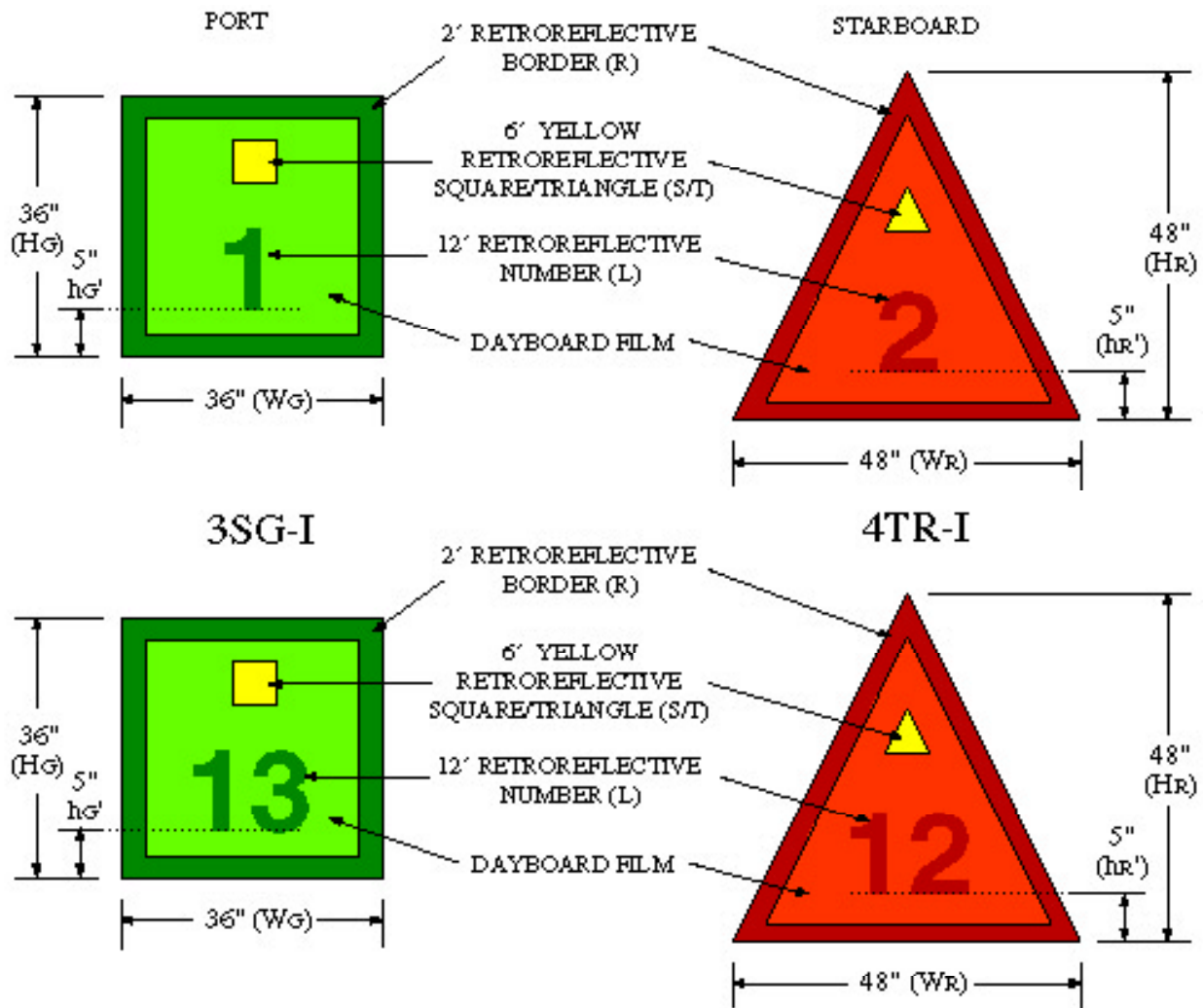
INTRACOASTAL WATERWAY (ICW) PORT AND STARBOARD MARKS

System: Intracoastal Waterway (ICW).

Function: Laterally significant port and starboard marks.

Nominal Range: 1, 2, and 3 nm.

Additional Data: ICW daymarks are identical to their general use counterparts (Data Sheets 5-E(1)—(3)) except for the yellow reflective ICW marking. For lateral aids, this marking consists of yellow squares (port) or triangles (starboard). The yellow square or triangle is centered between the top of the reflective character and the reflective border. Table 5-8 provides the dimensions for dayboards with nominal ranges of 1, 2, and 3 nm.



Data Sheet 5-E(12). Intracoastal Waterway (ICW) port and starboard marks.

5.E.

Table 5-8

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for Intracoastal Waterway (ICW) Port and Starboard Marks

Port

Mark	Nominal Range (nm)	$H_G \times W_G$ (in)	h_G' (in)	R (in)	S/T (in)	L (in) (1 number)	L (in) (2 numbers)	L (in) (3 numbers)
3SG-I	1	36 x 36	5	2	6	12	12	8
4SG-I	2	48 x 48	6	3	9	16	16	12
6SG-I	3	72 x 72	7	4	12	24	24	16

Starboard

Mark	Nominal Range (nm)	$H_R \times W_R$ (in)	h_R' (in)	R (in)	S/T (in)	L (in) (1 number)	L (in) (2 numbers)	L (in) (3 numbers)
4TR-I	1	48 x 48	5	2	6	12	12	8
6TR-I	2	72 x 72	6	3	9	16	16	12
8TR-I	3	96 x 96	7	4	12	24	24	16

Note—Character sizes (L) and placement of the number above the base of the dayboard (h_{GR}') are recommendations only. Smaller characters may be selected, however, the sizes must be uniform throughout the district.

INTRACOASTAL WATERWAY (ICW) PREFERRED CHANNEL MARKS

System: Intracoastal waterway (ICW).

Function: Laterally significant preferred channel marks.

Nominal Range: 1 nm (*as designated in Figure 5-16, below—use Table 5-9 for dimensions of ICW port and starboard marks with nominal ranges of 1-, 2-, and 3- nm).

Additional Data: ICW daymarks are identical to their general use counterparts (Data Sheet 5-E(4)) except for the yellow reflective ICW marking. For lateral aids, this marking consists of yellow squares (port) or triangles (starboard). The yellow square or triangle is centered between the top of the reflective character and the reflective border.

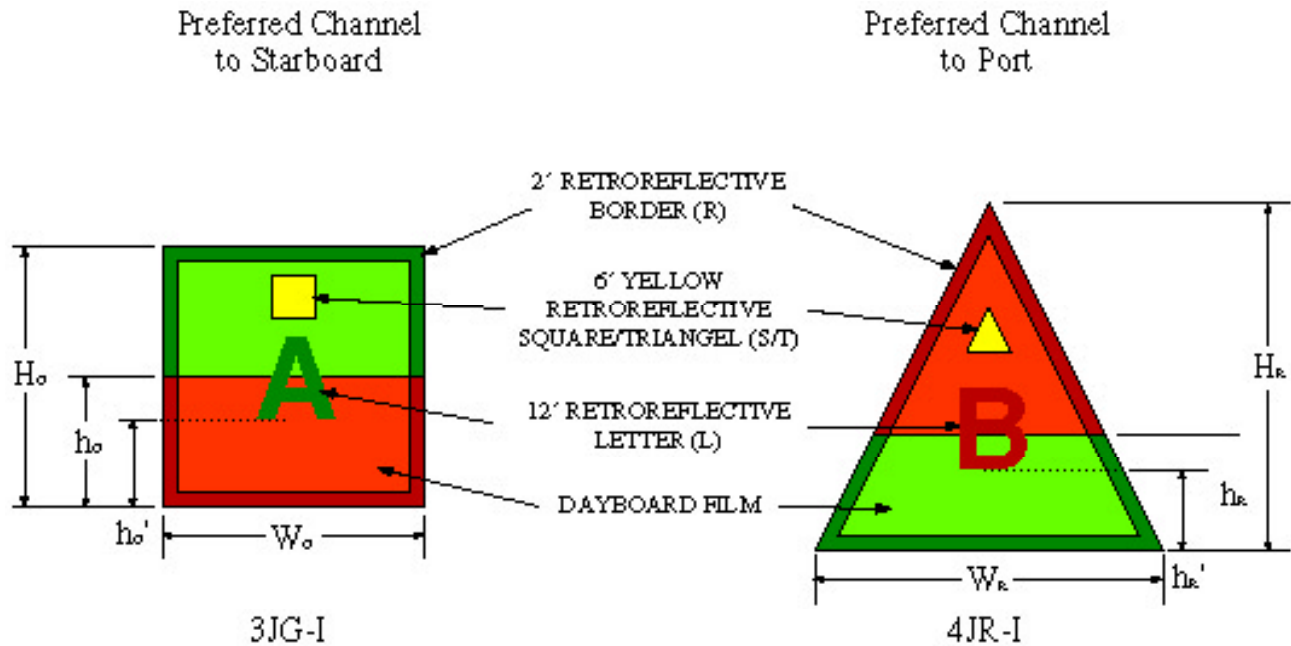


Figure 5-16. Intracoastal Waterway preferred channel marks.

Data Sheet 5-E(13). Intracoastal Waterway (ICW) preferred channel marks.

5.E

Table 5-9

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for Intracoastal Waterway (ICW) Preferred Channel Marks

Port

Mark	Nominal Range (nm)	$H_G \times W_G$ (in)	h_G (in)	h_G' (in)	R (in)	S/T (in)	L (in)
3JG-I	1	36 x 36	18	12	2	6	12
4JG-I	2	48 x 48	24	16	3	9	16
6JG-I	3	72 x 72	36	24	4	12	24

Starboard

Mark	Nominal Range (nm)	$H_R \times W_R$ (in)	h_R (in)	h_R' (in)	R (in)	L (in) (1 letter)	L(in) (2 letters)
4JR-I	1	48 x 48	16	10	2	6	12
6JR-I	2	72 x 72	24	16	3	9	16
8JR-I	3	96 x 96	32	20	4	12	24

Note—Character sizes (L) and placement of the number above the base of the dayboard ($h_{G/R}'$) are recommendations only. Letters can be centered on the dividing line between the upper and lower sections of the dayboard, or may be lowered to provide for greater separation between the letter and the ICW marking (similar to placement on the SG-I and TR-I dayboards described in Data Sheet 5-E(12)). In either case, the letter(s) shall be the same color as the upper portion of the daymark. Smaller characters than those recommended in Table 5-9 may be selected, however, the sizes must be uniform throughout the district.

Data Sheet 5-E(13). (cont'd).

5.E.

DUAL PURPOSE (GENERAL USE/ICW) PORT AND STARBOARD MARKS

System: Combined General Use and Intracoastal Waterways.

Function: Laterally significant dual purpose port and starboard marks.

Nominal Range: 1, 2, and 3 nm.

Additional Data: Dual use port and starboard marks are identical to ICW port and starboard marks, except that the dayboard shape and color indicates the purpose of the mark in the General Use waterway only, while the ICW marking (yellow retroreflective square or triangle) indicates the purpose of the mark in the ICW. Therefore, the dayboard may mark opposite sides of the channels for the two waterways. Use the dimensions in Table 5-8 for daymarks with nominal ranges of 1, 2, and 3 nm.

DUAL PURPOSE PORT & STARBOARD MARKS (GENERAL USE MARKING SAME AS ICW MARKING)

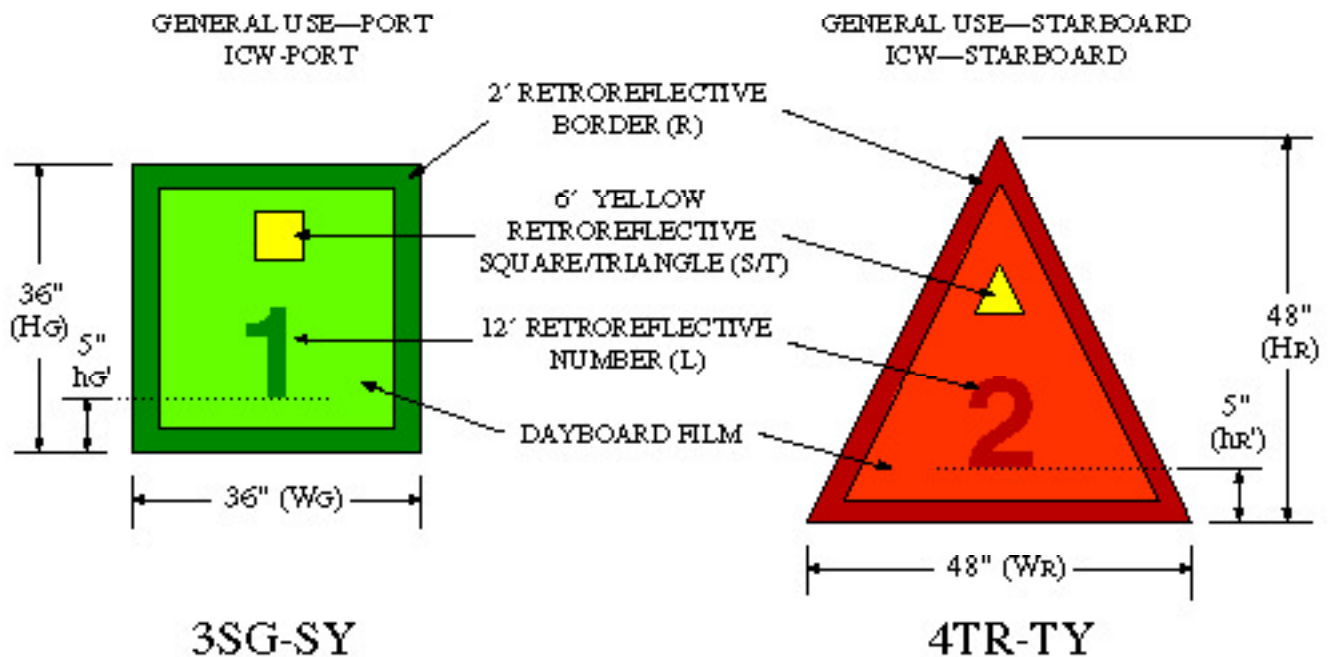


Figure 5-17a. Dual Use port and starboard marks
(where lateral aid is same in General Use and ICW channels).

Data Sheet 5-E(14). Dual Use (General Use and ICW) port and starboard marks.

5.E.

DUAL PURPOSE PORT & STARBOARD MARKS (GENERAL USE MARKING OPPOSITE OF ICW MARKING)

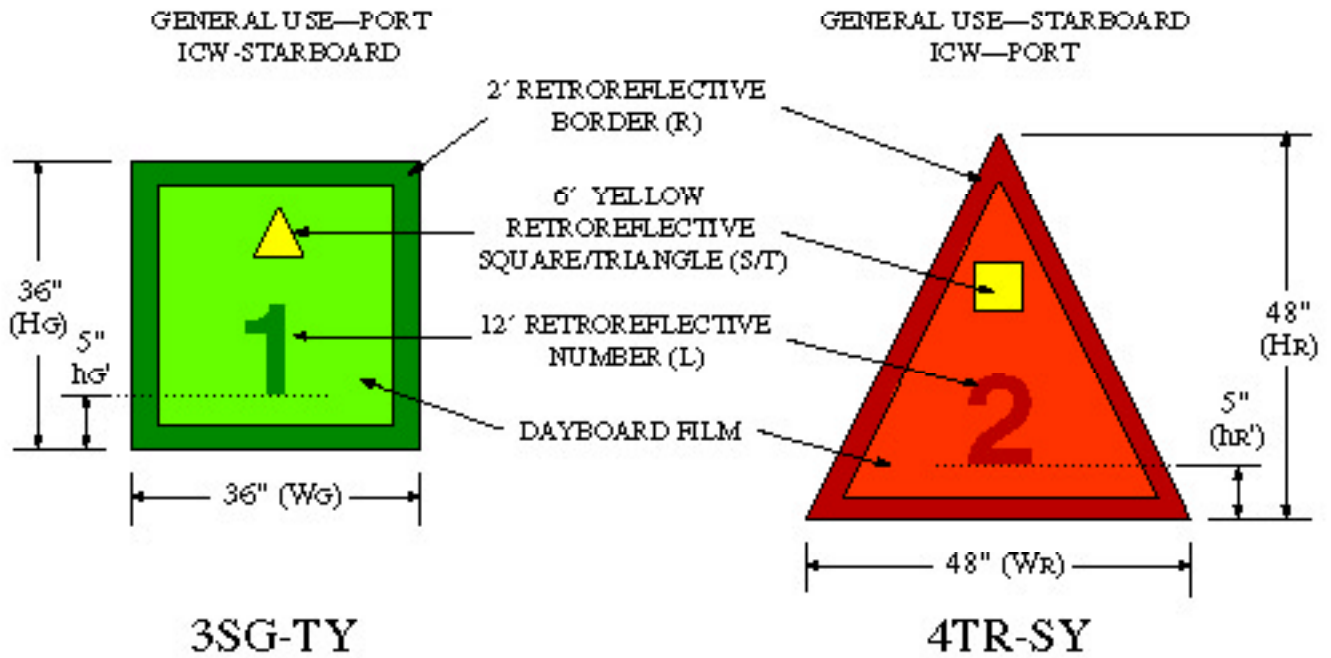


Figure 5-17b. Dual Use port and starboard marks
(where lateral aid is opposite in General Use and ICW channels).

Data Sheet 5-E(14). (cont'd).

5.E.

DUAL PURPOSE (GENERAL USE/ICW) PREFERRED CHANNEL MARKS

System: Combined General Use and Intracoastal Waterway.

Function: Laterally significant dual purpose preferred channel marks.

Nominal Range: 1, 2, and 3 nm.

Additional Data: Dual use preferred channel marks are identical to ICW preferred channel marks, except that the dayboard shape and color indicates the purpose of the mark in the General Use waterway only, while the ICW marking (yellow retroreflective square or triangle) indicates the purpose of the mark in the ICW. Therefore, the dayboard may mark opposite sides of the channels for the two waterways. Use the dimensions in Table 5-9 for daymarks with nominal ranges of 1, 2, and 3 nm.

DUAL PURPOSE PREFERRED CHANNEL MARKS (GENERAL USE MARKING SAME AS ICW MARKING)

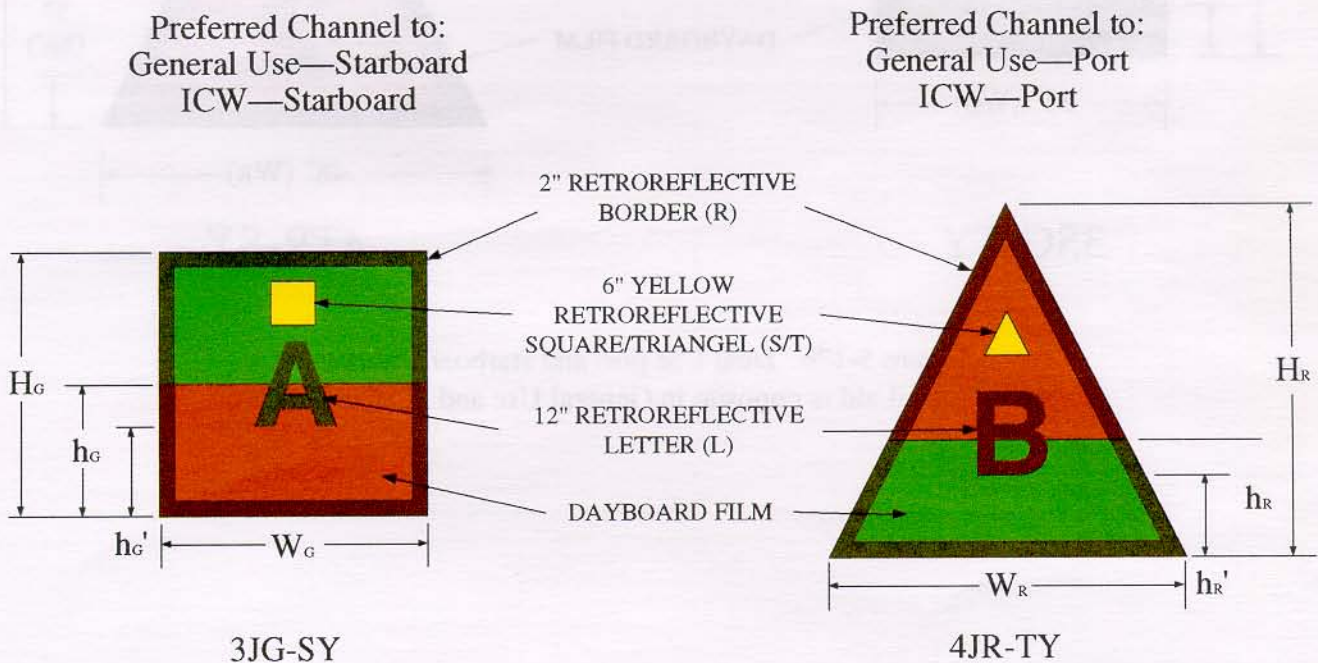


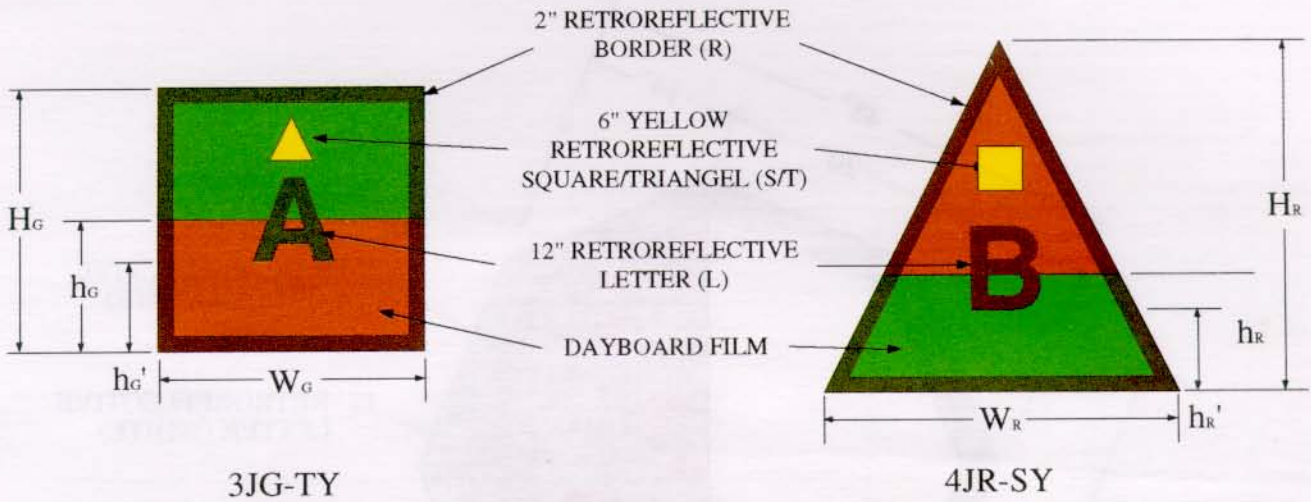
Figure 5-18a. Dual Use preferred channel marks
(where lateral aid is same in General Use and ICW channels).

Data Sheet 5-E(15). Dual Purpose (General Use and ICW) preferred channel marks.

DUAL PURPOSE PREFERRED CHANNEL MARKS
(GENERAL USE OPPOSITE OF ICW MARKING)

Preferred Channel to:
General Use—Starboard
ICW—Port

Preferred Channel to:
General Use—Port
ICW—Starboard



3JG-TY

4JR-SY

Figure 5-18b. Dual Use preferred channel marks
(where lateral aid is opposite in General Use and ICW channels).

5.E.

INTRACOASTAL WATERWAY (ICW) SAFE-WATER MARKS

System: Intercoastal Waterway (ICW).

Function: Safe-water marks.

Nominal Range: 1 and 3 nm.

Additional Data: ICW daymarks are identical to their general use counterparts (Data Sheet 5-E(5)) except for the yellow reflective ICW marking. For aids with no lateral significance, such as a safe-water mark, this marking consists of a two-inch high yellow strip along the bottom of the dayboard. Use dimensions in Data Sheet 5-E(5) for appropriate sizing of 1-nm and 3-nm nominal range ICW safe-water markers.

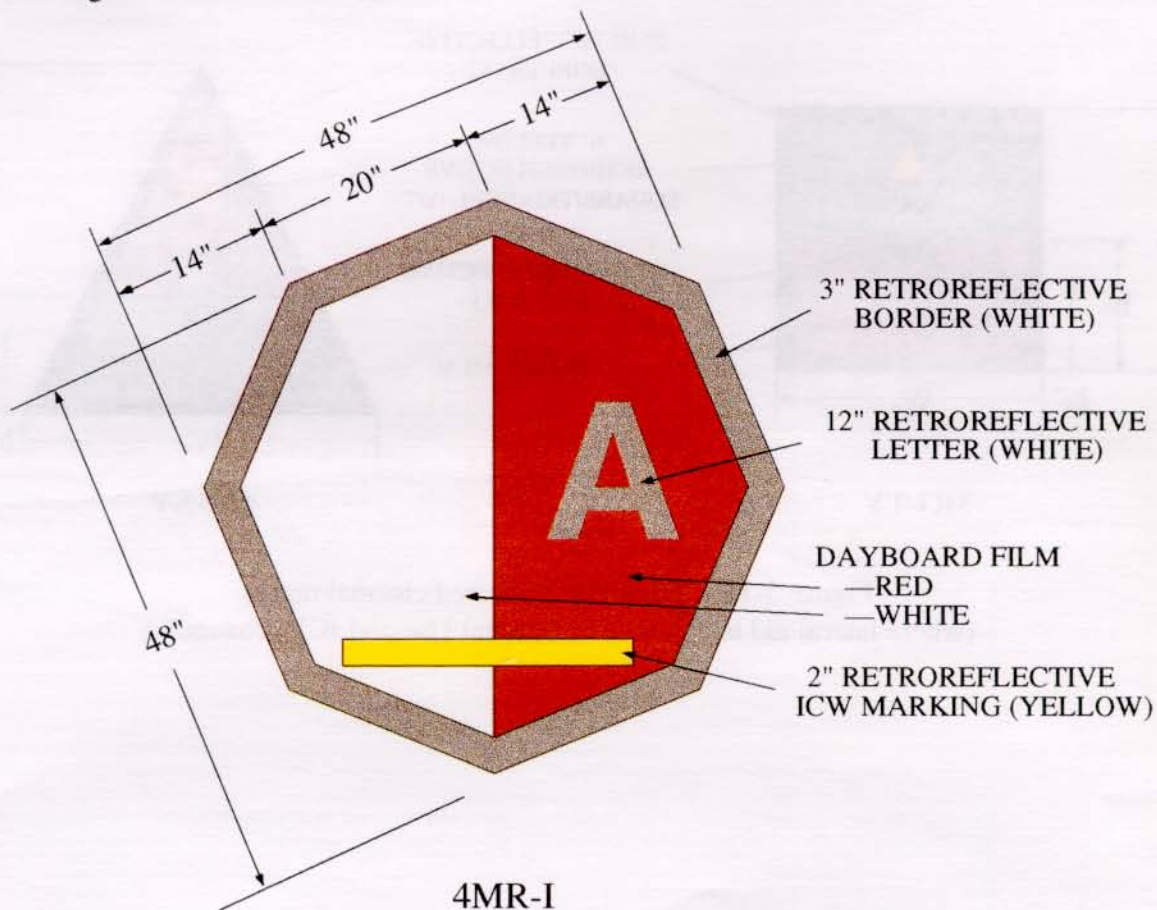


Figure 5-19. Intercoastal Waterway (ICW) safe-water mark.

Data Sheet 5-E(16). Intracoastal Waterway (ICW) safe-water marks.

INTERCOASTAL WATERWAY (ICW) RANGE MARKS

System: Intercoastal Waterway (ICW).

Function: Intercoastal Waterway (ICW) range marks.

Nominal Range: 1 to 5 nm

Additional Data: ICW range marks are identical to their general use counterparts (Data Sheet 5-E(6)) except for the yellow reflective ICW marking. For range marks the ICW marking consists of a two-inch high yellow strip along the bottom of the front range board. The yellow strip is placed on the front range board only. Use the information in Data Sheet 5-E(6) for the appropriate dimensions and colors of ICW range marks.

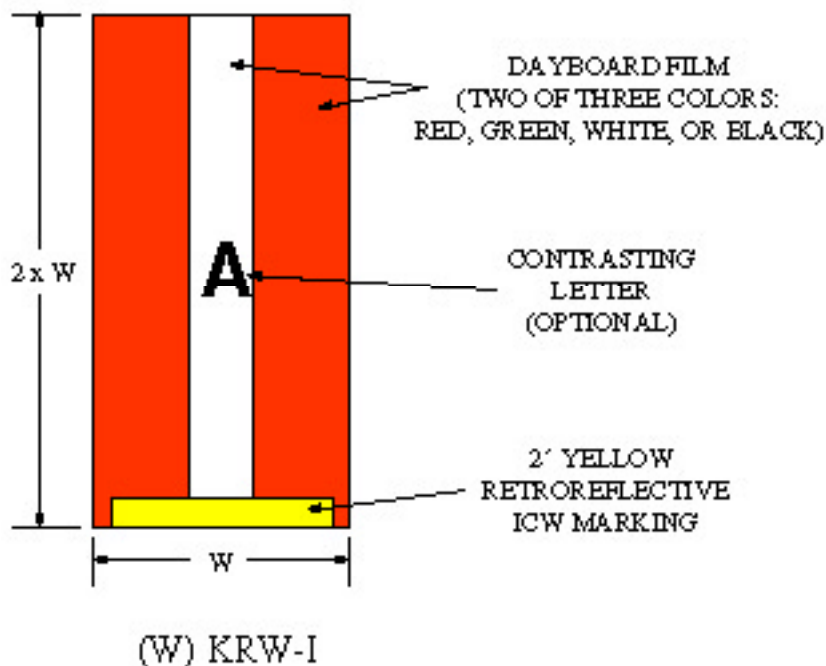


Figure 5-20. Intracoastal Waterway (ICW) range mark.

Data Sheet 5-E(17). Intercoastal Waterway (ICW) range marks.

5.E.

5.E.

INTRACOASTAL WATERWAY (ICW) DISTANCE MARKS

System: Intracoastal Waterway (ICW).

Function: No lateral significance distance (mile) marks.

Nominal Range: 1/2 nm.

Additional Data: Distance marks may be used in the ICW. A distance mark is normally placed on a structure immediately below the aid to navigation mark. The distance indicated is from a designated point, established by each district.

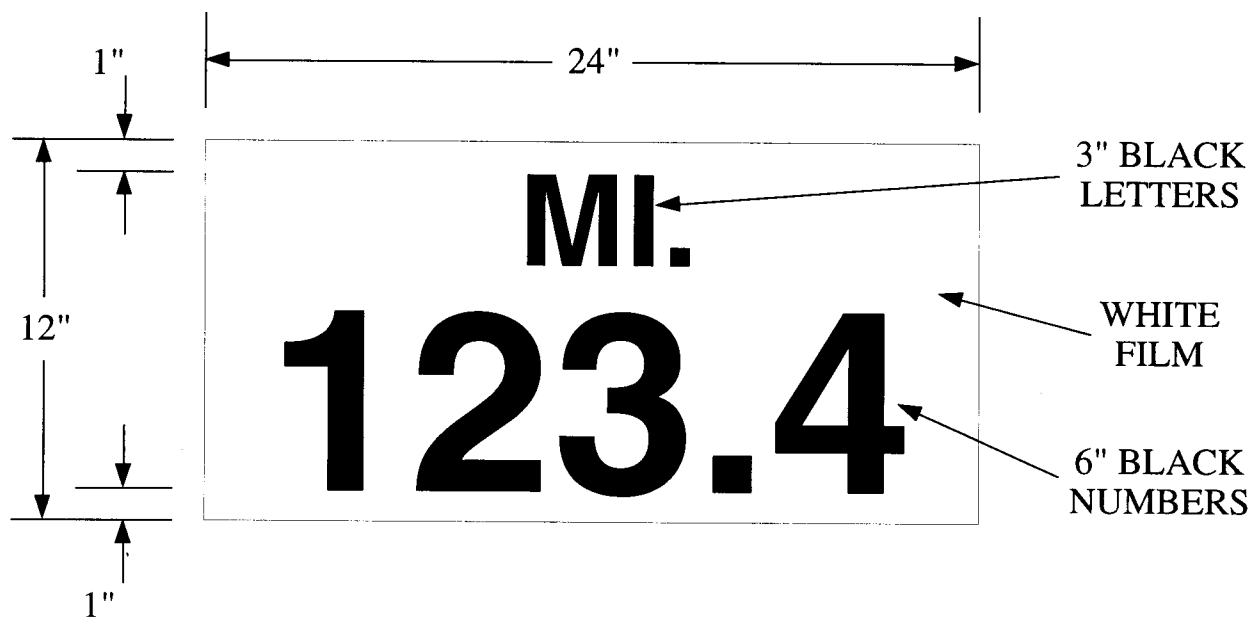


Figure 5-21. Intracoastal Waterway (ICW) distance mark.

Data Sheet 5-E(18). Intracoastal Waterway (ICW) distance marks.

5.E.

WESTERN RIVERS PASSING MARKS

System: Western Rivers.

Function: Laterally significant passing marks.

Nominal Range: 1, 2, and 3 nm.

Additional Data: Western River passing marks are identical to General Use port and starboard marks, with the exception that no numbers are used on the mark. Passing marks are typically used in conjunction with Western Rivers distance marks (see Data Sheet 5-E(21)). Use the dimensions from Table 5-10 for passing marks with nominal ranges of 1-, 2-, and 3-nm.

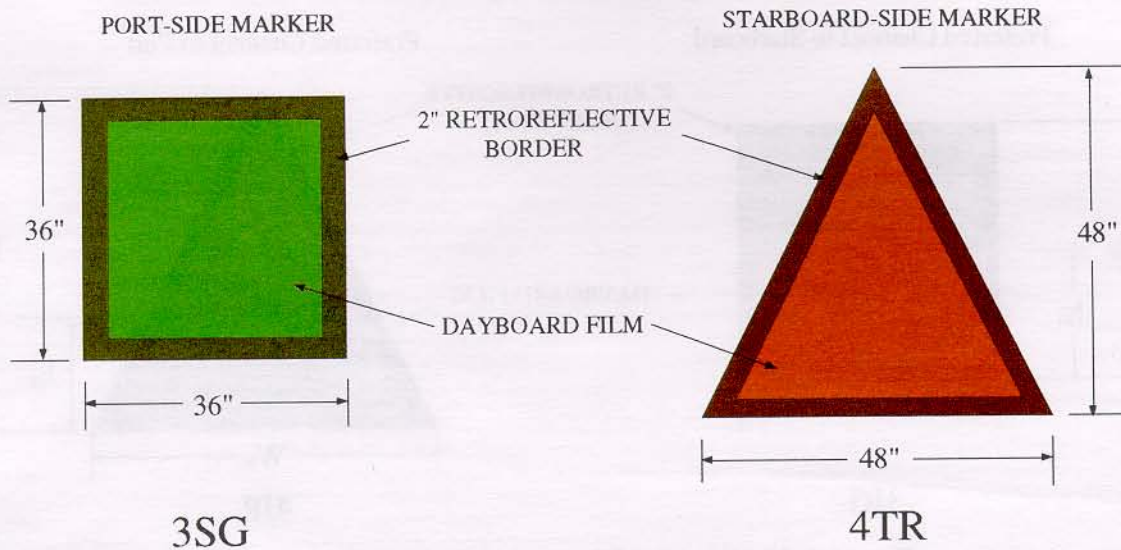


Figure 5-22. Western Rivers passing marks.

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for Western Rivers Passing Marks

Port-Hand Mark				Starboard-Hand Mark			
Mark	Nominal Range	$H_G \times W_G$ (in)	R (in)	Mark	Nominal Range	$H_R \times W_R$ (in)	R (in)
3SG	1 nm	36 x 36	2	4TR	1 nm	48 x 48	2
4SG	2 nm	48 x 48	3	6TR	2 nm	72 x 72	3
6SG	3 nm	72 x 72	4	8TR	3 nm	96 x 96	4

Data Sheet 5-E(19). Western Rivers passing marks.

5.E.

WESTERN RIVERS PREFERRED CHANNEL MARKS

System: Western Rivers.

Function: Laterally significant preferred channel marks.

Nominal Range: 1, 2, and 3 nm.

Additional Data: Western Rivers preferred channel marks are identical to General Use preferred channel marks, with the exception that no letters are used. Use Table 5-11 to size preferred channel marks with nominal ranges of 1-, 2-, and 3-nm.

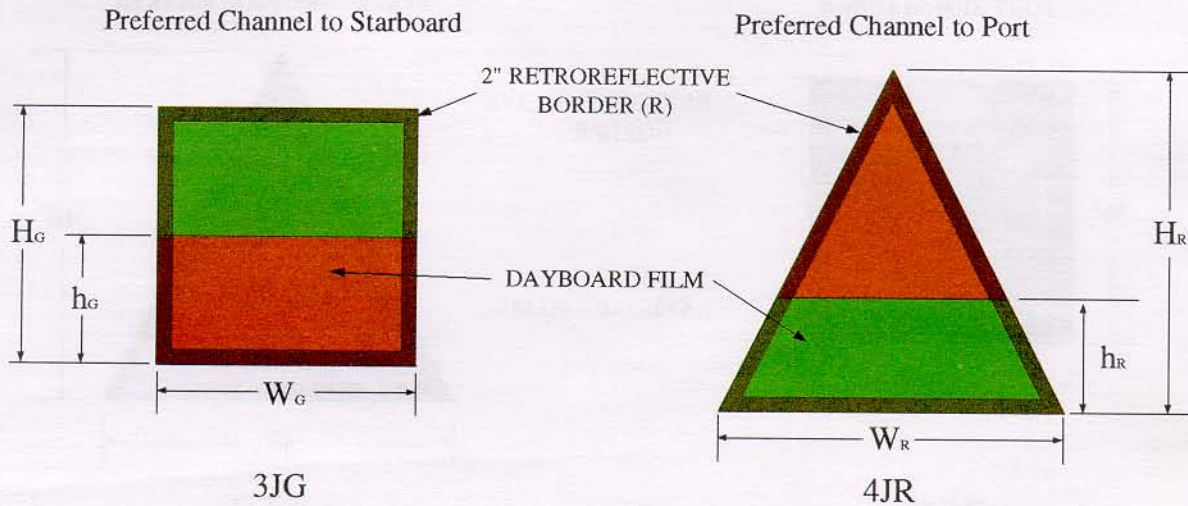


Figure 5-23. Western Rivers preferred channel marks.

Table 5-11

Dimensions for 1-, 2-, and 3-nm Nominal Range Dayboards
for Western Rivers Preferred Channel Marks

Preferred Channel to Starboard					Preferred Channel to Port				
Mark	Nominal Range	$H_G \times W_G$ (in)	h_G (in)	R (in)	Mark	Nominal Range	$H_R \times W_R$ (in)	h_R (in)	R (in)
3SG	1 nm	36 x 36	18	2	4TR	1 nm	48 x 48	16	2
4SG	2 nm	48 x 48	24	3	6TR	2 nm	72 x 72	24	3
6SG	3 nm	72 x 72	36	4	8TR	3 nm	96 x 96	32	4

Data Sheet 5-E(20). Western Rivers preferred channel marks.

5.E.

WESTERN RIVERS DISTANCE MARKS

System: Western Rivers.

Function: No lateral significance distance marks.

Nominal Range: 1 nm

Additional Data: Western Rivers distance marks are typically used in conjunction with passing marks (Data Sheet 5-E(19)) and non-lateral marks (Data Sheet 5-E(7)) which indicate where the channel crosses a river. Eight inch black numbers are horizontally and vertically centered on the dayboard. The 1-foot by 4-foot distance mark is used in conjunction with all size passing and non-lateral marks.

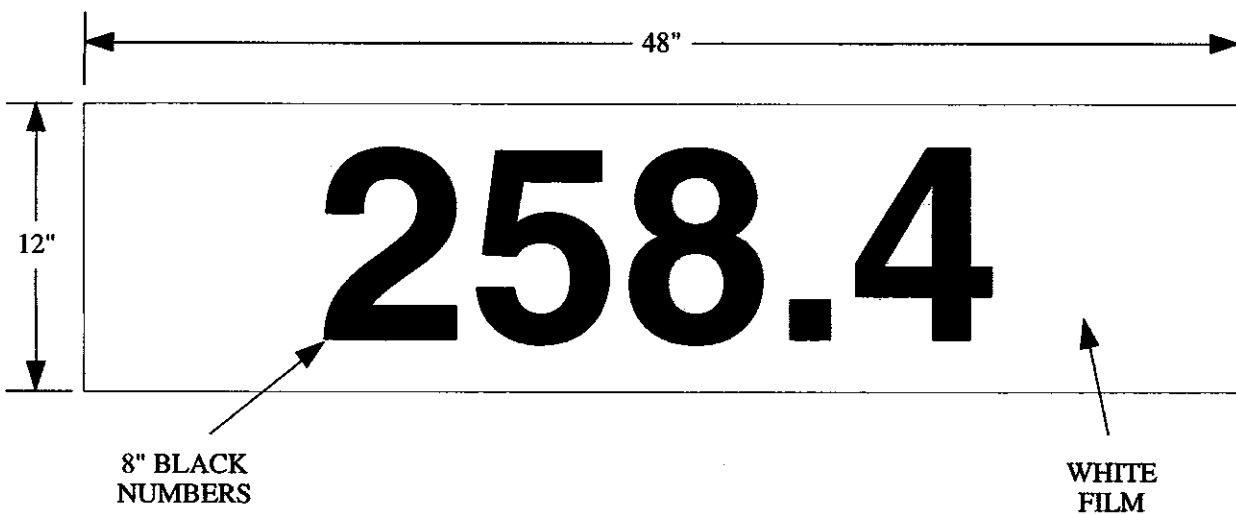


Figure 5-24. Western Rivers distance marks.

Data Sheet 5-E(21). Western Rivers distance marks.

5.E.

PLYWOOD CUTTING PATTERN

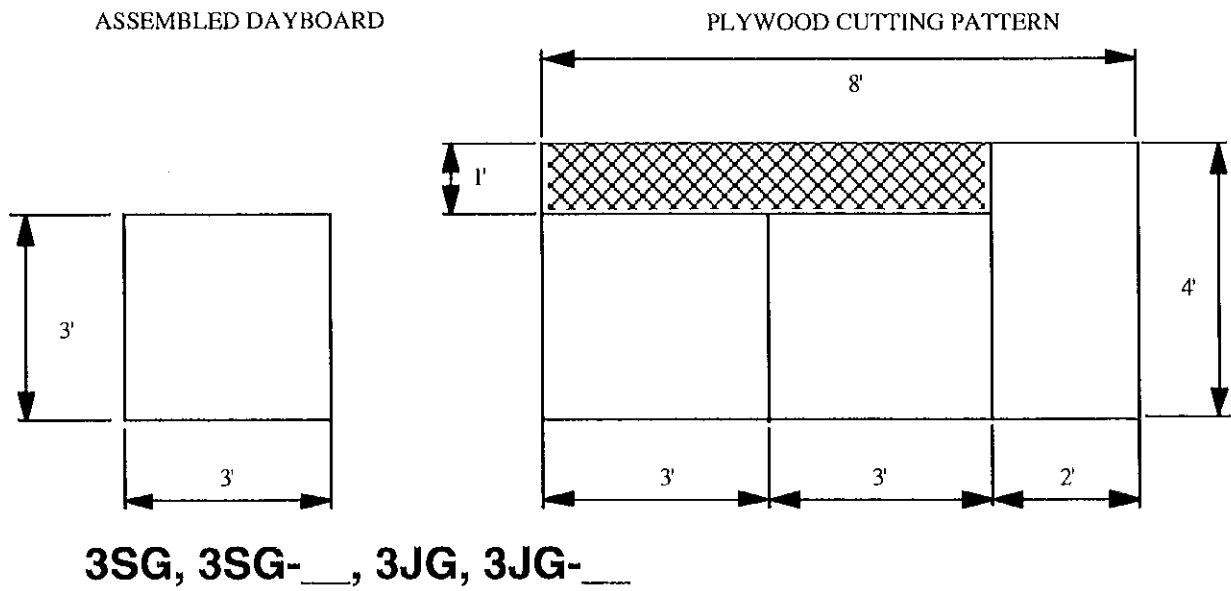


Figure 5-25.

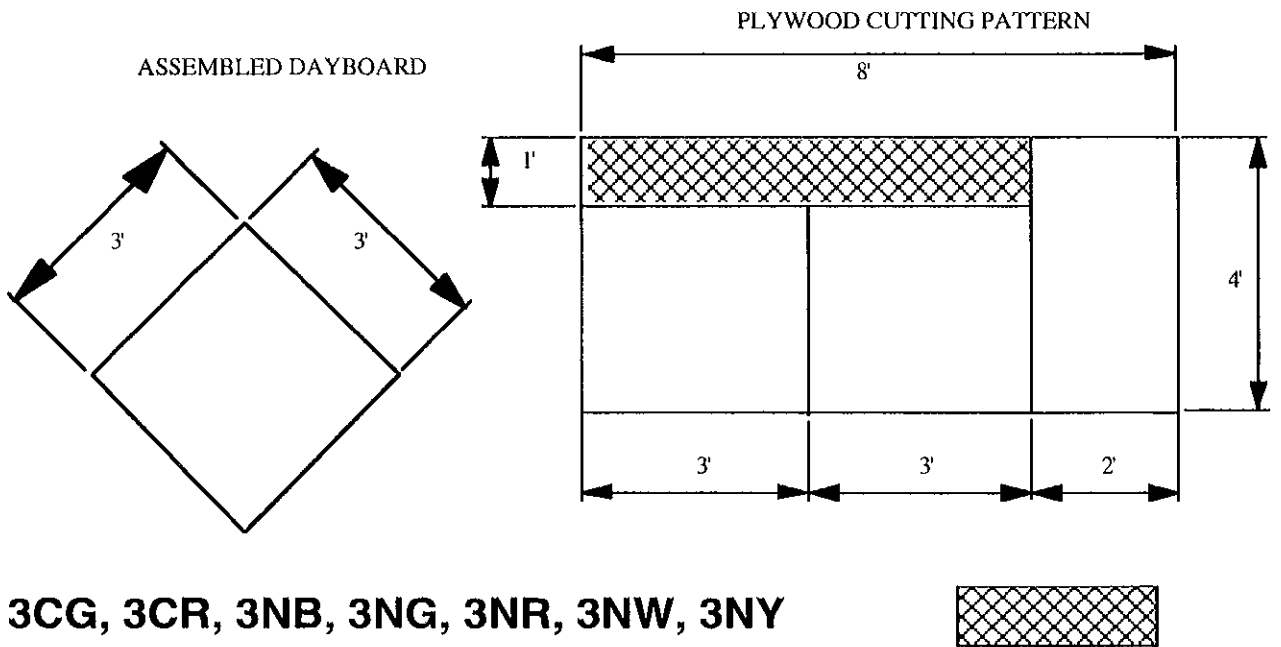
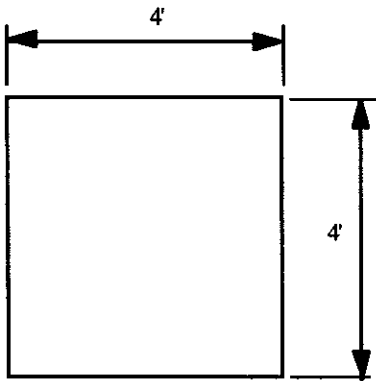


Figure 5-26.

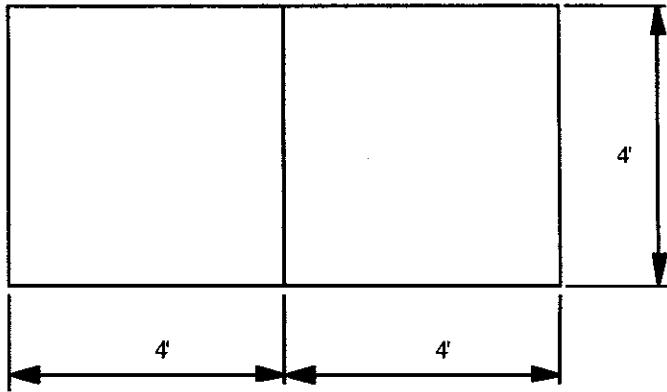
Data Sheet 5-E(22). Plywood Cutting Pattern.

5.E.

ASSEMBLED DAYBOARD



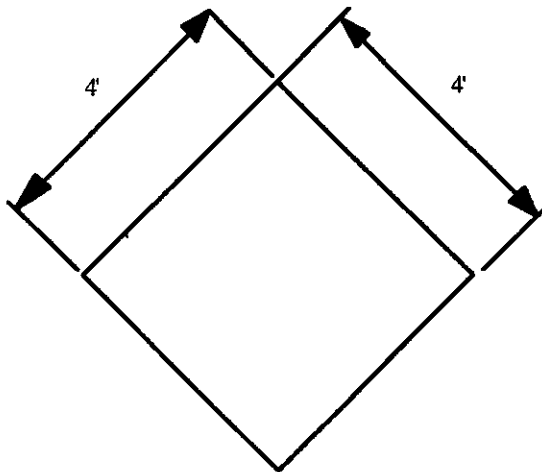
PLYWOOD CUTTING PATTERN



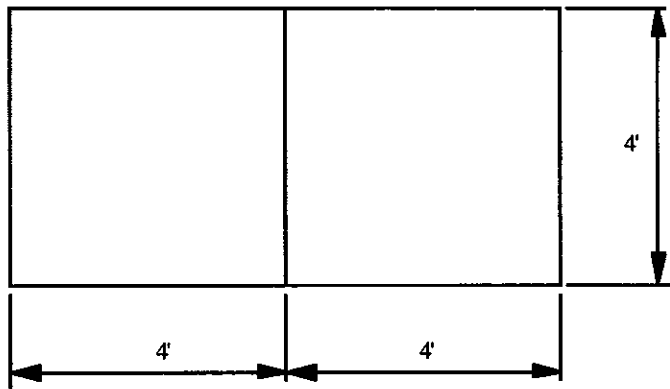
4SG, 4SG-__, 4JG, 4JG-__

Figure 5-27.

ASSEMBLED DAYBOARD



PLYWOOD CUTTING PATTERN



4CG, 4CR, 4NB, 4NG, 4NR, 4NW, 4NY

Figure 5-28.

Data Sheet 5-E(22). (cont'd).

5.E.

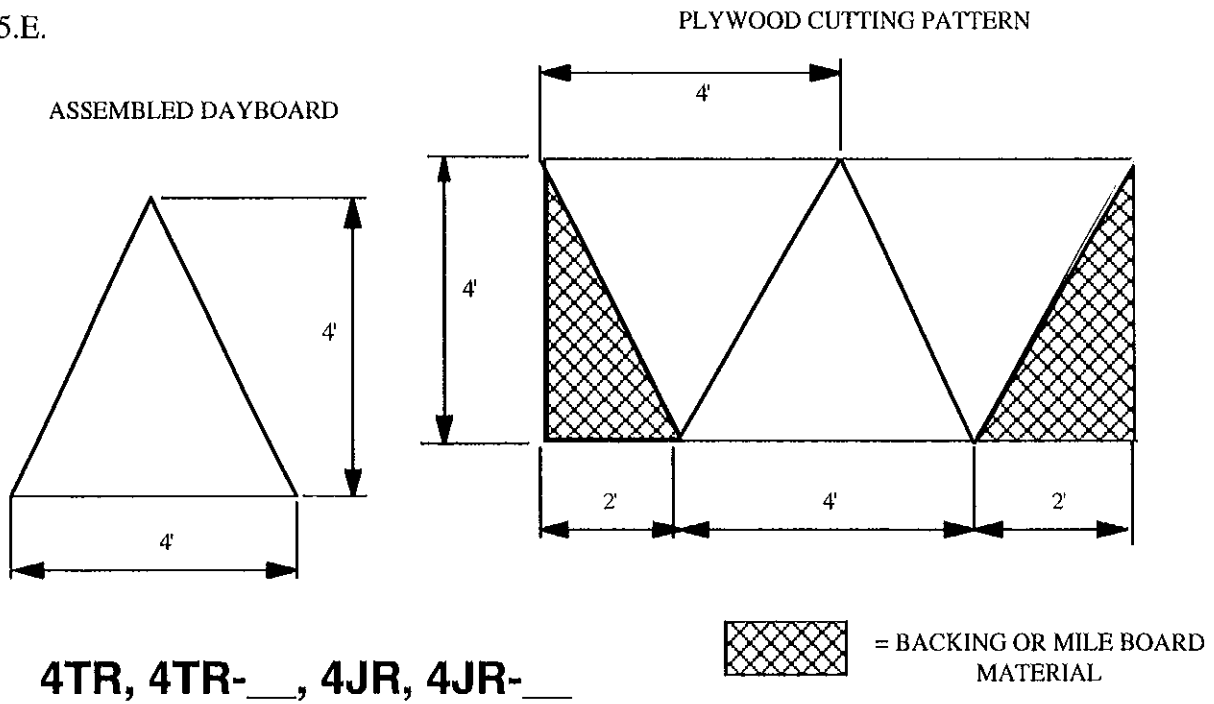


Figure 5-29.

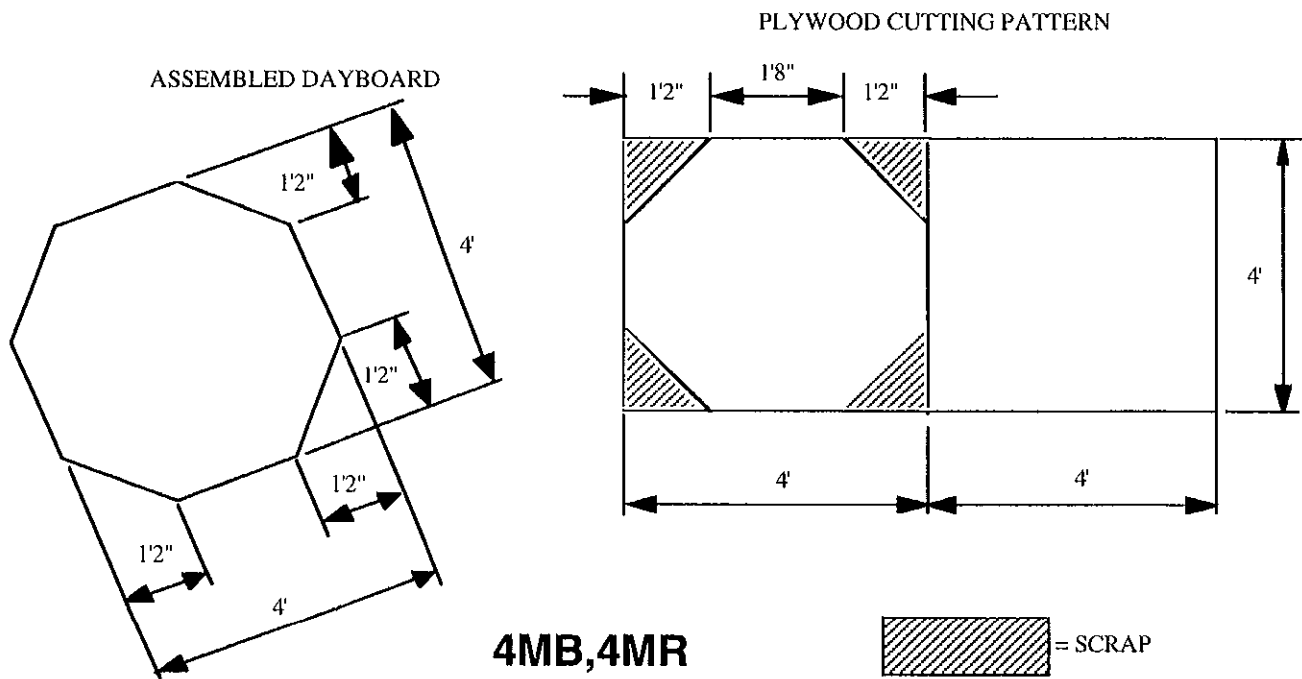
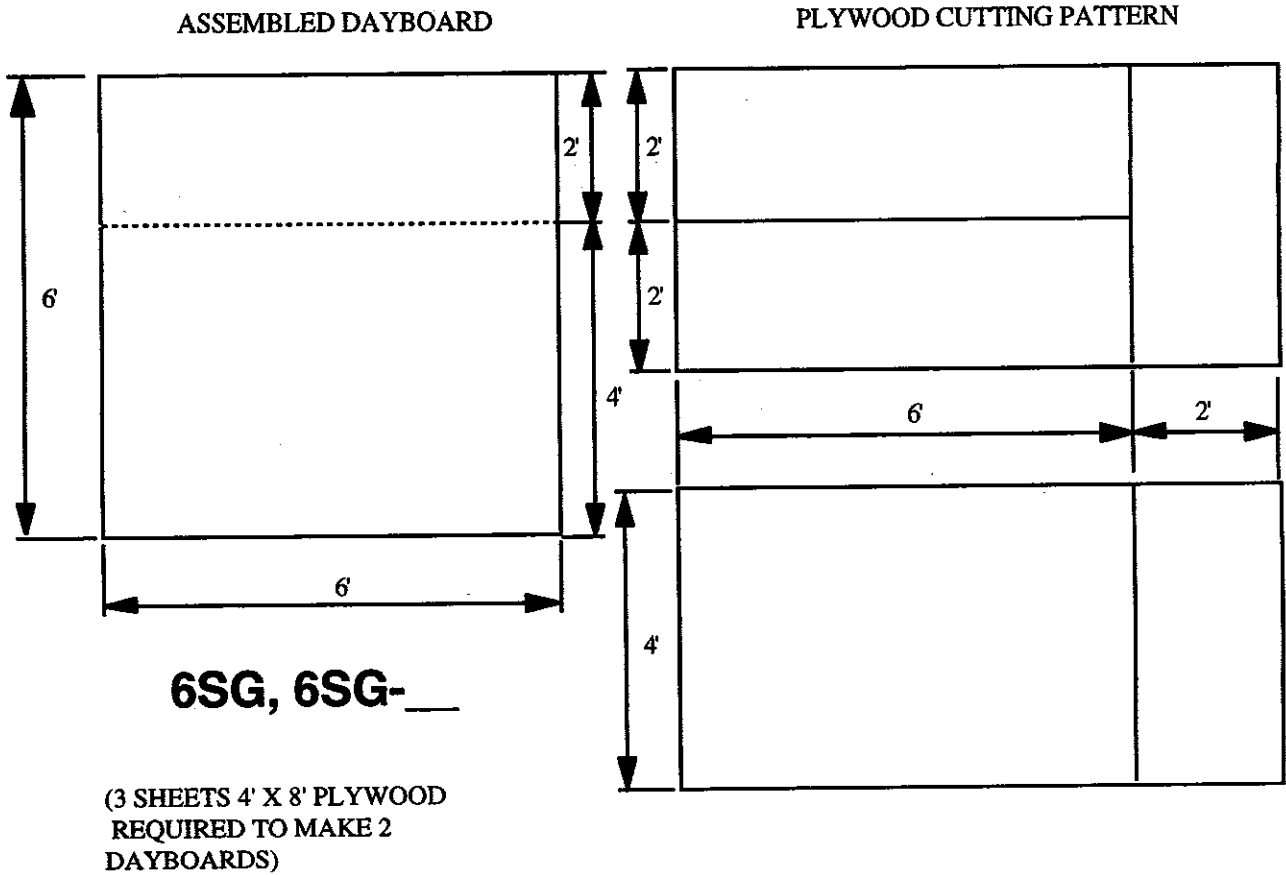


Figure 5-30.

Data Sheet 5-E(22). (cont'd).

5.E.

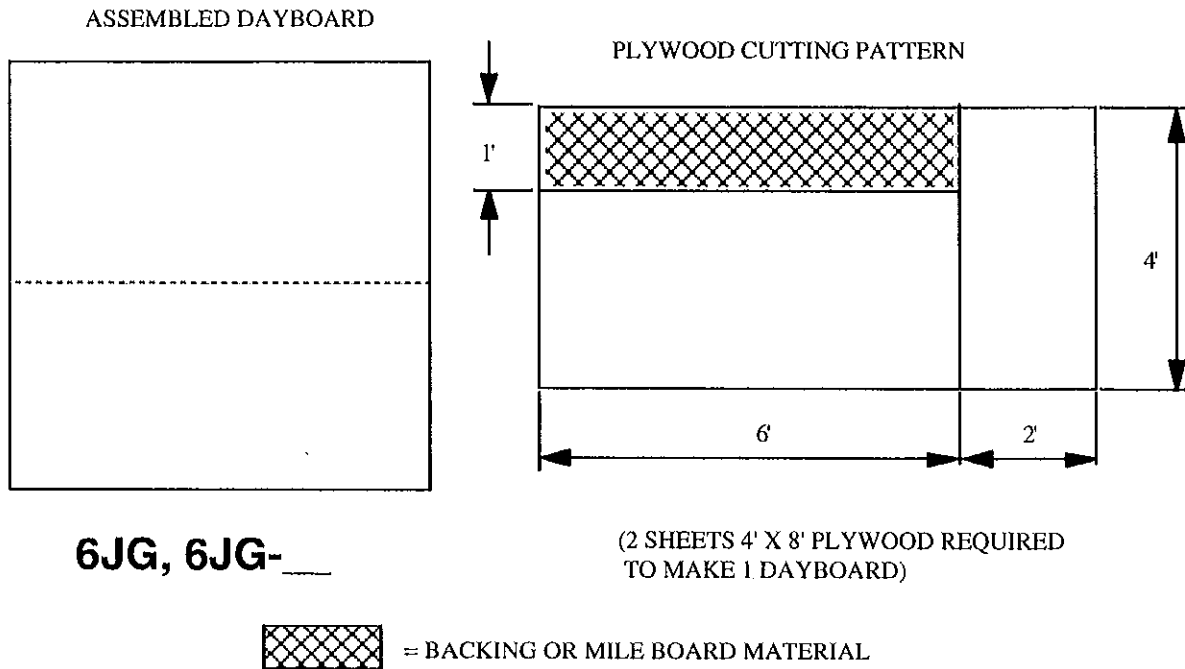


NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES

Figure 5-31.

Data Sheet 5-E(22). (cont'd).

5.E.

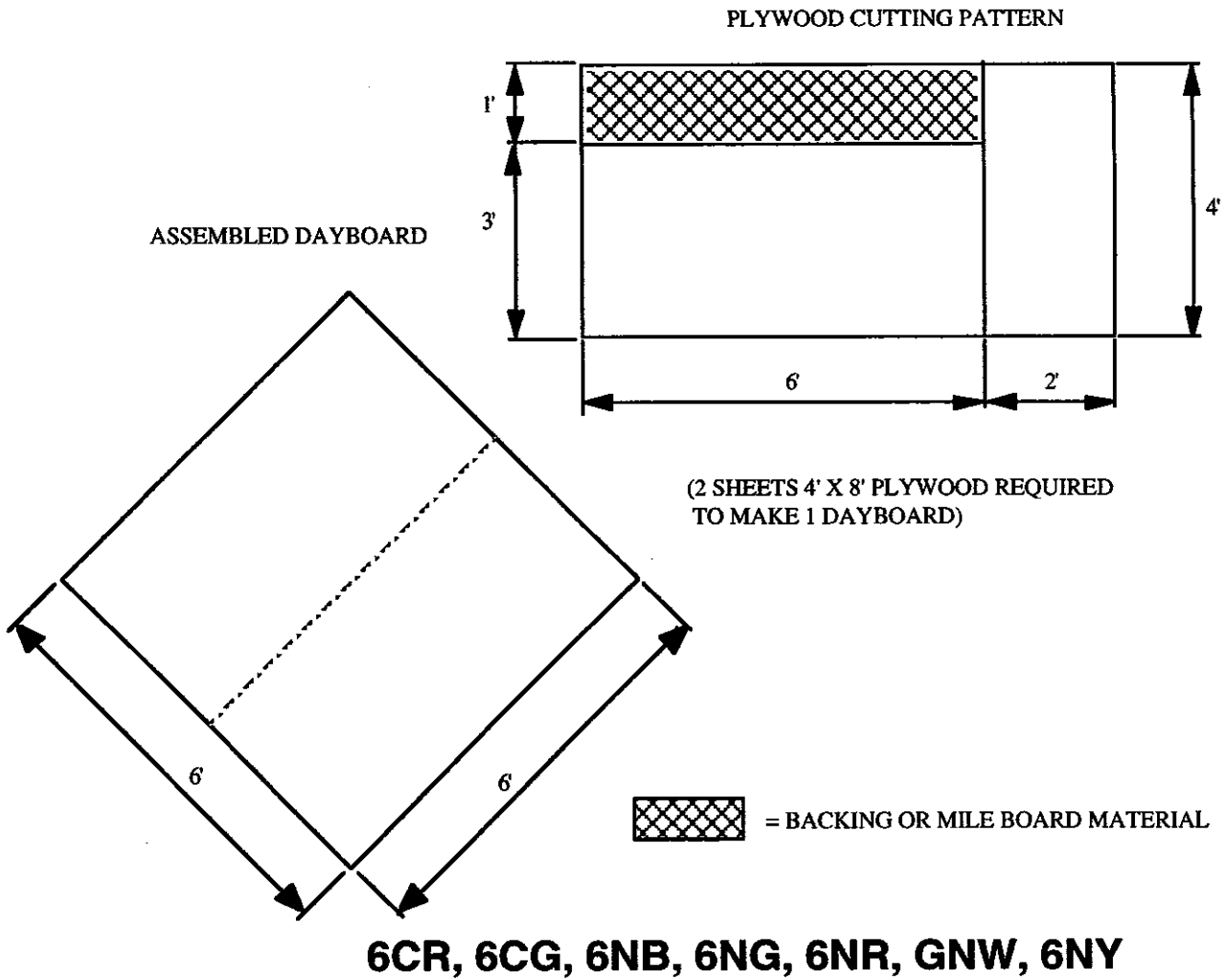


NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES

Figure 5-32.

Data Sheet 5-E(22). (cont'd).

5.E.

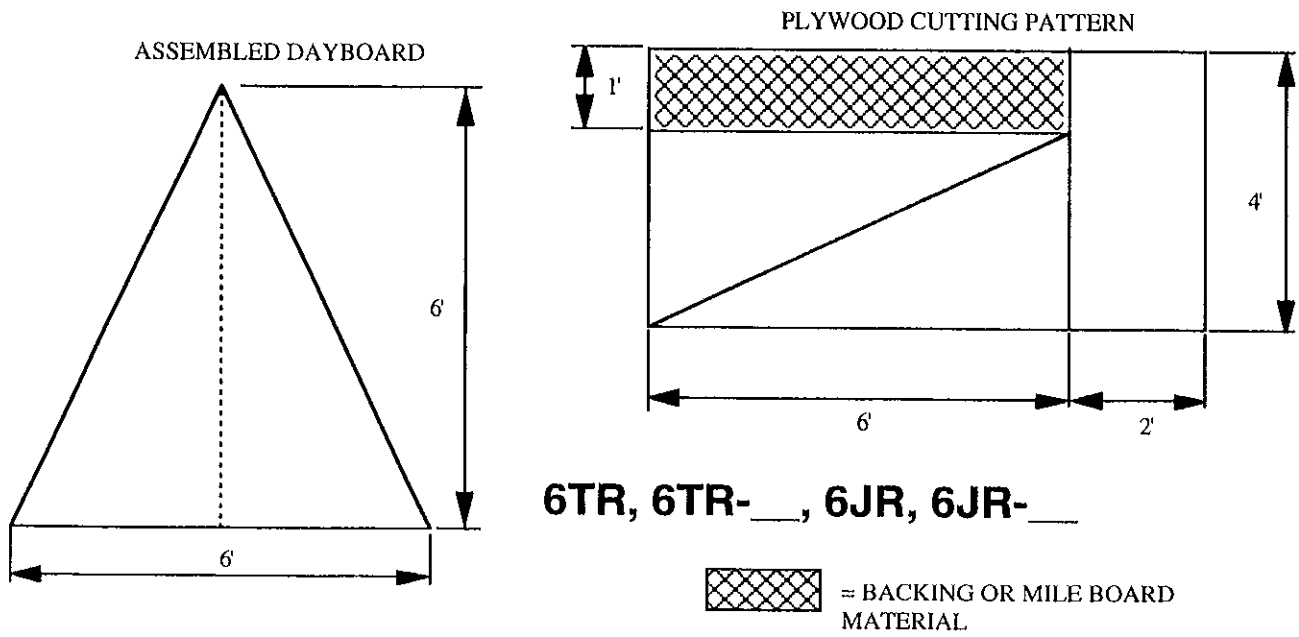


NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES

Figure 5-33.

Data Sheet 5-E(22). (cont'd).

5.E.

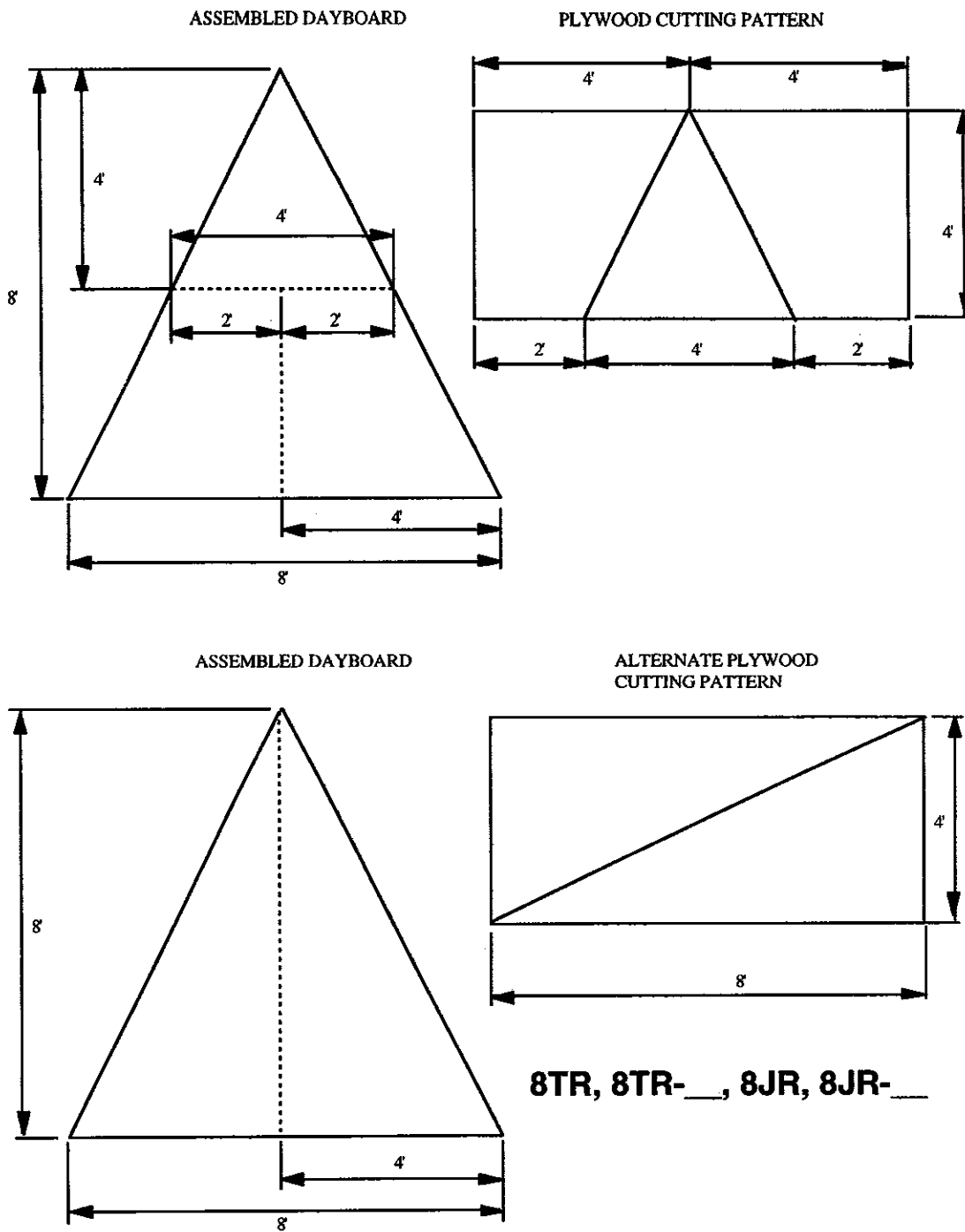


NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES

Figure 5-34.

Data Sheet 5-E(22). (cont'd).

5.E.



8TR, 8TR-___, 8JR, 8JR-___

NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES

Figure 5-35.

Data Sheet 5-E(22). (cont'd).

5.E.

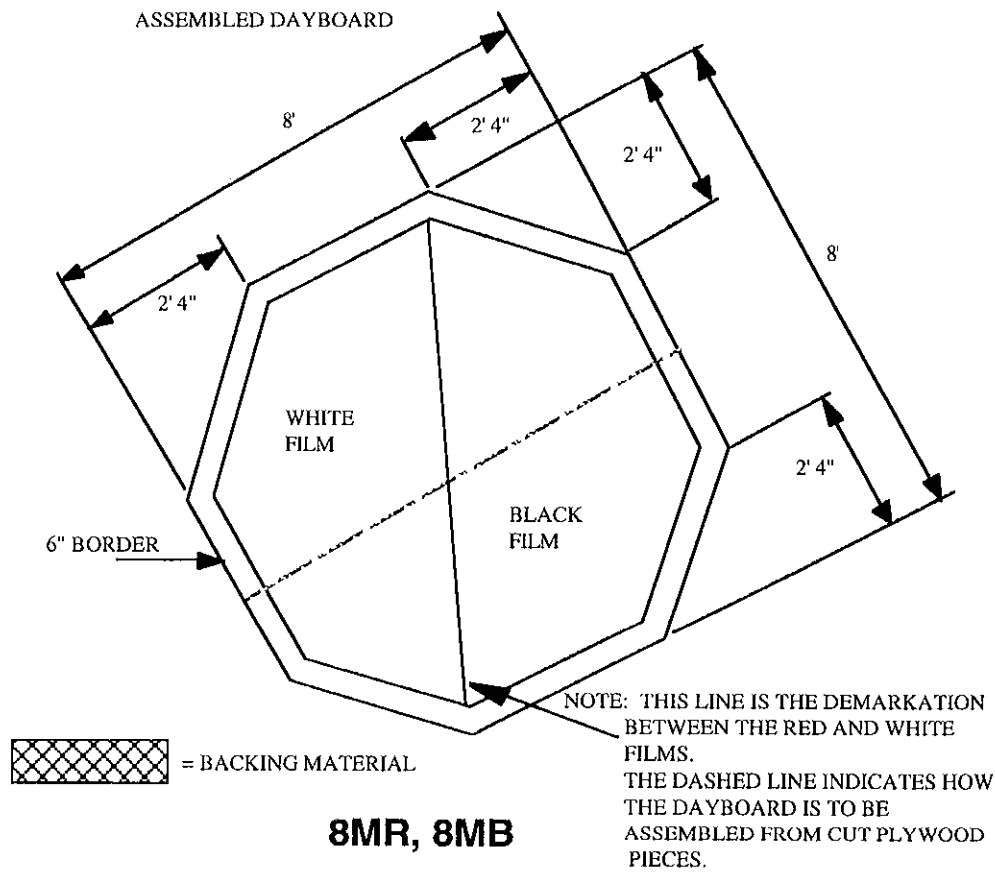
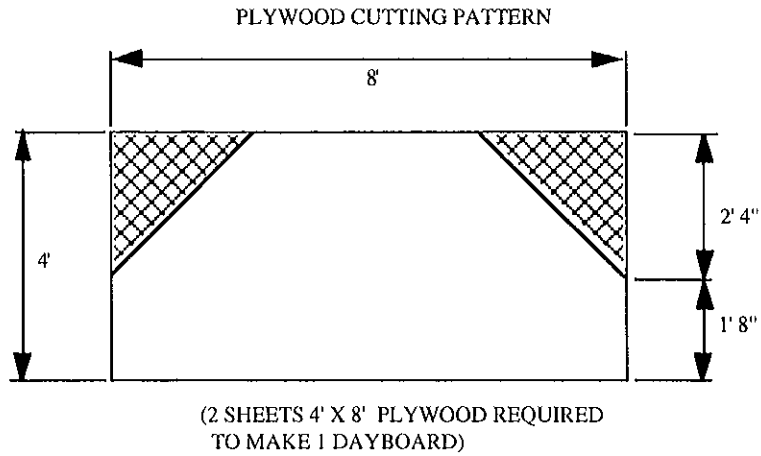


Figure 5-36

Data Sheet 5-E(22). (cont'd).

5.E.

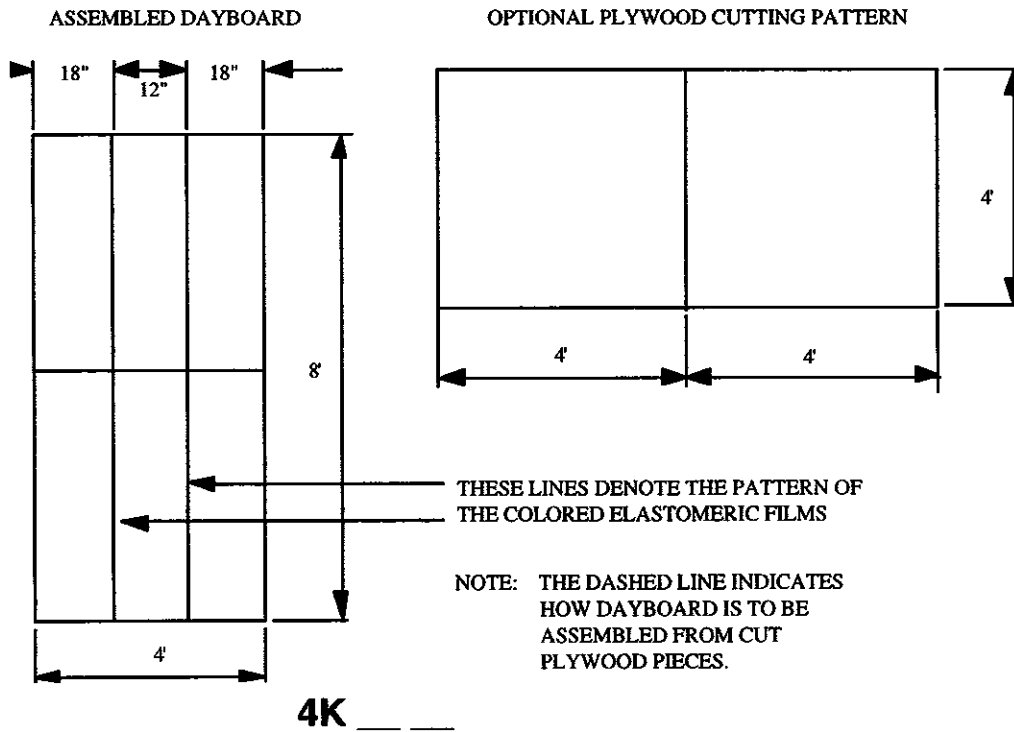
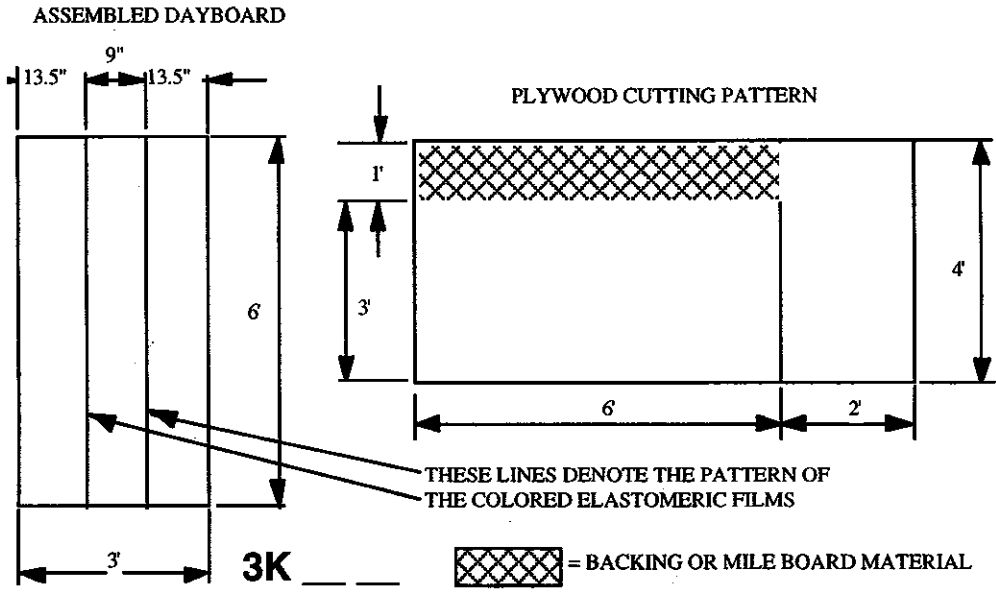
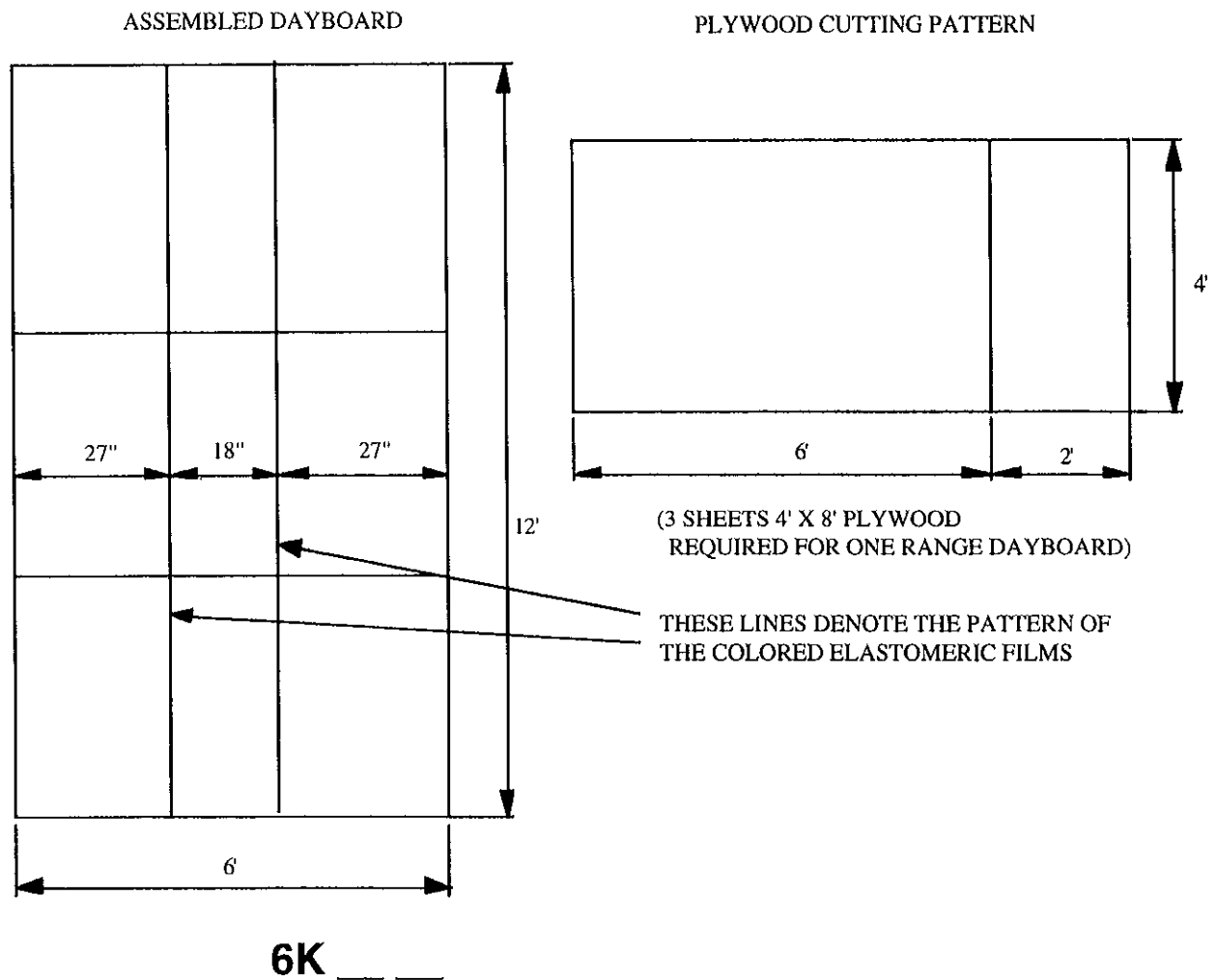


Figure 5-38

Data Sheet 5-E(22). (cont'd).

5.E.

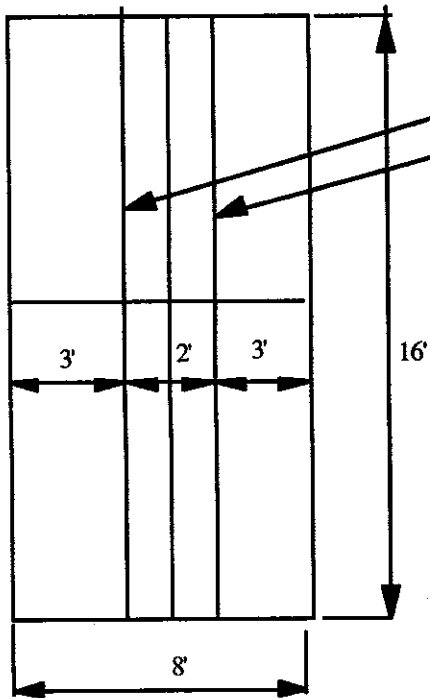


NOTE: DASHED LINES INDICATE HOW DAYBOARD IS TO BE ASSEMBLED FROM CUT PLYWOOD PIECES

Figure 5-39.

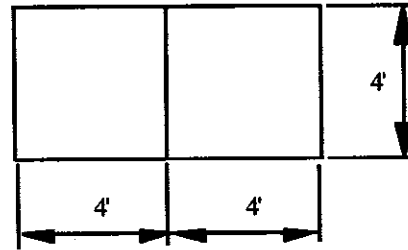
Data Sheet 5-E(22). (cont'd).

ASSEMBLED DAYBOARD



THESE LINES
DENOTE THE
PATTERN OF THE
COLORED
ELASTOMERIC
FILMS.

OPTIONAL PLYWOOD CUTTING PATTERN



8K _ _ _

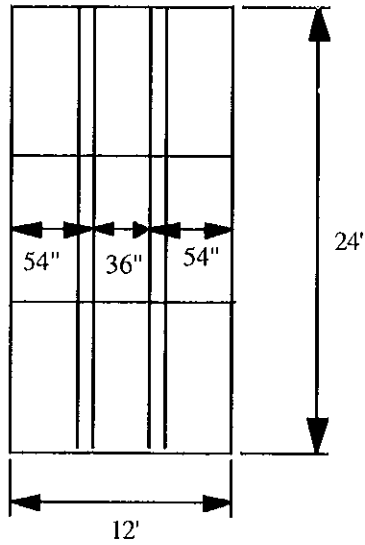
(4 SHEETS 4' X 8' PLYWOOD REQUIRED
FOR ONE RANGE DAYBOARD)

Figure 5-40.

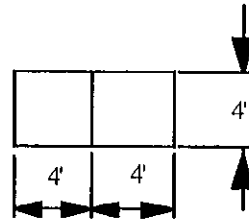
Data Sheet 5-E(22). (cont'd).

5.E.

ASSEMBLED DAYBOARD



OPTIONAL PLYWOOD CUTTING PATTERN



(9 SHEETS 4' X 8' PLYWOOD REQUIRED FOR ONE RANGE DAYBOARD)

12 K ___

DASHED LINES INDICATE HOW DAYBOARD MAY POSSIBLY BE ASSEMBLED FROM THE 4' X 8' PLYWOOD SHEETS, IF PLYWOOD IS NOT CUT.

Figure 5-41.

Data Sheet 5-E(22). (cont'd).

5.E.

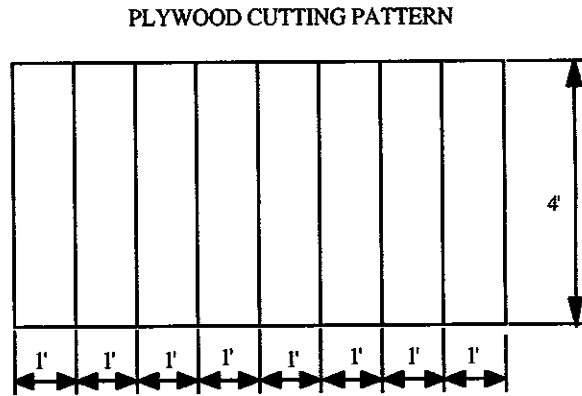
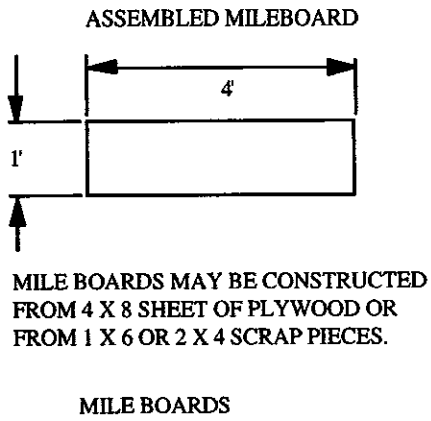


Figure 5-42.

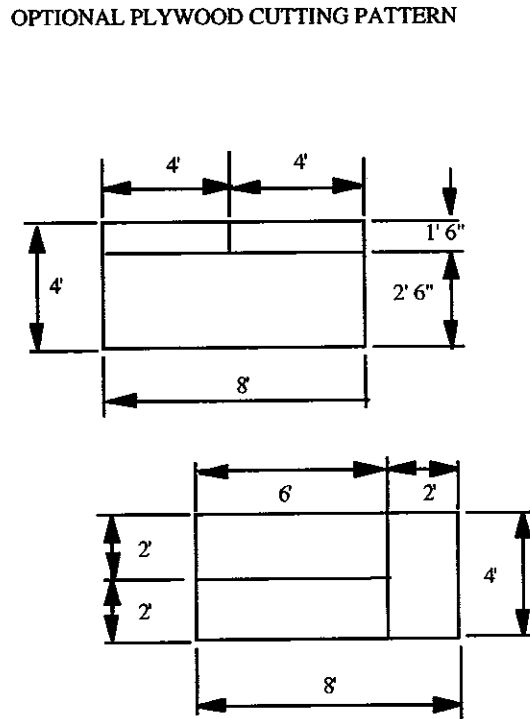
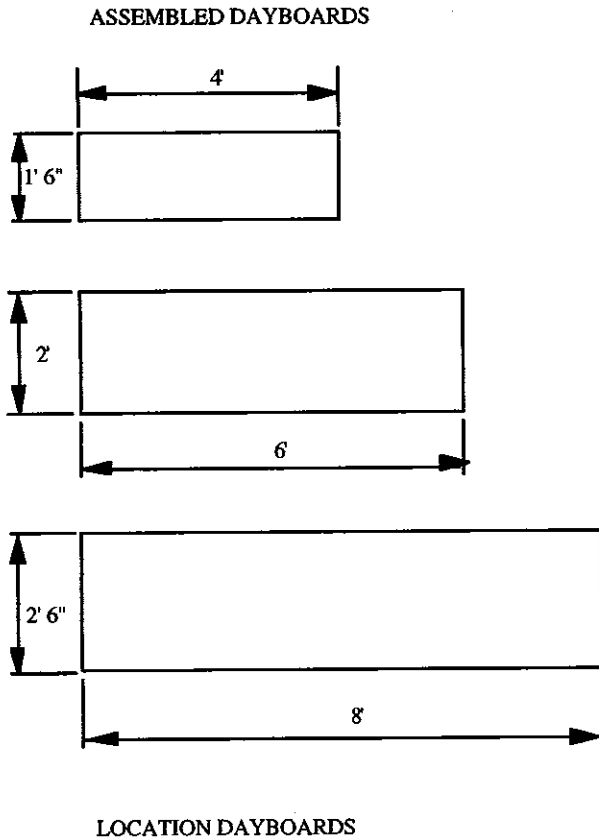


Figure 5-43

Data Sheet 5-E(22). (cont'd).

CHAPTER 6. LIGHT SIGNALS

- A. Introduction. This chapter describes the components of standard aids to navigation light signals—including the housing, lenses, lamps, lampchangers, flashers, daylight controls, and wiring. Unless otherwise authorized by Commandant, only standard equipment, as described in this chapter, may be used in new installations, or as replacements for existing equipment.
- B. Selecting an ATON Light Signal.
1. Criteria. The Visual Signal Design Manual, COMDTINST M16510.2 (series) describes the standard procedures to follow when selecting an optical system for a lighted aid to navigation. In general, these procedures require the Waterways Manager to:
 - a. State the operational requirement—in terms of the desired luminous range of the light for a specified percent of time. This is known as the *operational range*.
 - b. Specify additional information about the aid—including the color of the light signal, rhythm, location, background lighting conditions, and focal height of the light (for lighthouses). This information is required to assist in determining equipment requirements to meet the stated operational range.
 - c. Determine the geographic range of the light—to insure the light signal will be visible at the stated operational range. (Only required for lighthouses.)
 - d. Determine the meteorological visibility—for the aid location.
 - e. Calculate luminous intensity (I_e) required to meet the operational range.
 - f. Apply correction factor for lantern panes—if necessary.
 - g. Select optics that will meet the operational requirement. There may be more than one lens/lamp combination that meets the operational requirement. In that case, a decision needs to be made between competing engineering options as to which system provides the most cost-effective signal for the mariner.
 2. Purpose of Nominal Range. The *nominal range* of a light plays no part in the selection process. Nominal range is the calculated luminous range of a light at night, with no background lighting and a meteorological visibility of 10 nautical miles. This value is used on nautical charts and in light lists to advertise the range at which mariners might expect to see a light, assuming clear conditions and no background lighting. It is a useful engineering concept, allowing comparison of the optical performance of different systems, but does not assure that a light can attain the required operational range. The nominal ranges provided by standard omnidirectional lanterns and rotating beacons are listed in the respective data sheets to assist in the preparation of light lists and charts.

6.B.3

3. Light Signal Characteristics. A light signal may be colored and/or flashed to increase the conspicuity of the light against its background.

a. Colors of Light Signals. The color of a minor aid light signal is usually determined by its purpose; whether a lateral aid, safewater mark, isolated danger mark, etc. The Aids to Navigation Manual-Administrative, COMDTINST M16500.7 (series), prescribes the colors for the various purposes for which minor aids are used. Light signals for major aids were often colored to assist in identification of the aid.

b. Rhythm. There are eight basic classes of rhythms used by the Coast Guard:

Flashing.....displaying a single flash at regular intervals, the duration of light being less than the duration of darkness;

Quick flashing.....displaying not less than 60 flashes per minute;

Group flashingdisplaying groups of two or more flashes, the groups being separated by a longer interval of darkness;

Morsea group rhythm, with the flashes of different duration so as to produce a Morse characteristic;

Alternatingdisplaying different colored flashes of light;

Isophase.....displaying equal intervals of light and darkness;

Occulting.....displaying a single flash at regular intervals, the duration of light being greater than the duration of darkness; and

Fixedthe light signal is fixed on, with no periods of darkness.

(1) Omnidirectional lanterns and range lanterns may be flashed by use of a solid-state device that switches the lamp circuit on and off in a prescribed manner. Rotating beacons generate a regular pattern of flashes by their very nature. The VRB-25 rotating beacon may be outfitted with six lenses, or combinations of lenses and blanking panels, to provide a variety of characteristics. An alternating characteristic, where the light signal is made up of flashes of different colors, can only be produced by a rotating beacon.

6.B.3.b.(2)

- (2) The Coast Guard has adopted a relatively small number of rhythms for general use. Rhythms that are produced by standard Coast Guard flashers are described in Table 6-1.

Classification	Rhythm	ON/OFF times (sec)	Duty Cycle %
Quick Flashing	Q	0.3/0.7	30
Flashing	Fl 2.5 (0.3)	0.3/2.2	12
Flashing	Fl 2.5 (1)*	1.0/2.5	40
Flashing	Fl 4 (0.4)	0.4/3.6	10
Flashing	Fl 4 (1.0)*	1.0/3.0	25
Flashing	Fl 6 (0.6)	0.6/5.4	10
Flashing	Fl 6 (1.0)*	1.0/5.0	17
Group Flashing	Fl (2 + 1) 6	0.3/0.4/0.3/1.2/0.3/3.5	15
Group Flashing	Fl (2) 5	0.4/0.6/0.4/3.6	16
Group Flashing	Fl (2) 6	1.0/1.0/1.0/3.0	33
Morse	Mo (A)	0.4/0.6/2.0/5.0	30
Isophase	Iso 2	1.0/1.0	50
Isophase	Iso 6	3.0/3.0	50
Occulting	Oc 4	3.0/1.0	75
Fixed	F	—	100

Table 6-1. Standard Coast Guard Rhythms

* Rhythms developed for 12-volt 100 and 110-watt lamps.

- (3) The Aids to Navigation Manual-Administrative, COMDTINST M16500.7 (series) prescribes the characteristics displayed by most minor aids. Characteristics for major aids are generally historical in nature, and were originally selected to assist the mariner in identification of the aid.
4. Equipment Selection. Following the criteria provided in the Visual Signal Design Manual, the Waterways Manager is usually afforded several options to meet the operational requirements of an ATON light. These options may be limited, however, by other issues.
- a. Structure Limitations. One possible restriction on equipment selection is the structure on which it will be mounted. Only the 155mm and LED lanterns may be installed on buoys or wooden single-pile structures located in the water. The 250mm and 300mm

6.B.4.a. (cont'd)

marine lanterns are restricted for use on stable platforms. Rotating beacons should also be installed on structures that are not subjected to noticeable vibration. Some vibration may be dampened by installation of Army-Navy rubber grommets between the mounting plate and the beacon base. The VRB-25 rotating beacon Technical Data Sheet illustrates installation of vibration dampening grommets.

- b. LED Lanterns. LED lanterns are divided into two categories; self-contained and conventional. Self-contained lanterns have the solar power system, battery and LED optic head housed as a single unit. Most lanterns have variable intensity to match their incandescent counterparts and some lanterns have progressively larger power systems to operate in northern latitudes and/or greater range. No other components are necessary to produce a light signal. There are limitations when using self contained LED lanterns. The self contained power system presents limits on where the lantern can be used (geographically), the duty cycle (based on flash rhythm) and maximum effective intensity.

Conventional LED lanterns are replacements for their incandescent counterparts, like the 155mm, 250mm, 300mm and VRB-25. These lanterns require a legacy power system consisting of solar panels, batteries and in some cases a small charge controller (Range Power Box; RPB). The only limitations with conventional LED lanterns is range and that color sectors can not be used. Currently, the limit is 15 nautical miles, however as technology changes this upper limit will likely increase.

- c. Available Power. Another consideration in selecting lighting equipment is the availability of reliable commercial power. Commercial-power systems are generally simpler than those using solar power. In addition, although the 120-volt four-place lampchanger (CG-4P) holds fewer lamps than the 12-volt six-place lampchanger (CG-6P), the expected lamp life of the 120-volt, 150 watt and 250 watt lamps is 2000 hours, as opposed to 500 to 1000 hours for 12-volt marine signal lamps. Thus, use of commercial power and 120-volt lamps may allow for extending the service interval of an ATON light (see Section D, below).
- d. Modernization and Characteristics. Replacement of a “classical” lens with a modern optic may lead to difficulty in matching the characteristic with the required luminous intensity. This difficulty is exacerbated for projects intended to solarize aids with large omnidirectional lanterns. Classical lenses do not provide an acceptable light signal when outfitted with 12-volt lamps, thus, conversion to solar power REQUIRES installation of modern, standard optics. The largest modern omnidirectional LED lantern, the Vega VLB-44, can not provide a luminous intensity equal to that of even the smallest classical lens outfitted with 120-volt lamps; and rotating beacons can not replicate the characteristics generated by some flashed, omnidirectional lanterns (isophase, occulting and some group flashes).

6.B.4.d. (cont'd)

These limitations may necessitate a change of a historic characteristic, a reduction in the operational range, or both, when replacing an existing optic. Compromises of this nature should not be required for installation of a new aid to navigation. It is the responsibility of the Waterways Manager to balance the cost of an aid with the service provided. The use of standard hardware is the best means to achieving that balance.

5. Range Equipment Selection. A separate selection process is used for range lights. The Range Design Manual, COMDTINST M16500.4 (series), describes the *Range Design Program*, which provides minimum and recommended intensities for lights for a given range configuration. With this information, the Waterways Manager can identify the lens/lamp combinations that provide acceptable light signals. The light signals may be provided by omnidirectional lanterns or range lanterns. The benefit of an omnidirectional lantern is that the signal is visible while a vessel is off-axis, providing positional information to the mariner along a perpendicular approach to the channel axis. The greater intensity provided by range lanterns, however, is usually required for channel lengths longer than two miles.
 - a. Traditionally range lights were secured during daytime, with dayboards providing the daytime signal. Improvements in optics, combined with solar power, have allowed expanded use of daytime lighted ranges, even when commercial power is not readily available. The Range Design Manual provides criteria to help the Waterways Manager determine the appropriate daytime signal (dayboards or lights).
 - b. Nighttime range lights should provide sufficient intensity to mark the entire channel for 90% of the nights. The “minimum intensity” values provided by the Range Design Program will provide adequate signals; however, higher intensities will provide better signals. Experience indicates that intensity values ten times greater than the minimum values are preferred. The “recommended intensity” provided by the Range Design Program is approximately ten times the minimum value required for the channel length and visibility conditions. The recommended value may be adjusted downward by the program, to provide good illuminance balance or compensate for potential glare.
 - c. Daytime range lights should be of sufficient intensity to maximize the percentage of time the channel is adequately marked. If the minimum intensity recommended by the Range Design Program can be met, there is no need to exceed that value. If the minimum intensity can not be met, the Waterways Manager should put in the brightest light possible.

6.B.5.d.

- d. Whenever possible, the nighttime and daytime characteristics, including signal color, should match. For very long channels, or in areas with poor visibility, the daytime light signals may have to be white, even though the historic color for the nighttime light signals is red or green.
- e. Standard light rhythms for ranges are:

<u>Front</u>	<u>Rear</u>
Fixed*	Fixed*
Oc 4*	Oc 4*
Iso 6	Iso 6
Iso 2	
Fl 2.5 (1.0)	Notes: *Not recommended for solar power applications.
Q**	**Only for lamps rated for 2.03 amps or less.

6. Nonstandard Equipment. Nonstandard equipment includes both items that have not been approved for standard use, such as directional (sector) lights, and items that are no longer centrally supported, such as assembled (classical) lenses. Some LED lanterns deployed as part of a field test and evaluation, but not continued, are considered nonstandard.

- a. Directional (Sector) Lights. Directional lights are a form of “single-station range” lights. The optical components project a horizontal array of encoded light signals, with precise boundaries between one signal and the next. The usual means of encoding the light signals is by use of different colors, with red and green sectors on either side of a central, white sector (hence the name “sector lights”). The mariner maintains a track along the centerline of a channel by remaining within the white sector. If a vessel crosses a sector boundary, the mariner will observe a color change in the light signal. Additional colors are not normally used to generate more sectors, although the center sector may be amber or yellow, instead of white. Another means of encoding light signals to generate positional information is to display different flash rhythms in various sectors. By combining a changing flash rhythm across the colored sectors, a greater degree of positional information may be provided, without risking confusion through the addition of non-standard colors.

A standard two-station range is preferred over a directional light, as it provides not only positional information (relative to the channel centerline), but also provides information on whether a vessel is tending toward or away from the centerline. In general, that information is not provided by a directional light until a sector boundary is crossed. If you have a situation where it is not feasible to install a two-station range, call Commandant (CG-432A) for guidance on the potential application of a directional (sector) light.

6.B.6.b.

- b. **Assembled (Classical) Lenses.** Assembled, or “classical,” lenses include both omnidirectional and rotating optics. They are made up of a collection of prisms and lenses that serve to collect and project the light emitted from a central source. Light sources initially used in classical lenses had low values of surface brightness, and were consequently fairly large to provide a sufficient amount of light to generate an ATON signal. Since classical lenses were designed to use these large light sources, they do not provide adequate ATON signals when outfitted with 12-volt marine signal lamps. Thus, aids with classical lenses are not candidates for solarization.

Guidance on the retention of classical lenses, where reliable mains power exists, may be found in the Lighthouse Manual, COMDTINST M16500.8 (series). The effective intensities generated by classical lenses outfitted with 120-volt lamps are provided in the Visual Signal Design Manual.

C. Preparation and Installation.

1. **Equipment Inspection.** All ATON lighting components should be inspected upon receipt. Electrical components, such as LED lanterns, flashers, lampchangers, and rotating beacons should be bench tested for 24 hours prior to being placed in service.
2. **Servicing Guides & Manuals.** The Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series) (AC Servicing Guide) and the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series) (Short Range Servicing Guide) provide specific installation instructions for 120-volt and 12-volt aids to navigation lighting components, respectively. In addition, major components, such as rotating beacons and range lanterns, are supplied with a manufacturer’s installation and maintenance manual. Refer to these manuals prior to installation of a beacon or lantern and when performing preventive maintenance or troubleshooting.
3. **Outfitting ATON Lights.** The various components, such as daylight controls, flashers, lampchangers, lamps, etc., that are used with an optic to make a complete ATON light, are identified in the various lantern and beacon data sheets found in Section E of this chapter and in the Servicing Guides. Refer to the appropriate data sheet and the Servicing Guides for proper assembly of the light.
4. **Wiring-12-volt DC.** Requirements for wiring 12-volt solar powered aids are discussed in the Solar Design Manual. The information found herein provides general information on selection of appropriate wiring for ATON lights. More detailed information will be found in the Solar Design Manual, COMDTINST M16500.24 (series) and the applicable Standard Configuration Drawings are available on the Ocean Engineering website: http://www.uscg.mil/hq/cg4/cg432/drawings_2a.asp.

6.C.4.a.

- a. Conventions. Wires used for power leads and for internal wiring are color-coded. Power leads shall use BLACK as “Positive (+)” (12VDC) and WHITE as “Negative (-)” (0VDC). Internal wiring of an optical assembly uses RED for the lamp circuit (L), BLUE for the lampchanger turret-advance pulse (F), and YELLOW for the daylight control circuit (S). The negative lead shall use WHITE.
- b. Wire Type. Minor aids are typically wired with two-conductor, 12-2 SO-type cable. The use of SO, SEO, and similar wire is discouraged for installation at major aids, such as solar powered lighthouses and ranges, as their long term resistance to sunlight is poor. Individual insulated conductors, suitable for outdoor installation, should be installed in rigid plastic or steel conduit, or “Liquid-flex” flexible metal conduit. Leads for the VRB-25 rotating beacon shall be installed in grounded, metallic conduit only. Some LED lanterns use smaller conductors, which is acceptable. Consult with the appropriate LED instruction manual for recommended wire types and sources of supply (available at: <http://www.uscg.mil/hq/cg4/cg432/> under Products/Services.)
- c. Termination. Wires terminated under pressure or clamp type terminals do not require lugs, however, use of No-ox grease is recommended to prevent corrosion. Screw terminals require ring or locking spade lugs. Soldering the lugs to the wire, in addition to crimping with heavy-duty industrial crimpers, is recommended (see the Technical Data Sheet at http://www.uscg.mil/hq/cg4/cg432/2a_technicaldatasheets.asp for more information on crimping). Soldering will prevent crevice corrosion and eventual failure of the connection. If connections are not soldered, a visual inspection of all joints is required during scheduled service visits.
- d. Acceptable Voltage Drop. Wire size is based on the acceptable voltage drop of the circuit. The maximum acceptable voltage drop is 0.75 volts for the “charging system,” the wire run from the solar panels (or battery charger) to the battery. For minor aids, the maximum allowable voltage drop due to the wiring from the battery to the load(s) (the “power leads”) is 0.10 volts. For major aids and day/night ranges, the maximum allowable voltage drop for the power leads is 0.35 volts. Wire sizes may be calculated using the formulas in the Solar Design Manual, COMDTINST M16500.24 (series) or by using the spreadsheet at: <http://www.uscg.mil/hq/cg4/cg432/publications.asp> for ranges. Table 6-2 provides conservative values for the maximum length of power cable for 12-volt installations.

6.C.4.d (cont'd)

Lamp Rating	Maximum Length of Power Leads (ft)				
	Major Aids				Minor
	12AWG	10AWG	8AWG	6AWG	12AWG
0.55A	160	260	410	650	55
0.77A	115	180	290	460	40
1.15A, & 1.0A	75	120	195	310	27
2.03A, & 1.9A	45	70	110	175	15
3.05A, 3.0A, & 35W	30	45	75	115	10
50W	20	35	55	85	—
75W	15	25	35	55	—
100W & 110W	10	15	25	40	—

Table 6-2. Maximum Length—12-volt Power Leads

- e. 12VDC Wiring Details. Details on the wiring of internal components to an ATON light are described in the Short Range Servicing Guide, and in the various data sheets found in Section E of this chapter. Also, some LED lanterns have 18 AWG power cables which are adequate for them due to their low power consumption.
 - f. Obstructions. Vertical obstructions in front of omnidirectional lanterns should be avoided. Contact Commandant (CG-432A) for assistance in determining the reduction in service when obstructions are placed in front of any lantern.
5. Wiring—120-volt AC. The AC Servicing Guide, manufacturers’ manuals, and applicable Standard Configuration Drawings, provide guidance on the proper wiring of 120-volt powered ATON lights. Instructions on the internal wiring of lights are also contained in the various data sheets found in Section E of this chapter.
- a. **SAFETY WARNING. SECURE POWER TO 120-VOLT POWERED AIDS TO NAVIGATION EQUIPMENT PRIOR TO INSTALLATION OR SERVICING. CHECK TO BE SURE POWER IS OFF.**
 - b. Conventions. Wires are color-coded. Power leads shall use BLACK as “Hot” (120VAC), WHITE as “Neutral” and GREEN as “Equipment Ground.” Internal wiring in an optical assembly uses RED for the lamp circuit (L), BLACK for “Hot”, and WHITE for “Neutral.”

6.C.5.c.

- c. Wire Type. Simple systems are typically wired with three-conductor, 12AWG, SO-type cable. The use of SO-type cable is discouraged for exposed wiring and complex systems. Individual insulated conductors, suitable for outdoor installation, should be installed in rigid plastic or steel conduit, or “Liquid-flex” flexible metal conduit.
- d. Termination. Wires terminated under pressure or clamp type terminals do not require lugs, however, use of No-ox grease is recommended to prevent corrosion. Screw terminals require ring or locking spade lugs. Soldering the lugs to the wire, in addition to crimping with heavy-duty industrial crimpers, is recommended. Soldering will prevent crevice corrosion and eventual failure of the connection. If connections are not soldered, a visual inspection of all joints is required during scheduled service visits.
- e. Acceptable Voltage Drop. Wire size in 120-volt systems is based on the safe amperage carrying capacity, known as “ampacity,” of the leads. 12AWG wire has an adequate ampacity for standard Coast Guard 120-volt powered aids to navigation signals.
- f. 120VAC Wiring Details. Details on the wiring of internal components to an aid to navigation light are described in the AC Servicing Guide, and are outlined in the various data sheets herein.

6. Lamps.

- a. 12-volt Lamps. There are three different types of marine signal lamps used in 12-volt ATON lights; single-coil (C-8) tungsten filament lamps, coiled-coil (CC-8) tungsten filament lamps, and tungsten-halogen lamps. The orientation of the filaments is vertical for all three lamp types. Tungsten filament lamps are identified by the nominal current at rated voltage (e.g.: 0.77 amp or 0.77A for C-8 lamps/1.9A for CC-8 lamps). Tungsten-halogen lamps are identified by the nominal power consumption at rated voltage (e.g.: 50 watts or 50W). All 12-volt lamps have single-contact candelabra bases with prefocus collars. Lamps with a power consumption of 50 watts or greater must be installed in the high-wattage version of the six-place lampchanger (CG-6PHW).
- b. 120-volt Lamps. The three lamps used in 120-volt aids to navigation lights are all tungsten-halogen lamps, with vertically oriented, coiled-coil(CC-8) filaments. These lamps are identified by nominal power consumption. The 1000 watt lamp has a mogul bi-post base, while the 250 watt and 150 watt lamps have dual-contact bayonet bases. The 1000 watt lamp is installed in a two-place lampchanger (CG-2P), while 250 watt and 150 watt lamps are installed in a four-place lampchanger (CG-4P).

6.C.6.c.

- c. Handling of Lamps. Lamp envelopes should be protected from scratches, and handled as little as possible. All lamps should be cleaned after installation, by wiping the envelope with a medicinal swab or a clean cloth wetted with denatured alcohol. **Tungsten-halogen lamps are designed to operate at high temperature and pressure, and are subject to explosive failure if the envelope is contaminated with oil or dirt.** Tungsten-halogen lamps remain very hot for several minutes after power is secured.
- d. Selection of Lamps. The data sheets for the lanterns and beacons, found in Section E of this chapter, describe which lamps may be used with standard lanterns and beacons. The intensities provided by the various lens/lamp combinations are also detailed in the Visual Signal Design Manual.

7. Mounting and Leveling of Fixed Aids. A complete mounting hardware kit for all omnidirectional lanterns, including LED lanterns, and the VRB-25 rotating beacon, is comprised of three lengths of threaded rod ($\frac{1}{2}$ "—13 UNC x 4 $\frac{1}{2}$ " long), 12 hex nuts, six flat washers, and six split (locking) washers. Six self-locking (Nyloc) nuts may be used in place of 6 of the hex nuts and the split washers. Bolts may be used in place of the threaded rods and three of the hex nuts, except for the Vega VLB-36 and BWT 300 series LED lanterns which have blind holes. The RL14 and RL24 range lanterns require three $\frac{3}{8}$ " bolts, each with a hex nut, flat washer and split washer, or a self-locking nut and flat washer.

Use only three rods/bolts for mounting a light, even if the lantern or beacon has four bolt holes. This is to prevent breaking the casting of the lantern. Specific instructions for mounting lanterns and beacons are detailed in the respective data sheets, found in Section E of this chapter, and may also be found in the appropriate Servicing Guides and manufacturers' manuals. Mounting hardware may be procured locally and shall be made of stainless steel.

- a. Omnidirectional Lanterns. The 155mm buoy lanterns, all LED lanterns, and the 250mm and 300mm medium intensity lanterns all have a 7 $\frac{7}{8}$ " (200mm) bolt circle. The 155mm, 300mm and LED lanterns have three bolt holes equally spaced around the bolt circle. The 250mm lantern has four bolt holes. **Only three bolt holes shall be used to prevent cracking the 250mm base.**
- b. Rotating Beacons. The VRB-25 rotating beacon has a 7 $\frac{7}{8}$ " (200mm) bolt circle which has acetyl inserts to protect the beacon and mounting rods from galvanic corrosion. Do not remove these inserts. Replacement inserts are available from Commandant (CG-432A). The DCB-24 and DCB-224 rotating beacons have three equally spaced legs that are centered on a 21 $\frac{1}{2}$ inch (546mm) bolt circle. The beacons are mounted directly to the deck by the $\frac{3}{4}$ " cap screws that are provided.

6.C.7.c.

- c. Range Lanterns. The RL24 and RL14 range lanterns have three leveling bushings equally spaced on a 14³/₄" (375mm) bolt circle. The bushings have clearance for 1/2" or 3/8" bolts, respectively. The RL14 range lantern also has tilt and elevation adjustment levels mounted on top of the lantern bezel assembly. The RL24 range lantern does not have built-in levels.

8. Lamp Selection and Focusing.

- a. Lamp Selection. There are some restrictions on the use of certain lamps in various optics. Some of these restrictions are due to physical limitations; for example, there is insufficient clearance in the 155mm lantern to permit free rotation of the CG-6P lampchanger when outfitted with 12-volt, 3.05 amp lamps. Other restrictions are due to concerns about optical performance. Specific restrictions on lamp selection are discussed in the individual data sheets for the various optics.
- b. Focusing Requirements. Vertical or horizontal displacement of the lamp filament center from the true focal point of an optic will affect the projected beam. Depending on the type of optic, these variations will result in displacement of the beam up or down from the intended horizontal plane, or in a wider, less intense beam. To insure that the signal provided to the mariner meets the rated intensity for the lens/lamp combination selected, it is necessary to place the lamp filament at the focal point of the optic within prescribed tolerances.
- c. Prefocused Optics. Certain optics are described as "prefocused." That is, the manufacturing tolerances of the optic and the various components that are used to produce an ATON signal are such that no adjustment should be necessary to ensure that a lamp filament is situated at the focal point of the optic, within the prescribed tolerance for that specific optic. The following optics are considered to be prefocused optics:
 - (1) All LED lanterns;
 - (2) 155mm lantern, and
 - (3) RL14 range lantern.

While these optics do not provide for adjustment of the lamp filament position, the focus of the non-LED optics should be checked from time to time to ensure that none of the internal components, such as the lampchanger bracket, or lampchanger, have been damaged or are installed incorrectly. Procedures for checking the focus are outlined in the respective data sheets for these optics and in the servicing guides.

6.C.8. d.

- d. Optics Not Requiring Focusing. The following optics have adjustable focusing, but do not normally require focusing:

- (1) DCB-24 and DCB-224 rotating beacons; and
- (2) RL24 range lantern.

These optics are focused during manufacture. No further adjustment is required, unless the optical assembly is changed or taken apart for some reason (such as replacement of the lampchanger). Focusing adjustments are NOT required as part of normal lamp replacement.

- e. Optics Requiring Focusing. The following optics require focusing whenever the optic is relamped:

- (1) 250mm lantern;
- (2) 300mm lantern;
- (3) VRB-25 rotating beacon;
- (4) Non-LED sector lights.

Procedures for adjusting the focus are outlined in the respective servicing guides and manufacturers' manuals for these optics.

9. Lighthouse Lantern Requirements. In this section, the word *lantern* shall be understood to mean the structure at the top of a lighthouse that surrounds and protects the optic.

- a. Ventilation. Lanterns must have adequate rain-proof vents to equalize the inside and outside temperatures. Failure to maintain working vents may result in condensation on the lantern panes, severely reducing the light intensity. This requirement is especially true in lighthouses with 12-volt signals, which do not emit enough excess heat to evaporate condensation that may form.
- b. Prevention of False Flashes. False flashes occur when a beam from a rotating beacon is reflected off a lantern pane, and is emitted out the far side of the lantern. It is especially prevalent in lighthouses outfitted with the DCB-24 rotating beacon, or when the DCB-224 or VRB-25 rotating beacons are used to produce group rhythms. Where practicable, lantern panes should be installed with the top edge slanted out $\frac{3}{8}$ " per foot of height beyond the bottom edge (approximately 3 degrees from vertical). For lanterns that cannot readily be modified, retractable shades may be hung in the lantern. The shades shall extend radially from the optic to the astragals supporting the lantern panes.

6.C.9.c.

- c. Obstructions in the Optical Plane. Mullions (glazing supports) in lanterns that house a fixed flashing light are installed diagonally to prevent obstruction of the light source as drum lenses project an image of the vertical filament through the lantern pane. Mullions in lanterns with rotating beacons are installed vertically as the light source is a projection of the mirror or flash panel. A drum lens (155mm, 250mm, 300mm) installed in a lantern with vertical mullions will have no coverage outside this area. LED lanterns may be used at all installations since the projecting surface is comprised of multiple LEDs in the horizontal plane.
- d. Control of Ambiguous Color Sectors. Producing colored sectors by use of colored lantern panes will result in an ambiguous zone between white and colored sectors. The angular size of the zone is proportional to the ratio of the emitting surface of the light to the distance between the emitting surface and the color filter. In general, colored sectors should not be installed at aids with rotating beacons due to the relatively large ambiguity zone created. Prior to replacing an omnidirectional lantern with a rotating beacon at aids with colored sectors, the impact of an enlarged ambiguity zone must be evaluated. Existing colored sectors at aids with rotating beacons may be retained. Color sectors can not be used with LED lanterns. White LED light does not contain as much red and green light as an incandescent source. Placing a color filter in front of a white LED lantern will result in an unacceptable low intensity on the far side of the lantern pane.

If a DCB-224 rotating beacon is used at an aid with colored sectors, the two beams shall be separated by 180 degrees and point radial outward from the axis of rotation, or the two beams shall be separated by 90 degrees.

- e. Colored Lantern Panes. UV stabilized, transparent lexan or plexiglass (acrylic) may be used to replace colored glass lantern panes. Plexiglass color numbers that are suitable for use are 2124 (green), 2226 (red), and 2129 (red). Use off-the-shelf transparent cast sheets. Sheeting should be rated by the manufacturer to have 20 to 30 percent transmission of incandescent light. Due to the difficulty in obtaining red lantern panes, Commandant (CG-432A) has stocked 4 by 8 foot sheets of red cast acrylic in the supply fund at the Engineering Logistics Center. Sheets may be obtained by MILSTRIP using stock number 9330-01-429-6103.

D. Inspection, Maintenance and Repair on Station.

- 1. Inspection and Maintenance Schedule. The inspection and maintenance schedule for ATON light signals will vary from semi-annual to triennial, depending on the equipment in service. The service interval will be the lowest result after calculating the service interval for the components. In addition the unit commander should consider any history of vandalism, excessive guano or any other problem that suggests the aid should be visited more frequently than every three-years. The limiting item to allowing a three-year service interval for minor aids is often lamplife.

6.D.1. (cont'd)

- a. Lighthouses. Follow the guidelines prescribed for the installed equipment, as set forth in the Major Aids to Navigation Preventive Maintenance System Guide, COMDTINST M16500.10 (series).
- b. Fixed and Floating 12-volt DC Lighted Aids (except ranges). The servicing interval shall not exceed three years, or the “Maximum Allowable Service Interval Due to Lamplife” shown in Table 6-2A. The Aids to Navigation Servicing Interval Flowchart (ATON SIF), used to determine the allowable servicing interval of existing aids, is provided in Chapter 7 of the Aids to Navigation Manual - Administration, COMDT M16500.7 (series).
- c. Fixed 120-volt AC Lighted Aids (except ranges). The servicing interval for 250mm and 300mm lanterns with 250-watt lamps shall not exceed three years, or the “Maximum Allowable Service Interval Due to Lamplife” shown in Table 6-2A. The servicing interval for aids with 1000-watt lamps shall not exceed two years, or the “Maximum Allowable Service Interval Due to Lamplife” shown in Table 6-2A.
- d. Ranges. The service interval shall not exceed two years, or the “Maximum Allowable Service Interval Due to Lamplife” shown in Table 6-2A. For day/night ranges with different day/night lights, the maximum allowable service interval for both the daytime and the nighttime optics must be computed separately. Use the lesser of the two solutions to establish the service interval of all the optics for the range. For day/night ranges with the same optic burning day and night, the Maximum Allowable Service Interval Due to Lamplife should be $\frac{1}{2}$ of the value shown in Table 6-2A.
- e. LED Lanterns. The conservative life of LEDs is 50,000 hours of operation. For a fixed-on light, this is 10 years of nighttime use (100 years for a FL4(.4)). The housing and lens are the limiting factors. When the LED lantern can no longer provide a useful signal to the mariner, it should be replaced. Battery replacement in self-contained LED lanterns is required at the interval specified in the instructions, available at: <http://www.uscg.mil/hq/cg4/cg432/>. To determine the servicing interval, consult the Aids to Navigation Servicing Interval Flowchart (ATON SIF), provided in Chapter 7 of the Aids to Navigation Manual - Administration, COMDT M16500.7 (series).
- f. Arduous Conditions. Under arduous environmental conditions the actual lamplife may be less than that shown in Table 6-2A. Experience may dictate a shorter Service Interval than that shown in Table 6-2A.

6.D.1.f. (cont'd)

Flash Characteristic	C-8 and CC-8 Tungsten Filament Lamps in 6-place Lampchanger (Note 1)	C-8 Tungsten-Halogen Filament Lamps in 6-place Lampchanger (except 110W lamp) (Note 2)	110W C-8 Tungsten-Halogen Lamps in 6-place Lampchanger	150W & 250W 120VAC Lamps in 4-place Lampchanger	1000W 120VAC Lamps in 2-place Lampchanger
Fl 4, Fl 6	11 yrs + 8 mo	23 yrs + 4 mo	11 yrs + 8 mo	14 yrs + 12 mo	N/A
Fl 2.5	9 yrs + 9 mo	19 yrs + 5 mo	N/A	12 yrs + 6 mo	N/A
Fl (2+1) 6	7 yrs + 9 mo	15 yrs + 7 mo	N/A	9 yrs + 12 mo	N/A
Fl (2) 5	7 yrs + 4 mo	14 yrs + 7 mo	N/A	9 yrs + 4 mo	N/A
Q, Mo(A)	3 yrs + 11 mo	7 yrs + 9 mo	N/A	4 yrs + 12 mo	N/A
Fl (2) 6	3 yrs + 6 mo	7 yrs + 1 mo	3 yrs + 6 mo	4 yrs + 6 mo	N/A
Fl 2.5 (1)	2 yrs + 11 mo	5 yrs + 10 mo	2 yrs + 11 mo	3 yrs + 9 mo	2 yrs + 7 mo
Iso 2, Iso 6	2 yrs + 4 mo	4 yrs + 8 mo	2 yrs + 4 mo	3 yrs + 0 mo	2 yrs + 1 mo
Occ 4	1 yr + 7 mo	3 yrs + 1 mo	1 yr + 7 mo	2 yrs + 0 mo	1 yr + 4 mo
Fixed	1 yr + 2 mo	2 yrs + 4 mo	1 yr + 2 mo	1 yr + 6 mo	1 yr + 0 mo

Table 6-2A: Maximum Allowable Service Interval Due to Lamplife (years + months)

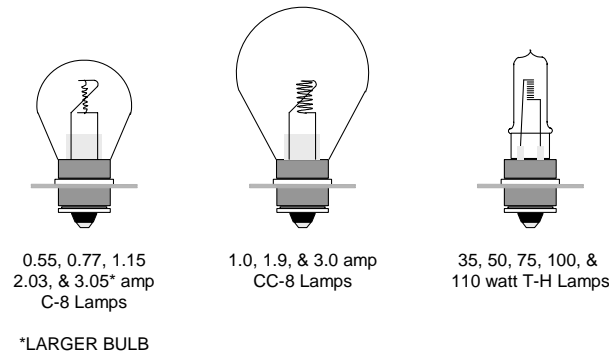
Note 1. Includes 0.25, 0.55, 0.77, 1.15, 2.03 & 3.05 amp C-8 lamps and 1.0, 1.9 & 3.0 amp CC-8 lamps.

Note 2. Includes 35, 50, 75 & 100 watt C-8 lamps.

2. Maintenance and Repair Guidelines. Detailed information on the maintenance and repair of standard equipment is provided in the Servicing Guides and in the manufacturers' manuals. Questions concerning specific maintenance requirements may be directed to the supporting Sector Office, the District Aids-to-Navigation Office, National ATON School staff, or Commandant (CG-432).

E. General Description Data Sheets.

1. **12-Volt Marine Signal Lamps**



- a. Function. 12-volt marine signal lamps are used with a variety of omnidirectional lanterns, as well as the RL14 range lantern and the VRB-25 rotating beacon. There are three types of 12-volt marine signal lamps: tungsten lamps with C-8 filaments (vertical coil); tungsten lamps with CC-8 filaments (vertical coiled-coil); and tungsten-halogen lamps with C-8 filaments. The C-8 tungsten filament lamps are normally used in omnidirectional lanterns at both fixed and floating aids, to provide a light with a nominal range of less than 9nm. **If a RL14 range lantern is outfitted with these lamps, a spread lens must be installed.** The CC-8 tungsten filament lamps are primarily used in the RL14 range lanterns; use of these lamps does not require a spread lens. Tungsten-halogen lamps may be used in the RL14 range lantern (spread lenses are not required) and in the VRB-25 rotating beacon. Due to the relative shortness of their filaments, the CC-8 tungsten filament lamps and tungsten-halogen lamps (except the 100 and 110 watt lamps) are not authorized for use in omnidirectional lanterns because the vertical divergence is very small.
- b. Features.
- (1) Omnidirectional light output in the horizontal plane.
 - (2) C-8 or CC-8 incandescent filament (vertical orientation).
 - (3) Minimum 1000-hr life expectancy when burned fixed.
 - (4) Prefocus collar, for accurate alignment of lamp in lampchanger.
 - (5) Nickel-plated brass, single-contact base.
- c. Related Equipment. The lamps are used with a CG-6P lampchanger and either a CG-181/493/504 flasher or a SAC-II/III. The 155mm omnidirectional lantern may only be equipped with C-8 tungsten filament lamps, up to and including the 2.03 amp lamp. The 250 and 300mm lanterns may only be equipped with C-8 tungsten filament lamps or the 100 or 110watt tungsten-halogen lamps. The RL14 range lantern may be equipped with C-8 tungsten filament lamps (with spread lens), CC-8 tungsten filament lamps (with or without spread lenses), and with C-8 tungsten-halogen lamps (with or without spread lenses). The VRB-25 rotating beacon may be equipped with any 12-volt lamp, however optimum performance is achieved with tungsten-halogen lamps.

6.E.1.d.

- d. Additional Data. Technical specifications for 12-volt lamps are given in specification number G-SEC-487. Lamps are stocked at the SFLC, Baltimore. Table 6-3(A-C) describes the operational data for the lamps, and provides stock numbers for ordering through the national stock system. 12-volt lamps are sold in boxes of ten.

Lamp Rating (Amps)	Lamp Life (Hours)	Output (Lumens)	Minimum On Time (Seconds)	Bulb Type	National Stock Number
0.55	1000	70	0.30	S-8	6240-01-199-2374
0.77	1000	120	0.30	S-8	6240-01-186-2033
1.15	1000	180	0.30	S-8	6240-01-186-2032
2.03	1000	380	0.30	S-8	6240-00-262-8845
3.05	1000	600	0.40	S-11	6240-00-262-8840

Table 6-3A: C-8 Tungsten Filament Lamps

Lamp Rating (Amps)	Lamp Life (Hours)	Output (Lumens)	Minimum On Time (Seconds)	Bulb Type	Activity Control Number
1.0	1000	145	0.30	S-11	6240-01-420-4236
1.9	1000	390	0.30	S-11	6240-01-420-4240
3.0	1000	600	0.40	S-11	6240-01-420-4246

Table 6-3B: CC-8 Tungsten Filament Lamps

Note: Recommended for use in the RL14 range lantern.

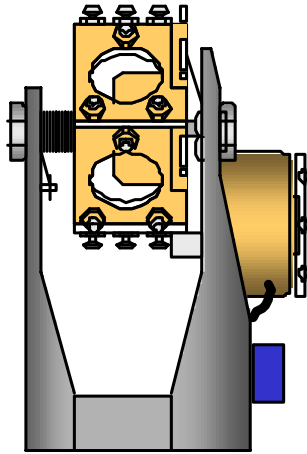
Lamp Rating (Watts)	Lamp Life (Hours)	Output (Lumens)	Minimum On Time (Seconds)	Bulb Type	National Stock Number
35	2000	630	0.40	T-4	6240-01-487-7863
50	2000	1000	0.50	T-4	6240-01-487-7880
75	2000	1600	0.60	T-4	6240-01-487-7892
100	2000	2400	1.00	T-4	6240-01-487-7898
110	1000	2600	1.00	T-4	6240-01-374-5113

Table 6-3C: C-8 Tungsten-Halogen Lamps

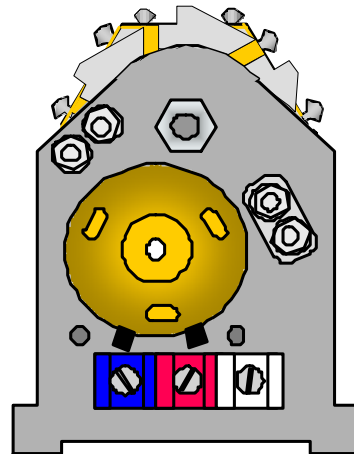
Note: Recommended for use in the RL14 range lantern and VRB-25 rotating beacon.

6.E.2

2. 12VDC Lampchanger (CG-6P & CG-6PHW)



End View



Side View

- a. Function. The CG-6P and CG-6PHW lampchangers support six 12-volt lamps with the filament of the burning lamp at the focal point of the lantern. A spare lamp rotates to the operating position when the burning lamp fails. The lampchangers do not sense lamp failure; relamping is triggered by a pulse from the CG-181, CG-493, CG-481 or CG-504 flasher, or a Solar Aid Controller II (SAC II & III). The CG-6P lampchanger will safely operate lamps with a current draw of 3.05 amps or less (including 35-watt tungsten-halogen lamps). The CG-6PHW lampchanger is used to operate lamps rated at 50 watts or greater. The lampchangers are similar in appearance, although the CG-6PHW lampchanger has a wire exiting the axis of the turret. The pins on the turret, which the prefocus collar snaps onto, are spaced so that the lamp can only be fitted in one orientation. The notch on the lamp collar is aligned between the two pins on the turret that are spaced closer together.
- b. Features.
- (1) Holds six 12-volt marine signal lamps in a spring-wound turret.
 - (2) Three color-coded terminals, for wiring to a 12VDC flasher.
 - (3) Accurately places the lamp in the operating position at the focal point of an optic.
 - (4) Corrosion resistant.
 - (5) Shadow-free to 52 degrees below the horizontal (focal) plane.
 - (6) Designed to maintain continuous circuit, even under the shock and vibration encountered on minor aids to navigation.
 - (7) Operates in both horizontal and vertical orientations.
 - (8) 56-ohm resistor parallel with the sixth lamp position to suppress the flasher from sending a pulse across the "F" terminal in the event all six lamps fail.

6.E.2.c.

c. Electrical and Mechanical Characteristics.

- (1) Input voltage: 10 to 14VDC
- (2) Maximum current: 4.0 amps/10.0 amps (HW)
- (3) Maximum lamp circuit resistance: 0.03 ohms
- (4) Solenoid coil resistance: 15 ohms
- (5) Solenoid coil voltage: 8 to 18 Vdc
- (6) Solenoid coil pulse duration: 0.25 to 5.0 sec
- (7) Ambient temperature range: 0 to +125 degrees F
- (8) Lamp positioning tolerance: Horizontally ± 0.031 in; Vertically ± 0.010 in.

d. Related Equipment. The CG-6P lampchanger is used with 12-volt marine signal lamps with a current draw of up to 3.05 amps (including 35 watt lamps), and the CG-181/493/504 flasher or SAC II. The CG-6PHW is used with 12-volt tungsten-halogen lamps rated at 50 watts or more, and the CG-481/504 (high-wattage) flasher or SAC II/III. All 12-volt powered optics may be equipped with the CG-6P lampchanger. They shall be equipped with the CG-6PHW lampchanger when outfitted with 12-volt tungsten-halogen lamps rated at 50 watts or more.

e. Additional Data. Technical specifications for the CG-6P lampchanger are given in G-SEC Specification 195, and for the CG-6PHW lampchanger in G-SEC Specification 478. The dimensions of the CG-6P and CG-6PHW lampchangers are the same (see figure 6-1). The lampchangers each weigh approximately 2.5 lbs. The CG-6P (NSN 6250-01-030-3485) and CG-6PHW (NSN 6250-01-374-5127) lampchangers are stocked at the SFLC Baltimore.

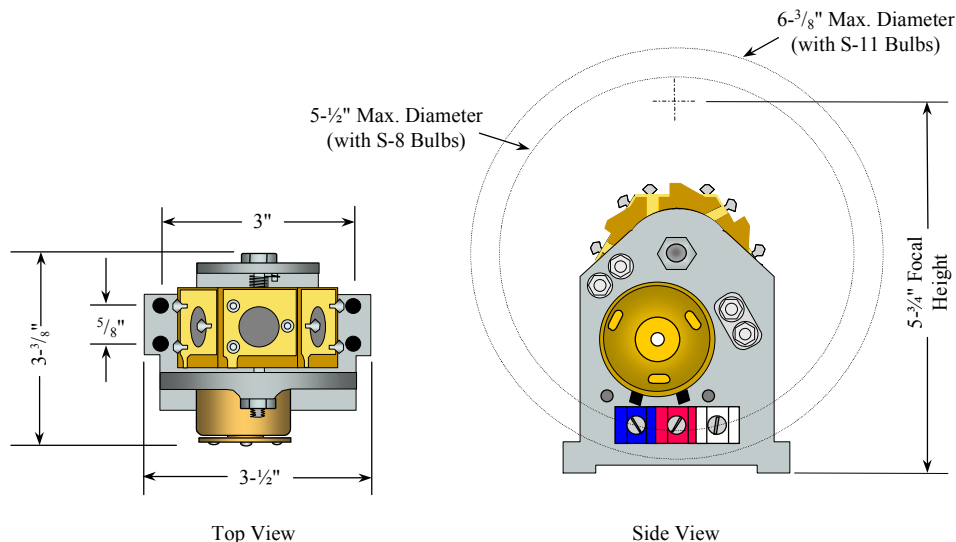


Figure 6-1. Dimensions of the CG-6P and CG-6PHW Lampchangers

6.E.3.

3. 12-Volt Focus Fixture



- a. Function. Focus fixtures are used to assist in the focusing of optics by placing an item with a defined height in the six-place lampchanger within an adjustable optic. There are two 12-volt focus fixtures; a commercial item used with the 155mm, 250mm and 300mm marine signal lanterns, and a precision fixture for use with the VRB-25 rotating beacon. A precision focus fixture is provided with each VRB-25 rotating beacon as part of the original provisioning. The focus fixtures are manufactured with the same prefocus collar as the 12-volt lamps, to ensure proper alignment in the lampchanger.
- b. Related Equipment. 12-volt focus fixtures are used with the CG-6P or CG-6PHW lampchanger to assist in adjusting the focus of the marine signal lanterns and the VRB-25 rotating beacon.
- c. Additional Data. Purchase of a focus fixture for use with the 155mm, 250mm and 300mm marine signal lanterns may be made as a Commercial-Off-The-Shelf (COTS) procurement from Tideland Signal Corporation, PO Box 52370, Lafayette, LA 70505-2370, 337-269-9113. The part number for the item is P/N 630.1022-01. This focus fixture may also be used with the VRB-25 rotating beacon, although it is not as precise as the focus fixture provided with that beacon.

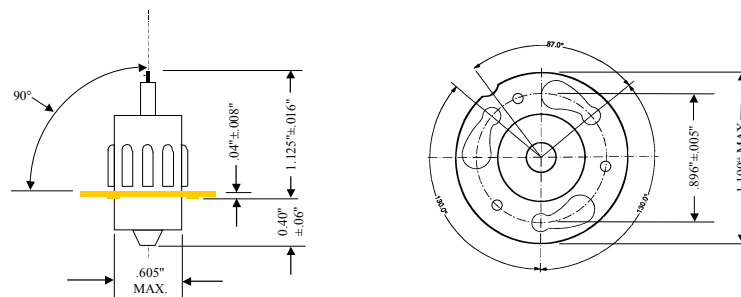
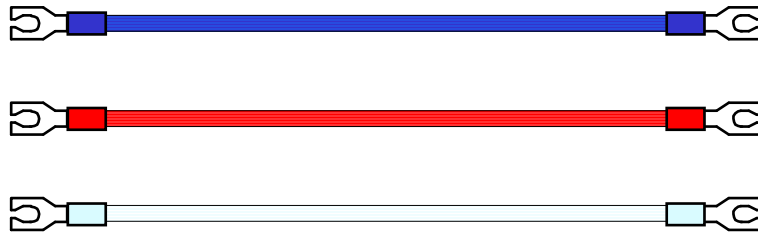


Figure 6-2. Dimensions of 12-volt lamp focus fixture.

6.E.4.

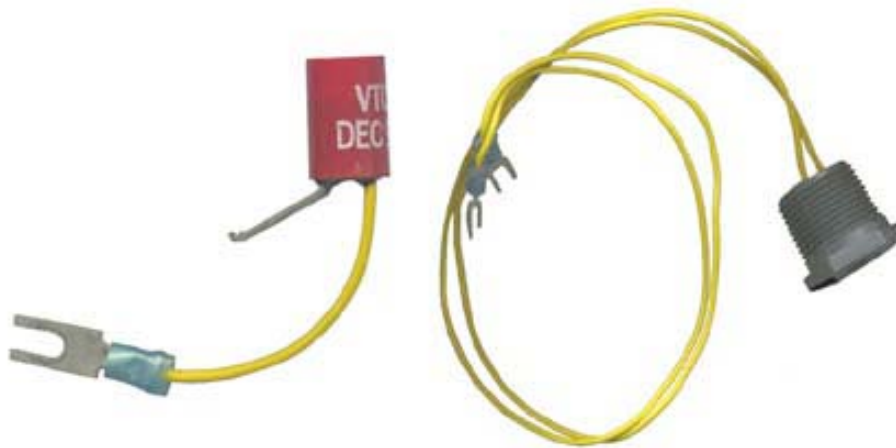
4. 12VDC Wiring Kit (WK-681)



- a. Function. The WK-681 wiring kit is used to electrically connect the CG-6P or CG-6PHW lampchanger to the CG-181, CG-493, CG-504 or CG-481 flasher. The WK-681 wiring kit comes with three color-coded leads (one each blue, red, and white).
- b. Features.
 - (1) Three color-coded leads.
 - (2) Single-conductor copper wire.
 - (3) Spring spade terminals for retention.
 - (4) Crimped and soldered terminals
- c. Dimensions.
 - (1) Wire size #16 AWG
 - (2) Lug size #14 to 16 AWG
 - (3) Wire length $6\text{-}1/2 \pm 1/4$ in.
- d. Additional Data. An installation diagram is included with the three leads in the WK-681 wiring kit. Technical specifications are provided in G-SEC Specification 261. The WK-681 wiring kit is stocked at the SFLC Baltimore (NSN 6150-01-040-6848).

6.E.5.

5. 12-Volt Daylight Control (DLC)



Type R and C (Internal)

Type L (External)

- a. Function. A daylight control is a photoelectric cell that changes resistance as the ambient light level changes. The type of cells used by the Coast Guard have an increasing resistance under conditions of decreasing illumination. When connected to CG-181, CG-493, CG-504 or CG-481 flasher, or the Solar Aid Controller II (SAC II/III), the changing resistance of the daylight control activates an on-off switch that turns the light on in the evening and off in the morning. The operating parameters for 12-volt daylight controls were selected so that lighted aids in a given waterway, regardless of the lens color, will switch on at sunset and off at sunrise.
- b. Features.
 - (1) Two classes; one class is mounted inside the lantern, the other is mounted externally.
 - (2) Total of three types; two for internal mounting, one for external mounting.
 - (3) Color-coded cases.
 - (4) Hermetically sealed.
 - (5) Low cost, non-repairable items.
- c. Related Equipment. For minor aids, a 12-volt daylight control is connected to a CG-181/493/504 or CG-481 flasher in the optic to be controlled. For solar-powered major aids, the externally mounted Type L daylight control is used with a SAC II/III, described in Chapter 9. The Type L daylight control is also used with the AC Flash Controller, Range Switch Box DC and the Audio-Visual Controller, described in Chapters 8 and 9. Table 6-4 matches the various lens types with the appropriate daylight control. A Type L daylight control must be used when a fixed-on rhythm is used. A Tideland Signal Corporation daylight control must be used with the FLAC-300 120 VAC flasher and the MLED-120 LED lantern.

6.E.5.d.

- d. Additional Data. Technical specifications for 12-volt daylight controls are given in G-SEC Specification 234. Figure 6-3 provides the dimensions of the external (Type L) and internal (Types C and R) daylight controls. Standard 12-volt daylight controls are stocked at the SFLC Baltimore.

Sensor Type**	Color	Resistance (ohms)*	Mounting	Lens Type	Lens Color	National Stock Number (NSN)
C	White	129K	Internal	Any	Clear/Yellow	5980-01-031-8858
R	Red	49K	Internal	Acrylic	Red/Green	5980-01-045-5470
L	Gray	129K	External	Any	All	5980-01-034-6058

Table 6-4. Daylight Control Specifications and Applicable Stock Numbers

*When illuminated by a tungsten source providing an illuminance of 2 ft-cd.

**Type B daylight controls for use with red/green glass lenses (old 200mm) are available from Commandant (CG-432A)

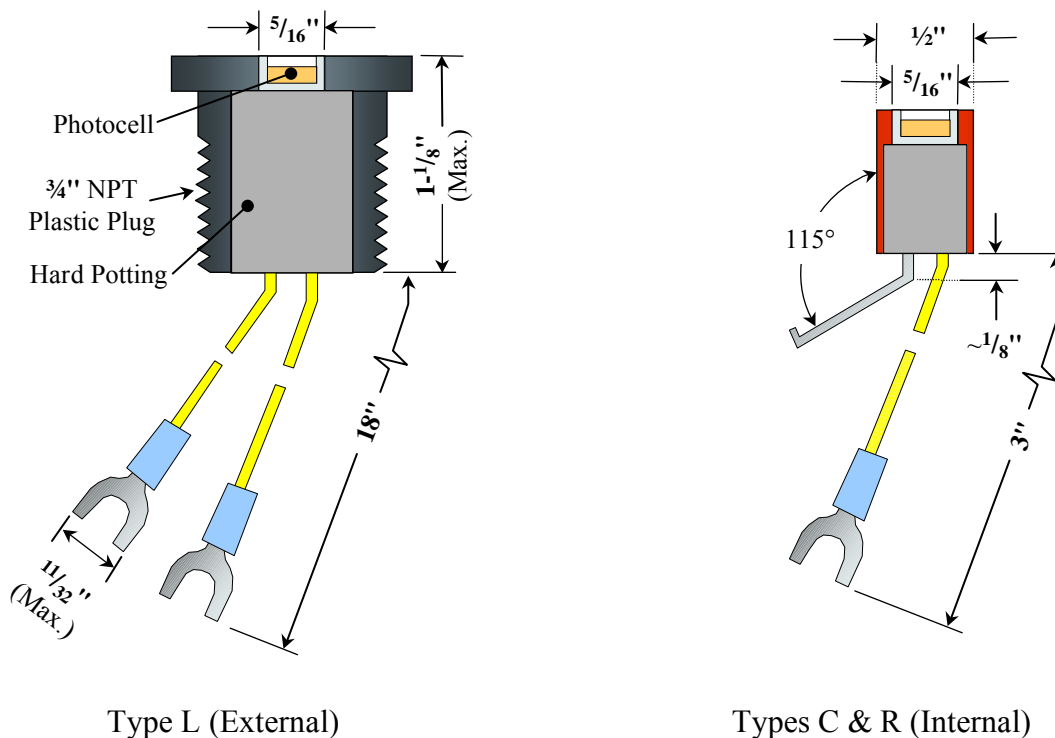
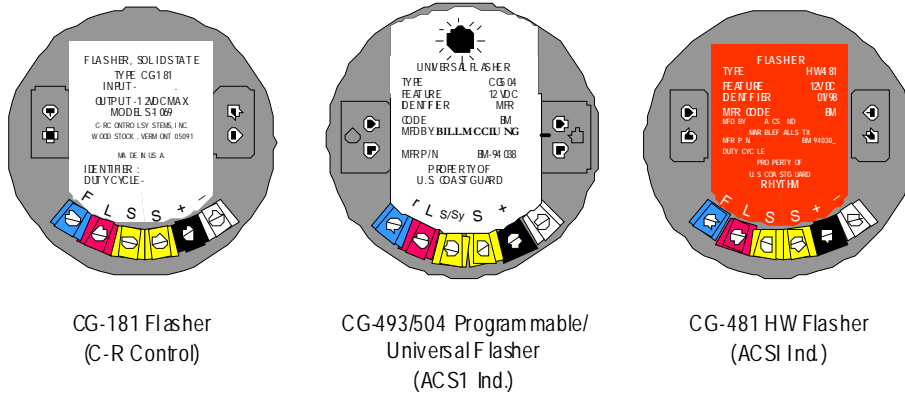


Figure 6-3. Dimensions of 12-volt Daylight Controls

6.E.6.

6. 12VDC Flasher (CG-181, CG-493, CG-481 & CG-504)



a. Function. The CG-181, CG-493, CG-481 and CG-504 flashers time-code (flash) and regulate the direct current voltage to 12-volt marine signal lamps. The flasher senses failure of the operating lamp and provides a pulse (known as the “F” pulse) to energize the solenoid on the CG-6P or CG-6PHW lampchanger, allowing the turret to index to a new lamp. The CG-493 programmable flasher is similar to the CG-181 except the programmability. With CG-493 and CG-504, users can select a flash rhythm by using the switch mounted on the flasher. When a daylight control is connected to the flasher, power to the lamp is turned off during daylight hours. The CG-181 and CG-493 flashers will safely operate lamps with a current draw of 3.05 amps or less (including the 35-watt tungsten-halogen lamp). The CG-481 flasher is used to operate lamps rated at 50 watts or greater. The CG-504 flasher combines programmability with capabilities to operate any standard 12VDC Coast Guard lamp. The CG-504 will replace all current CG-181, CG-481 and CG-493 flashers when supplies are exhausted.

b. Features.

- (1) Solid-state electrical components.
- (2) Short circuit protection.
- (3) Reverse polarity protection.
- (4) All standard Coast Guard flash rhythms are available (nonadjustable).
- (5) CG-493/504 flashers can be programmed to flash all standard Coast Guard rhythms.
- (6) CG-504 minor aid and range/lighthouse rhythms are separate to eliminate confusion.
- (7) Color-coded #8 screw terminals, for wiring to lampchanger, incoming power, and daylight control.
- (8) Watertight container, potted to protect internal electronics package.
- (9) CG-504 flasher can be synced without the need for a slave flasher.
- (10) Low cost, non-repairable item.

6.E.6.c.

c. Electrical and Mechanical Characteristics.

- | | |
|------------------------|---|
| (1) Input voltage | 10 to 18VDC |
| (2) Output voltage* | 9.25 to 12.2VDC |
| (3) Output current | 0.55 to 4.0 amps (CG-181/CG-493)
0.55 to 10.0 amps (CG-481)
0.050 to 10.0 amps (CG-504) |
| (4) Ambient temp range | 0 to +125 degrees F |
| (5) Timing tolerance | ±5 percent |

*The output voltage is specified to be between 11.66 and 12.20VDC, or to no less than 0.75 volts below the input voltage (for input voltages between 10.0 and 12.4 volts). For CG-504 flashers, the output may be pulsed-DC so it can not be measured with a standard ATON voltmeter.

- d. Related Equipment. The CG-181, CG-493 or CG-504 flasher is used with a CG-6P lampchanger, WK-681 wiring kit, 12-volt lamps (0.55 amp-3.05 amp & 35 watt) and a daylight control, to outfit any of the omnidirectional optics, the VRB-25 rotating beacon, or the RL14 range lantern. The CG-481 (high-wattage) or CG-504 flasher is used with the CG-6PHW lampchanger, WK-681 wiring kit, 12-volt tungsten-halogen lamps (50 watts or greater) and a daylight control, to outfit the 250 or 300mm marine signal lanterns (100 or 110 watt lamps only), the VRB-25 rotating beacon, or the RL14 range lantern. A CG-181/493/504 flasher is used in the AC Flash Controller and the Audio-Visual Controller to flash 1000 watt AC lamps (see Chapter 8).
- e. Wiring—Standard. Brackets are used to secure the lampchanger/flasher assembly in the focal position of the lantern. The type of bracket will vary from lantern to lantern. (Procedures for mounting the lampchanger/flasher assembly into an optic are described in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series)) The basic procedures for wiring the lampchanger and flasher together are illustrated below:

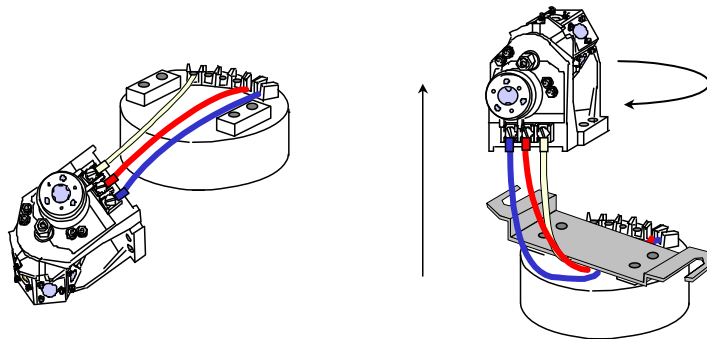


Figure 6-4. Wiring Procedures

- (1) If a CG-493/504 is used, set the flash rhythm by turning the knob (ACSI) or arranging the DIP switches (C-R) to the desired setting.

6.E.6.e.(2).

- (2) Lay a CG-6P/CG-6PHW lampchanger behind a CG-181/484/493/504 flasher with the terminals facing up.
- (3) Install a WK-681 wiring kit to the lampchanger by pushing the spring lugs under the terminal screws. Tighten the terminal screws firmly. (Note: the wires are color-coded to match the color-coding of the lampchanger terminals.)
- (4) Run the wires across the flasher and install the other end of the WK-681 wiring kit to the flasher terminals *from the inside*.
- (5) Place the bracket over the flasher so the mounting holes are aligned. The appropriate brackets are identified in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series). (Note: the wires must pass through the bracket used for the 250mm marine signal lantern. Wire the flasher with the bracket already on the flasher.)
- (6) Turn the lampchanger 180 degrees as it is placed over the bracket and flasher (the terminals will be on the opposite side of the mounting bracket). Align the mounting holes.
- (7) Secure the lampchanger to the flasher with four 1-inch long 10-32 screws.
- (8) Install the proper internally mounted daylight control (if used) to the two yellow "S" (or "S/Sy") terminals on the flasher. The daylight control housing should go next to the "+" terminal.

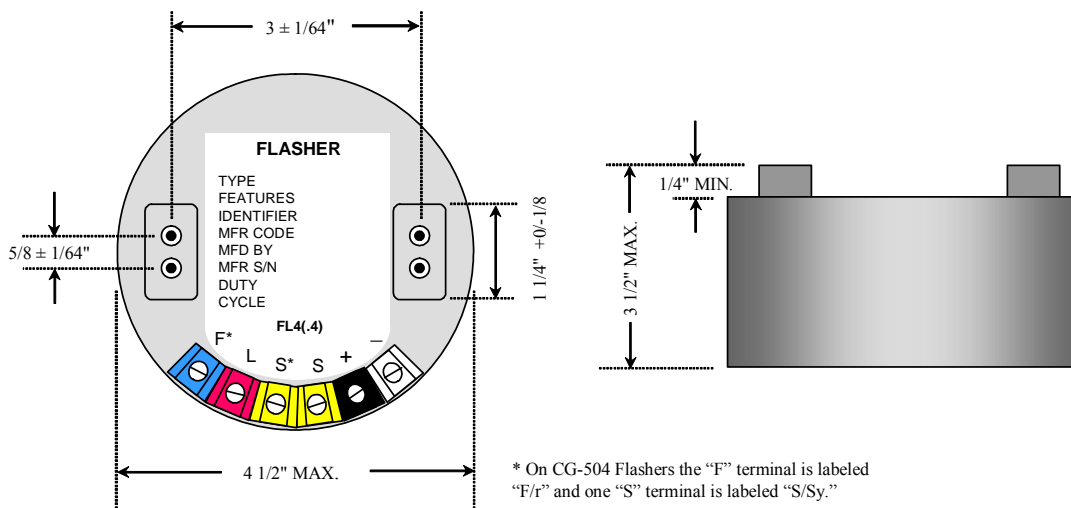


Figure 6-5. Dimensions of the CG-181, CG-493, CG-504 & CG-481 Flashers.

6.E.6.f.

- f. Wiring—Synchronized. Dedicated “slave” flashers were used for synchronization of the characteristic displayed by multiple optics. The CG-504 may be used as a “master” or “slave” flasher. The optic assemblies may have a common or separate power supplies. Figure 6-6 illustrates the wiring diagram for synchronized lights.

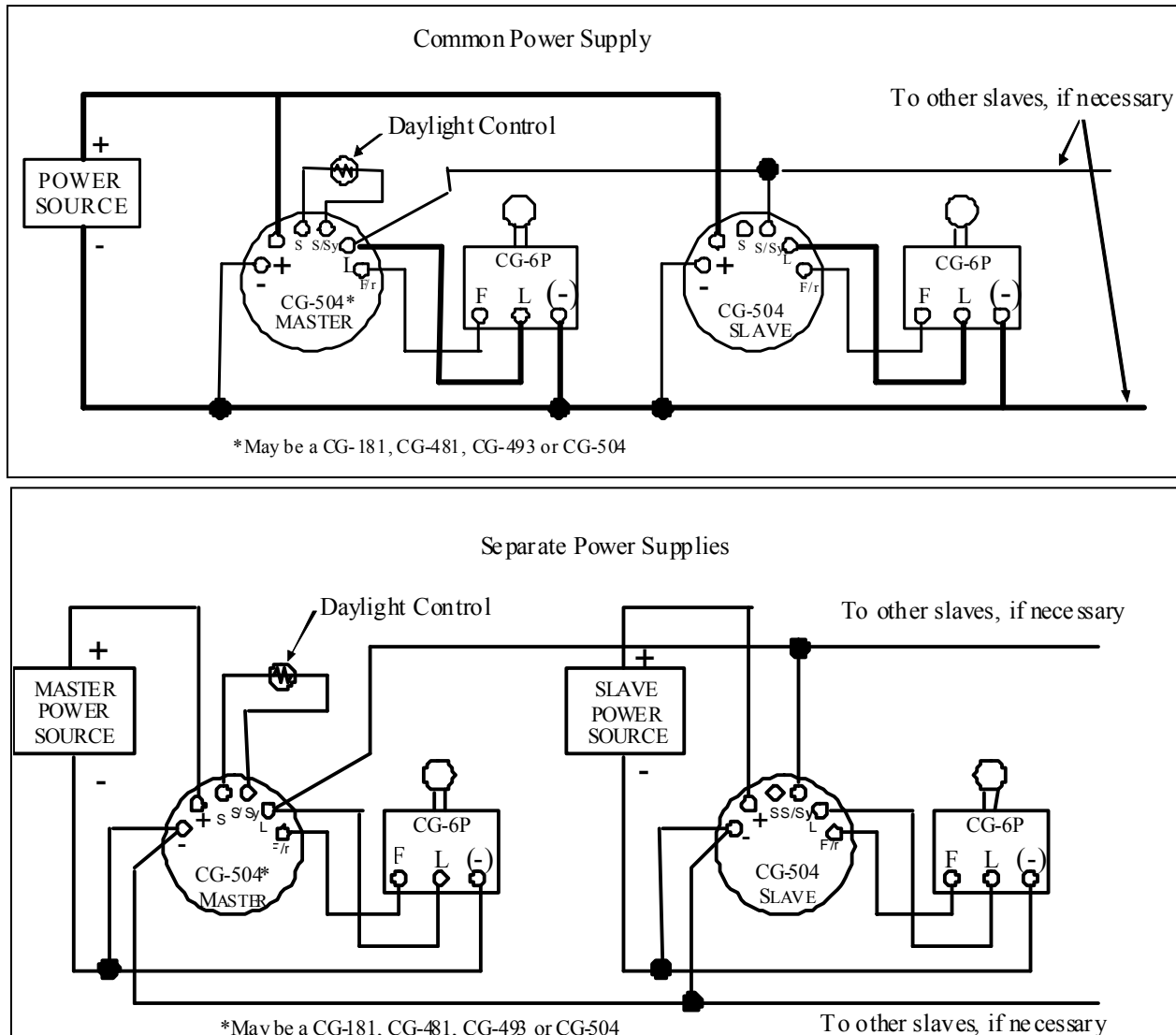


Figure 6-6. Wiring diagram for synchronized lights (common and separate power supplies)

- g. Additional Data. Technical specifications for the CG-493, CG-481 and CG-504 flashers are provided in the Ocean Engineering Division specifications website: <http://www.uscg.mil/hq/cg4/cg432/specification.asp>. Flashers are stocked at the Engineering Logistics Center. Figure 6-5 provides the dimensions of the flashers. Special rhythm flashers may be purchased directly from approved manufacturers. A list of approved manufacturers is available from Commandant (CG-432A). The CG-504 can replace all current slave flashers.

6.E.6.g (cont'd)

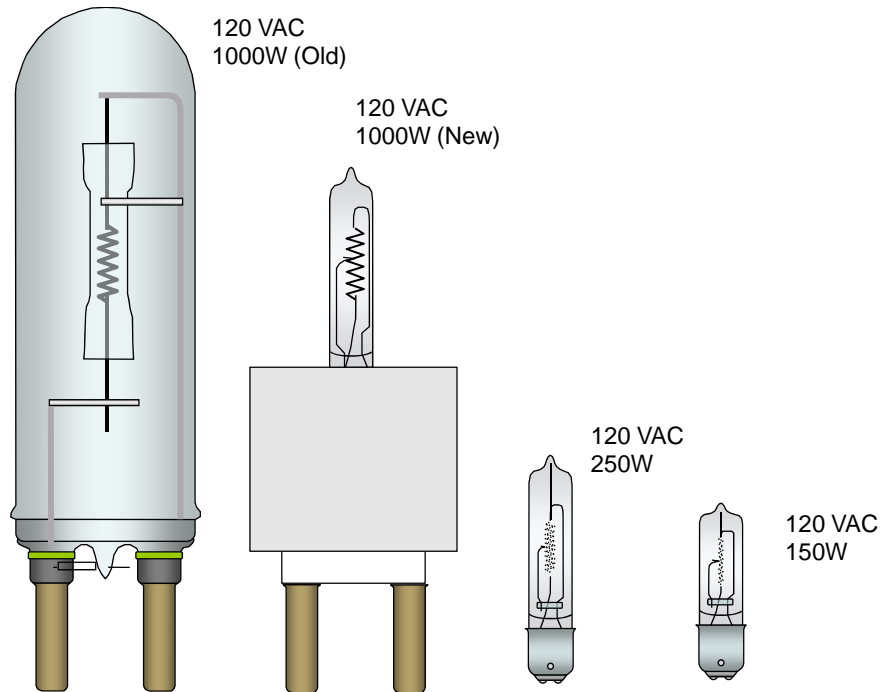
Code	Type	National Stock Number	Timing Sequence (on/off) in sec.	Duty Cycle
FL6(0.6)	CG-181*		0.6 / 5.4	0.10
FL6(1)	CG-481*	5945-01-GL3-5359	1.0 / 5.0	0.17
FL4(0.4)	CG-181*		0.4 / 3.6	0.10
FL4(1)	CG-481*	5945-01-GL3-5358	1.0 / 3.0	0.25
FL2.5(0.3)	CG-181*		0.3 / 2.2	0.12
FL2.5(1)	CG-181*	5945-01-GL3-5357	1.0 / 1.5	0.40
	CG-481*			
Q	CG-181*		0.3 / 0.7	0.30
FL(2) 5	CG-181*		0.4 / 0.6 / 0.4 / 3.6	0.16
FL(2) 6	CG-181*		1.0 / 1.0 / 1.0 / 3.0	0.33
FL(2+1) 6	CG-181*		0.3 / 0.4 / 0.3 / 1.2 / 0.3 / 3.5	0.15
Mo(A)	CG-181*		0.4 / 0.6 / 2.0 / 5.0	0.30
ISO 2	CG-181*	5895-01-GL7-6171	1.0 / 1.0	0.50
	CG-481*			
ISO 6	CG-181*	5945-01-GL3-5356	3.0 / 3.0	0.50
	CG-481*			
OC 4	CG-181*	5945-01-GL3-5355	3.0 / 1.0	0.75
	CG-481*			
Fixed	CG-181*	5945-01-GL3-5354	Continuous	1.00
	CG-481			
Programmable	CG-493	5945-00-460-3349	Programmable, to 3.05a/35W Programmable, All lamps	Programmable
	CG-504	5945-01-561-4709		

Table 6-5. Standard Flash Rhythms

* Discreet rhythms are no longer being purchased and will be replaced by programmable flashers as supplies are exhausted.

6.E.7.

7. 120-Volt Lamps



- a. Function. The 120-volt lamps are used when a light with a nominal range greater than 9 nm is required and commercial power is available. These lamps can be used in fixed and rotating lanterns to generate pencil beams and omnidirectional fan beams. The 150 and 250 watt lamps are also used in the RL14 range lantern.
- b. Features.
 - (1) Incandescent filament.
 - (2) Tungsten-Halogen cycle for long life expectancy and high lumen maintenance.
 - (3) Quartz bulbs.
 - (4) Large filaments for easy focusing and large vertical divergences.
- c. Related Equipment.
 - (1) The 1000W lamp is used in the 24-inch optics, including the DCB-24, DCB224, and RL24. It may also be used in classical lenses.
 - (2) The 250W lamp is used in the 250mm and 300mm signal lanterns, and may also be used in the RL14 range lantern and smaller classical lenses.
 - (3) The 150W lamp is used in the FA-251-AC rotating beacon and the RL14 range lantern.
 - (4) The Carlisle & Finch Company manufactures a two-place, horizontal-swing lampchanger (CG-2P) for use with the 1000W lamp.

6.E.7.c.(5)

- (5) Tideland Signal Corporation manufactures a four-place lampchanger (CG-4P) for use with both the 250W and 150W lamps. (Note: see the CG-4P section for availability.)
- (6) The FLAC-300 (Data Sheet 6-E(12)), the AC flash controller and the Audio-Visual Controller, described in Chapter 8, are used to flash 120-volt lamps.

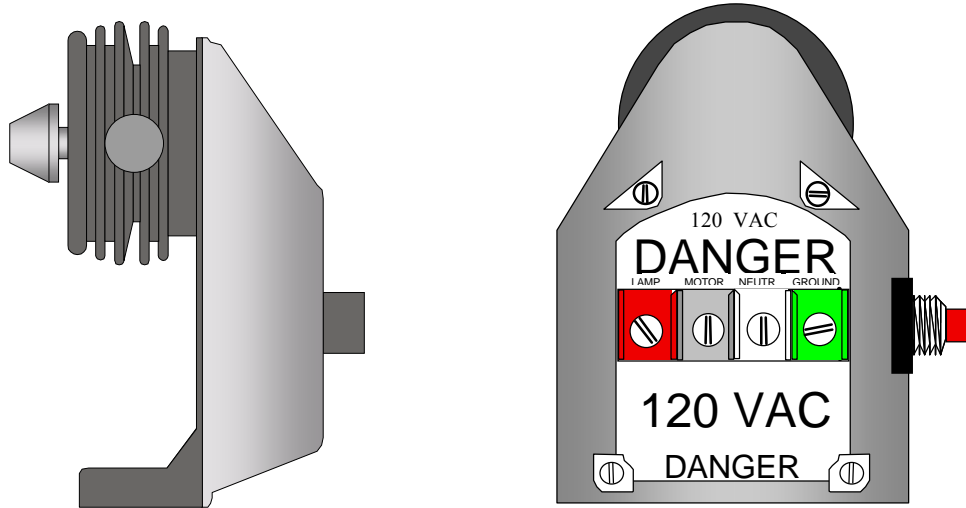
Table 6-6
120-volt Lamp Specifications

Lamp power rating (watts)	1,000	150	250
Current (amps)	8.33	1.25	2.08
Bulb type	T-20 (old)	T-4	T-4
Base type	mogul bi-post	DC bayonet	DC bayonet
Minimum on time (sec)	0.62	0.30	0.30
Life expectancy (hr)	3,000	2,000	2,000
Lumen output (lm)	17,200	2,600	4,700
NSN/ANSI Code	6240-00-905-7512	ETC	ESS

Additional Data. The 1000W lamps are manufactured by the General Electric Company and are available for purchase from SFLC Baltimore. The 150W and 250W lamps are manufactured by several companies, including General Electric and Wiko. These lamps are purchased from local lamp suppliers. For greater reliability, purchase 150W and 250W lamps with central filament supports. Be especially careful to use the correct ANSI Code, listed in Table 6-6, when purchasing the 150W lamp, as there is a similar lamp in the Federal Supply System that has a filament that resembles an upside-down V. This lamp is not suitable for use in ATON beacons and lanterns.

6.E.8.

8. 120VAC Four-Place Lampchanger (CG-4P)



- a. Function. The CG-4P lampchanger supports four 120-volt 250 or 150 watt lamps with the filament of the operating lamp at the focal point of the lantern. A lamp-out sensing circuit automatically rotates the turret (CCW) to the next serviceable lamp. In the event that all four lamps fail, the CG-4P lampchanger secures power to the lamp circuit.
- b. Features.
- (1) Fixed contact assembly; no moving electrical contacts or brushes other than lamps.
 - (2) Automatic contact cleaning before each lamp is activated.
 - (3) Lamps easily installed and removed; push in to install, tilt and pull out to remove.
 - (4) Symbolic “X” formed when all four lamps are burned out; serves as a visual alarm.
 - (5) Test button simulates lamp failure and activates turret motor.
 - (6) Fail-safe lamp-out sensing not affected by power outages or daylight controlling.
 - (7) Conical profile reduces lampchanger shadowing.
 - (8) Heat sinking built into turret maintains cool lamp base temperature.
 - (9) Turret thermally isolated from electronic enclosure by Teflon bushing.
- c. Electrical Characteristics.
- | | |
|----------------------------|--|
| (1) Input voltage range: | 100-130VAC. |
| (2) Frequency range: | 57-63 Hz. |
| (3) Operating impedance: | 5000 ohm (maximum). |
| (4) End of search: | 10 megohm (minimum) impedance. |
| (5) Control circuit power: | 5 watt (maximum) continuous. |
| (6) Safety: | Frame, turret & cover are electrically grounded. |

6.E.8.d.

d. Mechanical Characteristics. The mounting holes for the lampchanger are threaded for 10-32 screws. This allows the lampchanger to be mounted to the lampchanger bracket without requiring nuts.

- (1) Weight: 24 oz.
- (2) Mounting Pattern: 3.00" x 0.625" ± 0.005" (threaded holes).
- (3) Mounting Screws: 10-32 x .50 binding head (4 required).
- (4) Lamp Focal Position:
 - 250 watt lamps: 6.500" ± 0.062" above and central to mounting pattern.
 - 150 watt lamps: 6.250" ± 0.062" above and central to mounting pattern.

e. Related Equipment. The CG-4P lampchanger fits the following Coast Guard optics:

- (1) 300mm Marine Signal Lantern—Use adapter mounting bracket, Tideland Signal Corporation P.N. 245.1265. Only the 120-volt, 250 watt lamp will be used with the 300mm lantern and the CG-4P lampchanger.
- (2) 250mm Marine Signal Lantern (vented)—Use lampchanger bracket kit, Automatic Power, Inc., P.N. 2101-146. Only the 120-volt, 250 watt lamp will be used with the 250mm lantern and the CG-4P.
- (3) FA-251-AC Rotating Beacon—Use the lampchanger bracket provided with the beacon. Only the 120-volt, 150 watt lamp may be used in the FA-251-AC.
- (4) RL14 Range Lantern—Use the mounting blocks and lampchanger bracket provided with the beacon. Both 120-volt 250 watt and 150 watt lamps may be used in the RL14 Range Lantern. ***Insure that the mounting blocks and lampchanger bracket are correctly positioned for the selected lamp.***

The CG-4P lampchanger may be used by itself for fixed-on lights, or wired to a FLAC-300 flasher. Wire harness is provided with the FLAC-300. When used by itself, a K-4121 120-volt photoresistor is used to provide daylight control.

f. Additional Data. Technical specifications for the CG-4P Lampchanger are provided in G-ECV Specification 266. Wiring details are provided in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series). New lampchangers may be purchased via GSA (www.gsaadvantage.gov) from Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113, P.N. 630.1087-00, Tideland designation: *LC-300 4-Place Lampchanger CG4P*. Reconditioned lampchangers (P.N. RC630.1087-00) are also available (at a substantially reduced price), with turn-in of a defective unit. Tideland Signal Corporation provides a standard commercial warranty, with a one-year period, on the CG-4P lampchanger.

6.E.9.

9. 120VAC Two-Place Lampchanger (CG-2P)



- a. Function. The CG-2P lampchanger supports two 120-volt, 1000 watt lamps with the filament of the operating lamp at the focal point of the 24-inch optics. A lamp out sensing circuit automatically rotates the lampchanger to the secondary lamp in the event of failure of the primary lamp.

- b. Features.
 - (1) Holds two 120-volt, 1000 watt lamps with mogul bi-post bases.
 - (2) Spring-wound rotation mechanism.
 - (3) Trip lever to manually test rotation.
 - (4) Relay closes in secondary lamp position; provides monitor information.
 - (5) Word “TRIPPED” displayed when in secondary position.
 - (6) Pre-focused at point of manufacture.
 - (7) Horizontal position of lamp sockets adjustable.
 - (8) Auxiliary reflectors to improve light-capture.
 - (9) New lampchangers include arc-suppression, to eliminate arcing when rotating to secondary position.

- c. Electrical and Mechanical Characteristics.

(1) Input voltage range	120 VAC \pm 10%.
(2) Frequency range	60 Hz \pm 10%.
(3) Voltage drop	\leq 0.5 volts.
(4) Weight	24 oz.
(5) Ambient temperature	-30° to +140°F

- d. Related Equipment. The lampchanger is used with all standard Coast Guard 24-inch optics; the DCB-24 and DCB224 rotating beacons, the RL24 range lantern and classical lenses.

6.E.9.e

- e. Additional Data. All 24-inch optics come with the CG-2P lampchanger installed, and adjusted for optimal focus. Instructions on how to check and adjust the focus, and wiring guidelines, are outlined in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series). Figure 6-7 illustrates the physical dimensions of the CG-2P lampchanger. The CG-2P lampchanger may be purchased as a Commercial-Off-The-Shelf (COTS) item from The Carlisle & Finch Company, 4562 West Mitchell Ave., Cincinnati, Ohio, 45232-1798, (tel) (513) 681-6080, P.N. LC8949.

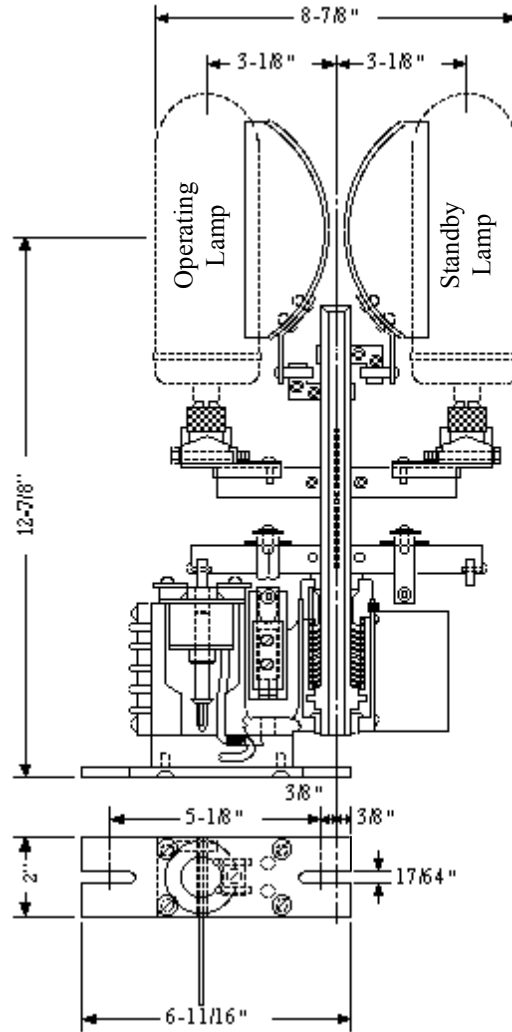
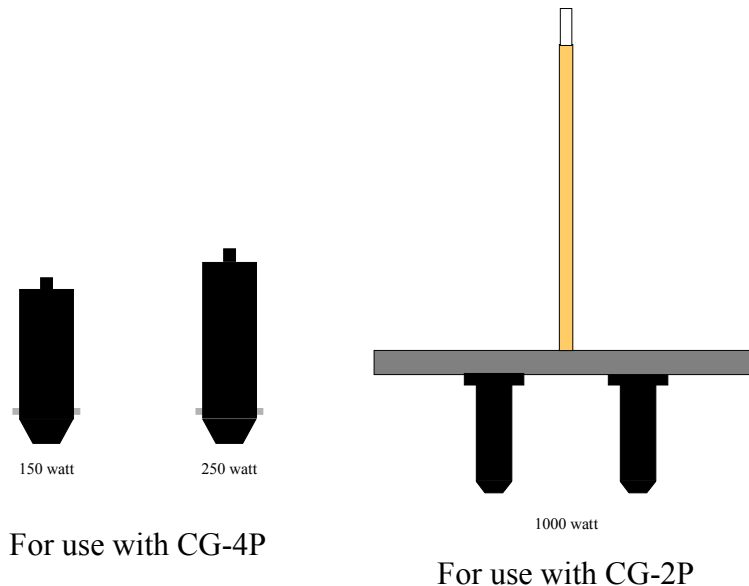


Figure 6-7. Dimensions of CG-2P Lampchanger

6.E.10.

10. 120-Volt Focus Fixture



- a. **Function.** Focus fixtures are used to assist in the focusing of optics by placing an item with a defined height in the appropriate 120-volt lampchanger within an adjustable optic. There are three different 120-volt focus fixtures: (1) for the 250 or 300mm marine signal lanterns outfitted with 250 watt lamps, (2) for the FA-251-AC rotating beacon with 150 watt lamps, and (3) for the 24-inch optics. The focus fixtures for use with the 250 and 150 watt lamps are commercial items. The focus fixture for use with 24-inch optics (DCB-24 and DCB224 rotating beacons and RL24 range lantern) is called a “dummy lamp gauge.” A dummy lamp gauge is part of the initial provisioning provided with a 24-inch optic.
- b. **Related Equipment.** Focus fixtures are used with the appropriate lampchanger for the optic and application.
- c. **Additional Data.** Purchase of a 120-volt focus fixtures for use with the 250 or 150 watt lamps may be made as a Commercial-Off-The-Shelf (COTS) procurement from Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113. The part number for the focus fixture for the 250 watt lamp is P/N 342.1055-01. The part number for the focus fixture for the 150 watt lamps is P/N 342.1055-04. These focus fixtures look the same; the only difference being their overall height. Be sure to use the correct focus fixture. The dummy lamp gauge (focus fixture) for 24-inch optics may be fabricated locally or purchased from The Carlisle & Finch Company, 4562 West Mitchell Ave., Cincinnati, Ohio, 45232-1798, (tel) (513) 681-6080. Instructions on fabricating the dummy lamp gauge are provided in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series); a slightly different version is shown in figure 6-9.

6.E.10.c. (cont'd)

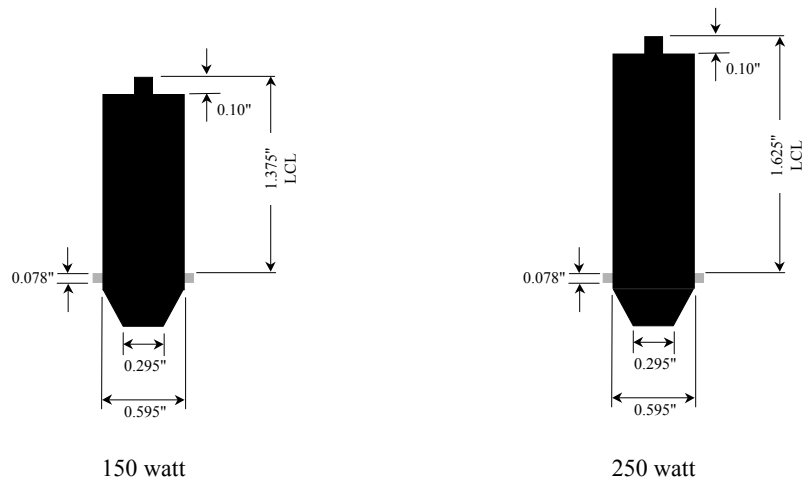


Figure 6-8. Dimensions of the 120-Volt Focus Fixtures used with the CG-4P.

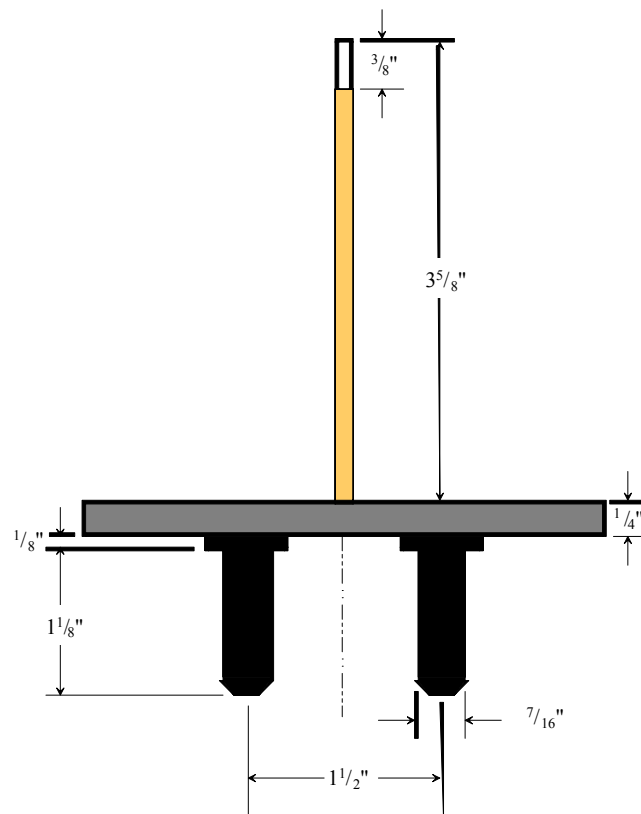


Figure 6-9. Dimensions of the "Dummy Lamp Gauge" used with the CG-2P.

6.E.11.

11. 120VAC Photocell (Type K DLC)



- a. Function. The 120VAC photocell (Type K Day Light Control - DLC) is a switch controlled by a photoresistor. The photoresistor changes resistance as the ambient light level changes, causing a bi-metallic thermal switch to open or close. At sunset, the switch will close, completing the electrical circuit, and allowing a light to be energized. At sunrise, the switch opens, causing the light to turn off. For fixed-on lights only.
- b. Features.
- (1) Direct control of loads, up to and including 120-volt, 1000 watt lamps, fixed rhythm.
 - (2) Available with and without a swivel base.
 - (3) Hermetically sealed.
 - (4) Wire color codes: black-line; white-neutral; red-switched.
 - (5) Low cost, non-repairable items, with 5-year warranty.
- c. Related Equipment. The Type K DLC may be used with the CG-4P lampchanger to daylight-control fixed-on lamps. The 120VAC photocell is also used with the Range Switch Box-AC (RSB-AC), described in Chapter 9. The Type K DLC has a ½" NPT fitting. A ¾" to ½" reducer pipe bushing is needed to install the Type K DLC in standard AtoN lanterns; McMaster-Carr P/N: 4443K734.
- d. Additional Data. Type K DLCs are purchased commercially from electrical distributors. Acceptable items include the Intermatic K-4121 and K-4221 (shown above) photocells, and the Precision Photocontrol Lumatrol T-15 and ST-15 photocells. The K-4221 and ST-15 photocells have swivel bases, and are preferred when used with the RSB-AC. The wiring schematic for a Type K DLC and CG-4P lampchanger is illustrated in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series). As the switching action in a Type K DLC is a thermal process, allow up to 5 minutes for switching when testing the operation of a Type K DLC by covering and uncovering the photoresistor.

6.E.12.

12. 120VAC Flasher (FLAC-300)



- a. Function. The FLAC-300, when used in conjunction with the CG-4P lampchanger, will provide timing-codes (flashes) for a wide range of flash rhythms. It may be used with the 120-volt, 150 watt and 250 watt lamps. A Tideland's daylight control is used to command the light off during daylight hours.
- b. Features.
- (1) Solid-state electronic components.
 - (2) Field-adjustable flash rhythms (256 available).
 - (3) Watertight, non-metallic container.
 - (4) Gold-plated electrical contacts.
 - (5) Replaceable plug-in circuit cards.
 - (6) Integrated lightning protection.
 - (7) Can be synchronized by a landline.
 - (8) Provisions for daylight control.
- c. Electrical Characteristics.
- | | |
|-------------------------------|------------------------|
| (1) Input voltage | 120 volts AC, 50-60 Hz |
| (2) Output voltage | 120 volts AC |
| (3) Maximum load | 250 watts |
| (4) Ambient temperature range | -30C to +55C |
| (5) Timing tolerance | ±6% |

6.E.12.d

d. Mechanical Characteristics.

- (1) Height 4 5/8" (117mm)
- (2) Diameter 3 15/16" (100mm)
- (3) Weight 16 oz (0.45kg)

e. Related Equipment. The FLAC-300 Flasher is used with the CG-4P lampchanger outfitted with 120-volt, 150 or 250 watt lamps. A Tidelands daylight control may be added to provide day/night switching. The FLAC-300/CG-4P combination may be used in the 250mm and 300mm marine signal lanterns (with 250 watt lamps only), and the RL-14 range lantern. The wiring schematic for the FLAC-300/CG-4P combination is illustrated in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series).

f. Additional Data. The FLAC-300 Flasher has two replaceable cards, the FLAC-300 card and the omnibus flasher timer card. The FLAC-300 card provides for daylight control of the aid, and allows aids to be synchronized. The omnibus flasher timer card controls the flash rhythm. Both cards are inserted into edge connectors on the FLAC-300 motherboard; located on the backside of the flasher cap. Figure 6-10 illustrates the two cards found in the FLAC-300. The FLAC-300 motherboard is shown in figure 6-11. Figure 6-12 shows how the cards are plugged into the motherboard. The FLAC-300 may be purchased as a Commercial-Off-the-Shelf (COTS) item from Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113, P.N. 520.1163-01. Reconditioned flashers are available (add "RC" before the P.N.) with turn-in of a defective unit. Tideland Signal Corporation provides a standard commercial warranty, with a one-year period, on the FLAC-300.

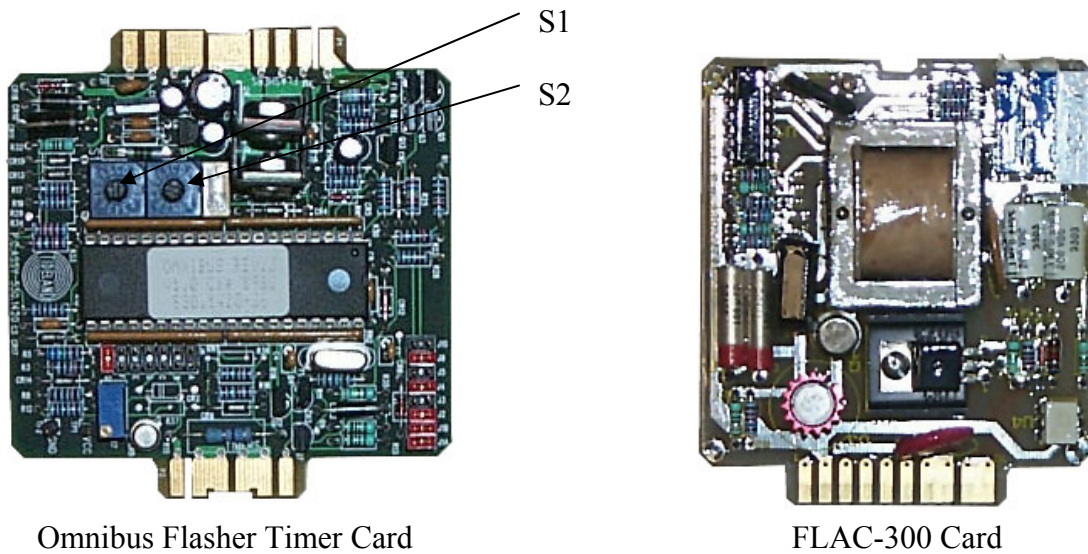


Figure 6-10. FLAC-300 Flasher Cards.

6.E.12.f. (cont'd)

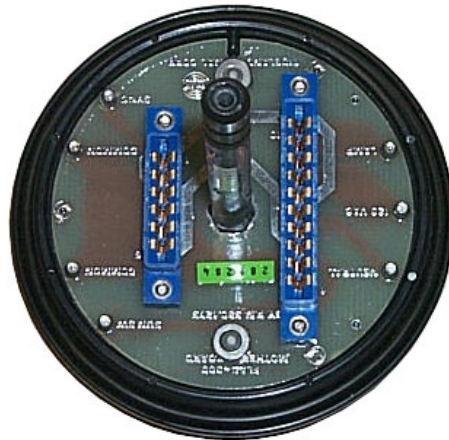
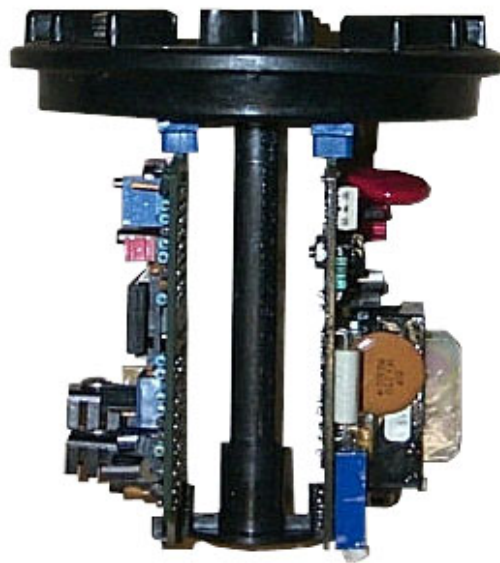


Figure 6-11. FLAC-300 Motherboard



Rhythm	S1	S2
Q	9	9
FL2.5(.3)	1	C
FL2.5(1)	0	3
FL4(.4)	0	9
FL4(1)	0	B
FL5(1)	0	E
FL6(.6)	1	D
FL6(1)	1	1
FL10(1)	1	4
FL15(1)	1	5
FL(2)5	8	D
FL(2)6	2	3
ISO2	5	1
ISO6	5	5
OC4	9	0
FIXED	0	0

Figure 6-12. FLAC-300 Card Assembly & Flash Rhythms

- g. Rhythm Selection. The omnibus flasher timer card has two rotary switches that permit selection from among 256 rhythms. (Earlier versions of the FLAC-300 had pre-set timer cards that could not be adjusted.) A *Code Selection Guide* booklet is available from Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113, P.N. 011.1092-00. Common rhythms are detailed above. Ordering units may specify the rhythm, if factory preset of the timer card is desired. If no rhythm is specified, the FLAC-300 will be factory set for a Quick Flash (Q) rhythm (0.3 second flash, 0.7 second eclipse).

6.E.13.

13. 155mm Marine Signal Lantern



Tideland Signal Corp. Automatic Power, Inc

- a. Function. The 155mm lantern is approved for use on buoys and single-pile wooden structures. A maximum omnidirectional range of 8nm can be obtained with standard 12-volt lamps.
- b. Features.
 - (1) High-impact plastic base with four 1/16-in. drain holes
 - (2) Replaceable clear, green, red, or yellow acrylic lenses
 - (3) No focusing adjustment (insure lampchanger bracket is not deformed).
- c. Related Equipment. The 155mm lantern must be equipped with the following standard 12VDC equipment—12-volt lamps, CG-6P lampchanger, CG-181/493/504 flasher, daylight control, and WK-681 wiring kit. Only the 0.55 amp through the 2.03 amp tungsten-filament marine signal lamps may be used with the 155mm lantern. Installation and wiring are detailed in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series).

6.E.13.d.

d. Performance Characteristics. The performance characteristics of the 155mm lantern are provided in Table 6-7.

NOMINAL RANGES (NMI) – 155 MM LANTERN (ACRYLIC LENS)

LENS	LAMP 12V	FL 2.5(0.3) FL (2+1) 6 Q	FL 4(0.4) FL (2) 5 Mo (A)	FL 6(0.6)	FL (2) 6 FL 2.5(1) ISO 2	ISO 6 OCC 4	FIX
CLEAR	0.55A	5	5	5	5	6	6
	0.77A	5	6	6	6	6	6
	1.15A	6	6	6	7	7	7
	2.03A	6	6	6	6	6	6
YELLOW	0.55A	4	5	5	5	5	5
	0.77A	5	5	5	6	6	6
	1.15A	5	6	6	6	6	6
	2.03A	6	6	7	7	7	8
RED	0.55A	3	3	4	4	4	4
	0.77A	4	4	4	4	4	4
	1.15A	4	4	4	5	5	5
	2.03A	5	5	5	6	6	6
GREEN	0.55A	3	4	4	4	4	4
	0.77A	4	4	4	5	5	5
	1.15A	4	5	5	5	5	5
	2.03A	5	5	6	6	6	6
12V LAMP CURRENT RATING (AMPS)							
Vertical Divergence (degrees)		0.55A	0.77A	1.15A	2.03A		
50% beam width		+2.1	+2.6	+2.6	+2.5		
15% beam width		+3.7	+3.7	+3.9	+3.8		

Table 6-7. 155mm Lantern Performance with 12-volt Lamps

Note: Consult with the Visual Signal Design Manual for effective intensities of flashing lights.

e. Dimensions. Ocean Engineering Drawing No. 120085, dated 19 February 1970, established the dimensional guidelines for manufacturers of 155mm lanterns. The overall dimensions of the Automatic Power, Inc. (API) version of the lantern are illustrated in figure 6-13. The weight, without flasher and lampchanger, is approximately 7 lbs. Fully outfitted, the lantern weighs 9½ to 10 lbs. (4.5 kg). The Tideland version is identical except it uses draw-catches to secure the lens in lieu of screws.

6.E.13.e. (cont'd)

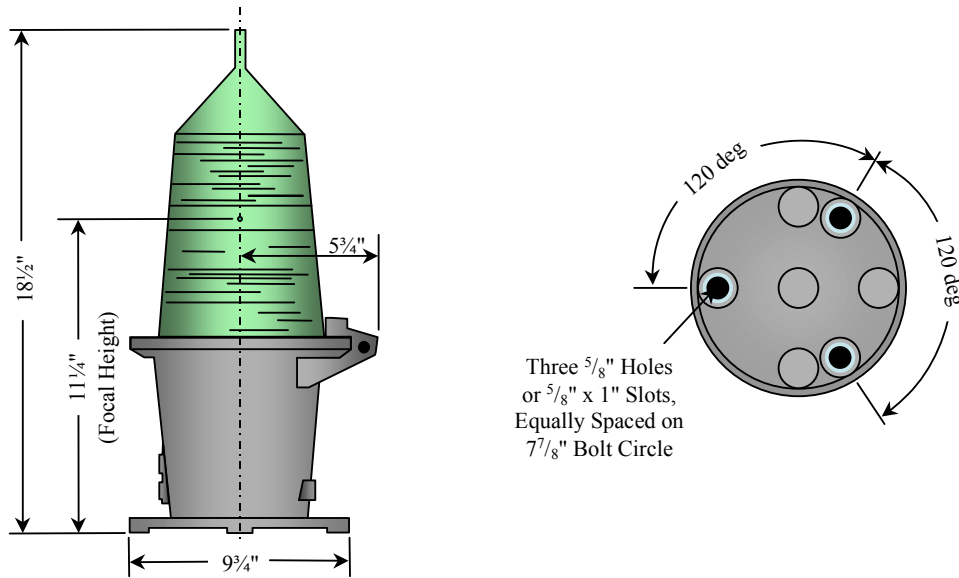


Figure 6-13. 155mm Lantern Dimensions (API version).

- f. Additional Data. Technical specifications for the 155mm lantern are listed in G-ECV Specification 205. The 155mm lantern and lenses are stocked at the Engineering Logistics Center. The following are applicable stock numbers for the lanterns and lenses:

(1) 155-mm lantern:

Clear lens	6210-01-029-4172
Green lens	6210-01-029-4173
Red lens	6210-01-029-4174
Yellow lens	6210-01-153-7620

(2) Tideland Lenses:

Clear	6210-01-035-0417
Green	6210-01-035-0418
Red	6210-01-095-5826
Yellow	6210-01-156-7860

(3) API Lenses (and old Amerace lanterns)

Replacement lenses for the API/Amerace lanterns are not stocked at the SFLC. The Tideland lens can be used as a *temporary* replacement on the API base by using the hinge pin and three captive screws and washers that come with the API lantern. This combination should be replaced with a standard base/lens combination as soon as practical.

6.E.14.

14. 250mm Marine Signal Lantern



- a. Function. The 250mm lantern is for use only on stable platforms. It shall not be used on buoys or on wooden single pile beacons located in the water. It may be installed on steel or concrete beacon structures in a hard bottom and not subject to collisions. Omnidirectional nominal ranges of up to 9 nm can be obtained with the standard 12VDC equipment.
- b. Features.
- (1) Optional color sectors.
 - (2) Condensing panels and reflex reflectors available for higher intensity pencil beams.
 - (3) Requires precision focusing and leveling.
 - (4) Requires azimuth sighting of beams and sectors.
 - (5) Replaceable clear, green, red, or yellow acrylic lens covers.
 - (6) Vented version for use with 120-volt lamps can dissipate 200 watts of heat continuously.
 - (7) Standard version can dissipate 75 watts of heat continuously.
 - (8) Aluminum base with four 1/16-in. drain holes.
- c. Related Equipment. The 250mm marine signal lantern may be equipped with either standard 12VDC equipment, including 12-volt lamps, CG-6P lampchanger, CG-181/493/504 flasher, daylight control, and WK-681 wiring kit; or 120VAC equipment. Lanterns outfitted for 120VAC power are outfitted with a CG-4P lampchanger and if flashed, a FLAC-300 flasher. A Tidelands daylight control is used if the aid is flashed and daylight controlled. Only the 120-volt, 250 watt lamp may be used in the 250mm lantern with the CG-4P.

6.E.14.d.

- d. Performance Characteristics. The performance characteristics of the 250mm marine signal lantern with 12-volt lamps and the 120-volt, 250 watt lamp are provided in Table 6-8.

NOMINAL RANGES (NMI) – 250 MM LANTERN (ACRYLIC LENS)

LENS	LAMP 12V	FL 2.5(0.3) FL (2+1) 6 Q	FL 4(0.4) FL (2) 5 Mo (A)	FL 6(0.6)	FL (2) 6 FL 2.5(1) ISO 2	ISO 6 OCC 4	FIX
CLEAR	0.55A	5	6	6	6	6	6
	0.77A	6	6	6	7	7	7
	1.15A	6	7	7	7	8	8
	2.03A	7	8	8	8	9	9
	3.05A		8	9	9	9	10
120V	250W	10	11	12	12	12	12
YELLOW	0.55A	5	5	5	5	6	6
	0.77A	5	6	6	6	6	6
	1.15A	6	6	6	7	7	7
	2.03A	7	7	7	8	8	8
	3.05A		7	8	8	9	9
120V	250W	10	10	11	11	12	12
RED	0.55A	4	4	4	4	4	5
	0.77A	4	4	5	5	5	5
	1.15A	5	5	5	5	6	6
	2.03A	5	6	6	6	7	7
	3.05A		6	6	7	7	7
120V	250W	8	9	9	10	10	10
GREEN	0.55A	4	4	4	4	4	4
	0.77A	4	4	5	5	5	5
	1.15A	5	5	5	5	6	6
	2.03A	5	6	6	6	7	7
	3.05A		6	6	7	7	7
120V	250W	8	9	9	10	10	10

	12V LAMP CURRENT RATING (AMPS)					120V
	0.55	0.77	1.15	2.03	3.05	250W
Vertical divergence (degrees)						
50% beam width	+1.1	+1.4	+1.6	+1.5	+1.7	+3.2
15% beam width	+1.7	+1.9	+2.2	+2.0	+2.3	+4.5
Condensing panel intensity (cd)						
clear lens (fixed rhythm)	1,800	4,000	5,500	9,000	11,000	50,000
red/green lens (fixed rhythm)	560	1,200	1,700	2,800	3,400	16,000
yellow lens (fixed rhythm)	1,300	2,800	3,900	6,400	7,800	36,000

Note: Consult the Visual Signal Design Manual for effective intensities of flashing lights.

Table 6-8. 250mm Marine Signal Lantern Performance

6.E.14.d. (cont'd)

The tabulated values for condensing panel intensity are at the center of the beam created by the condensing panel. The full width (to 50% intensity) of the beam is 1.5 degrees. At ± 3 degrees of the beam axis, the intensities fall to 150% of the standard values. From 3 degrees to 30 degrees on either side of the beam axis, the intensities fall to 50% of the standard values. When a reflex reflector is used opposite of the condensing panel, the intensities are increased by 20%.

- e. Dimensions. The dimensions of the 250mm marine signal lantern are illustrated in figure 6-14. The overall weight of the lantern is 14.5 lbs.

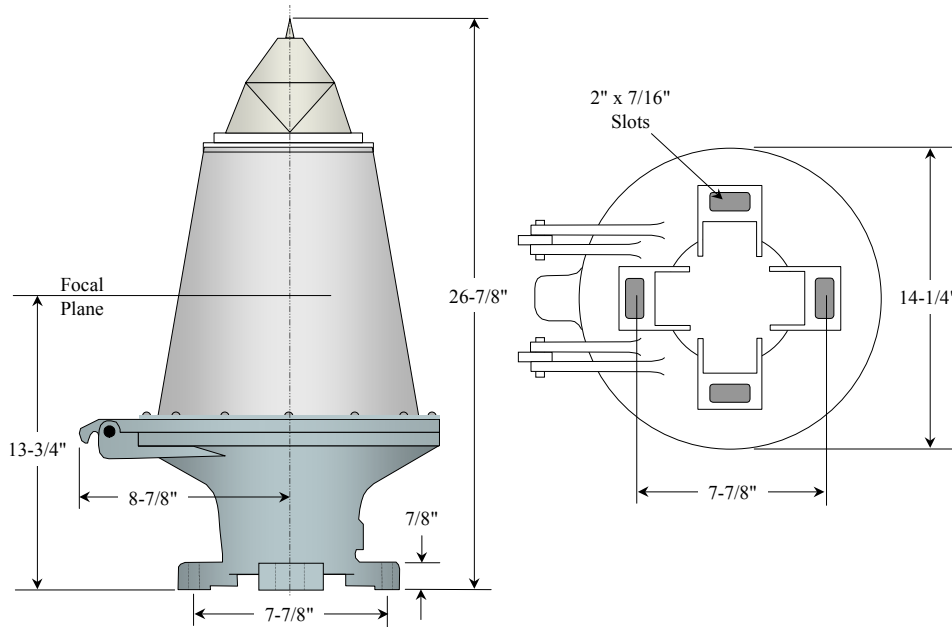


Figure 6-14. 250mm Marine Signal Lantern Dimensions and Base.

- f. Additional Data. The 250mm marine signal lantern and components may be purchased as commercial items from Automatic Power, Inc. (API), (713) 228-5208. The lens assembly consists of an omnidirectional drum lens and a lens cover with an integral bird spike. The drum lens is open at the top, to permit air circulation. The lens cover has a smooth surface, reducing dirt accumulation. The lens cover comes in clear, red, green and yellow, and may be *sectored* to provide different colored regions of light output. Installation instructions are detailed in the Short Range Aids to Navigation Servicing Guide, COMDTINST M15400.19 (series) and the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series). Additional options include condensing panels, reflex reflectors, and a vented lens cover (see figures 6-15, 6-16, and 6-17, respectively).

- (1) The condensing panel, shown in figure 6-15, is 60 degrees wide and two-thirds the drum lens height. It fits between the drum lens and the lens cover, with teeth base down on the lens support ring. The lens cover is positioned so that one of the five

6.E.14.f.(1) (cont'd)

teeth on the inside of the cover engages the center tooth space of the condensing panel. The condensing panel collects the light emitted by the drum lens over a 60-degree arc, and compresses it into a 1.5 degree (full width at half maximum) pencil beam, as indicated in Table 6-8. When the 250mm lantern with condensing panel is used as a range lantern, the beam must be accurately aligned with the channel centerline. The National Aids to Navigation School provides a handout, "True South Finder Construction and Use," that is beneficial in aligning the condensing panel with the channel centerline. (Note, final alignment of range lights should always be checked by a unit at the far end of the channel.)

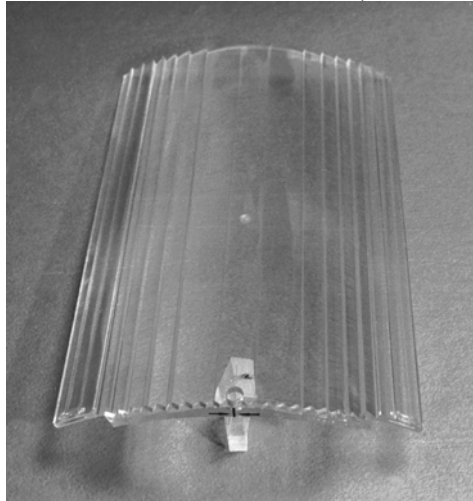


Figure 6-15. Condensing Panel for 250mm Marine Signal Lantern.

- (2) The reflex reflector, shown in figure 6-16 fits inside the drum lens, and reflects the light over a 60-degree arc towards the opposite side of the lantern. The output over the 60-degree sector opposite the reflex reflector is increased by approximately 30%. When used with a condensing panel, the peak intensity of the pencil beam emitted by the condensing panel is increased by approximately 20%.

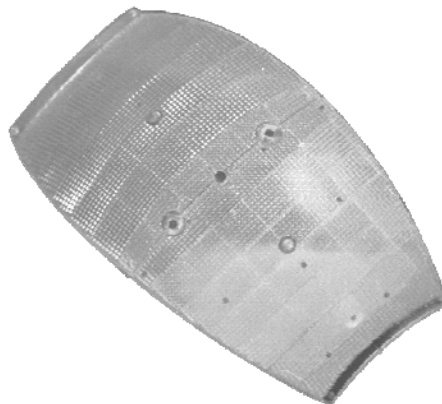


Figure 6-16. Reflex Reflector for 250mm Marine Signal Lantern.

6.E.14.f(3).

- (3) The standard 250mm lantern is capable of dissipating the equivalent of a continuous lamp-load of 75 watts. A vented 250mm lantern can dissipate the equivalent of 200 watts. Therefore, the vented 250mm lantern must be used with the 120-volt, 250 watt lamp, when the lamp is operated with a duty cycle equal to or greater than 30%, but is restricted to a duty cycle no greater than 80%. The vented lens cover assembly, illustrated in figure 6-17 is commercially available from API.

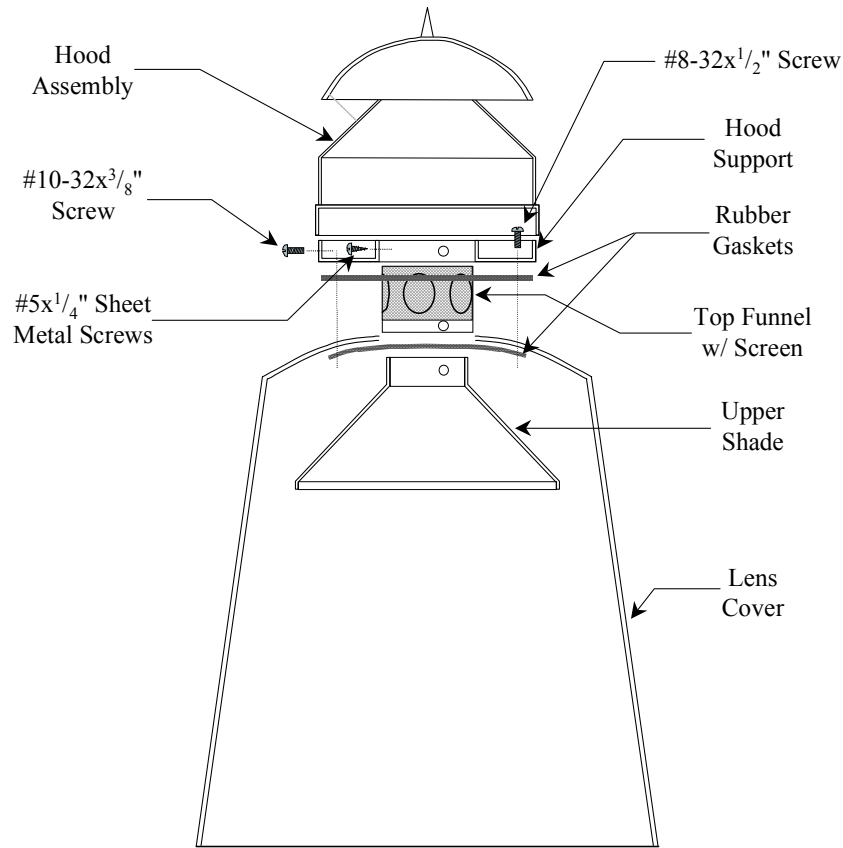


Figure 6-17. Vented Lens Cover Assembly for 250mm Marine Signal Lantern

- g. Optional Lantern. For new installations, or if a 250mm needs to be replaced, the use of a Vega VLB-44 LED lantern should be considered. The VLB-44 will provide higher intensities and will use less power than a 250mm lantern. The only advantage of a 250mm is that it can be used in a lighthouse lantern room that uses colored lantern panes to provide a colored sector and for use on ranges with a condensing panel.

6.E.15.

15. 300mm Marine Signal Lantern



- a. Function. The 300mm marine signal lantern is used only on stable platforms. It shall not be used on buoys and wooden single-pile structures located in the water. It may be installed on steel or concrete beacon structures in a hard bottom and not subject to collisions. Omnidirectional nominal ranges of up to 10nm can be obtained with standard 12VAC equipment.
- b. Optional Lantern. For new installations, or if a 300mm needs to be replaced, the use of a Vega VLB-44 LED lantern should be considered. The VLB-44 will provide higher intensities and will use less power than a 300mm lantern. The only advantage of a 300mm is that it can be used in a lighthouse lantern room that uses colored lantern panes to provide a colored sector.
- c. Features.
 - (1) Requires precision focusing and leveling
 - (2) Replaceable clear, green, red, or yellow acrylic lens
 - (3) Can dissipate 250 watts of heat continuously
 - (4) Plastic base with four 1/16-in. drain holes.
- d. Related Equipment. The 300mm marine signal lantern may be equipped with either standard 12VDC equipment, including 12-volt lamps (including the 12-volt, 100 and 110 watt tungsten-halogen lamps), CG-6P/CG-6PHW lampchanger, CG-181/493/504/481 flasher, daylight control, and WK-681 wiring kit; or 120VAC equipment. Lanterns outfitted for 120VAC power burning fixed-on 24-hours per day use a CG-4P lampchanger. For fixed-on lanterns that are daylight controlled, use a Type K daylight control and CG-4P. For flashing lights, install an FLAC-300 flasher, Type L daylight control, and CG-4P lampchanger. Only the 120-volt, 250 watt lamp may be used in the 300mm lantern with the CG-4P. The 300mm lantern comes with a focus lens, which must be used to accurately focus the lantern.

6.E.15.e.

- e. Performance Characteristics. The performance characteristics of the 300mm marine signal lantern with 12-volt lamps and the 120-volt, 250-watt lamp are provided in Table 6-9.

NOMINAL RANGES (NMI) – 300 MM LANTERN (ACRYLIC LENS)

LENS	LAMP 12V	FL 2.5(0.3) FL (2+1) 6 Q	FL 4(0.4) FL (2) 5 Mo (A)	FL 6(0.6)	FL (2) 6 FL 2.5(1) ISO 2	ISO 6 OCC 4	FIXED	
CLEAR	0.55A	6	6	6	7	7	7	
	0.77A	6	7	7	7	8	8	
	1.15A	7	7	8	8	8	8	
	2.03A	8	8	9	9	9	10	
	3.05A		9	9	10	10	10	
	120V 250W	11	12	12	13	13	13	
YELLOW	0.55A	5	5	6	6	6	6	
	0.77A	6	6	6	7	7	7	
	1.15A	6	6	7	7	7	7	
	2.03A	7	7	8	8	8	9	
	3.05A		8	8	9	9	9	
	120V 250W	10	11	11	12	12	12	
RED	0.55A	4	4	4	5	5	5	
	0.77A	5	5	5	5	5	5	
	1.15A	5	5	6	6	6	6	
	2.03A	5	6	6	7	7	7	
	3.05A		6	7	7	8	8	
	120V 250W	9	9	10	10	10	11	
GREEN	0.55A	4	4	4	5	5	5	
	0.77A	5	5	5	5	5	6	
	1.15A	5	5	6	6	6	6	
	2.03A	5	6	6	7	7	7	
	3.05A		6	7	7	8	8	
	120V 250W	9	9	10	10	10	11	
12V lamp current rating (amps)							120V	
							250W	
Vertical divergence (degrees) 50% beam width 15% beam width			0.55	0.77	1.15	2.03	3.05	
			+1.0	+0.9	+1.1	+1.3	+1.5	+2.5
			+1.5	+1.2	+1.4	+1.8	+2.1	+3.4
Note: Consult the Visual Signal Design Manual for effective intensities of flashing lights.								

Table 6-9. 300mm Marine Signal Lantern Performance

6.E.15.f.

- f. Dimensions. The dimensions of the 300mm marine signal lantern are illustrated in figure 6-18. The overall weight of the lantern is 19 lbs. (8.7kg).
- g. Additional Data. The 300mm marine signal lantern and components are on GSA schedule (www.gsaadvantage.gov, keyword: "Tideland", refine search for "300") and may be purchased Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113. The lens assembly is a single piece of cast acrylic, with an integral bird spike. The lens comes in clear, green, red and yellow transmissive colors. The 300mm lantern is capable of dissipating the equivalent of a continuous lamp-load of 250 watts. Thus, the 120-volt, 250 watt lamp may be operated fixed-on in the 300mm lantern. Installation instructions are detailed in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series) and the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series).

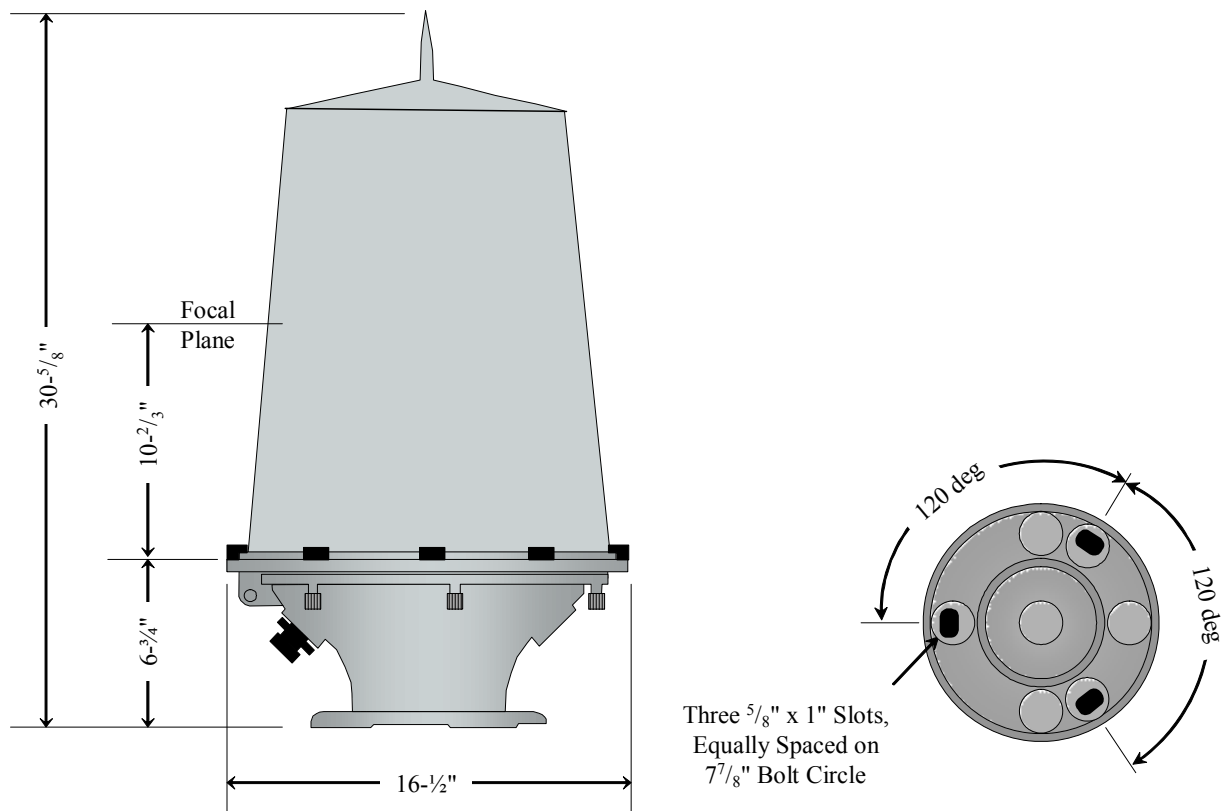


Figure 6-18. 300mm Marine Signal Lantern Dimensions and Base.

6.E.16.

16. VRB-25 Rotating Beacon



- a. Function. The VRB-25 rotating beacon is the standard rotating beacon for use when the required range for a white or colored light signal exceeds 14 nautical miles, or when an alternating characteristic is required. The VRB-25 rotating beacon may only be used on structures not subjected to vibration.
- b. Features.
 - (1) Constructed of corrosion resistant aluminum, anodized, with 2-part polyurethane paint on external surfaces.
 - (2) Requires precision focusing and leveling
 - (3) Replaceable clear, green, or red lenses and blanking panels.
 - (4) Uses all 12-volt marine signal lamps, up to and including the 110 watt lamp.
 - (5) Speed range of 2/3 to 15.9 rpm; user selectable. Speed tolerance is $\pm 2\%$.
 - (6) Requires a vibration-free platform.
 - (7) Internal components XB repairable.
 - (8) May be configured for internal or external control.

6.E.16.c.

c. Electrical Characteristics.

- (1) Operating voltage: 12VDC nominal; 11 to 18VDC allowable.
- (2) Motor Controller: Universal Vega type (CALC20), built in.
- (3) Drive Motor: 12VDC, three-phase, electronically-commutated, twenty-pole, direct drive motor.
- (4) Power Consumption: Less than 0.10 amps at 12VDC (not including lamp).
Drive motor operates 24-hours per day.

d. Operating Characteristics.

- (1) Lens Options: Clear, Red, Green, and Blanking Panels.
- (2) Character Sets: Flashing, Alternating, Group Flash (up to Group Flash 4).
- (3) Effective Intensity: See the Visual Signal Design Manual.
- (4) Nominal Range: Maximum of 22nm. (See Tables 6-10, 6-11, and 6-12 for specific capabilities with various lamps and at various rotation rates for clear, green, and red lenses, respectively.)
- (5) Beam Patterns: See figure 6-19.

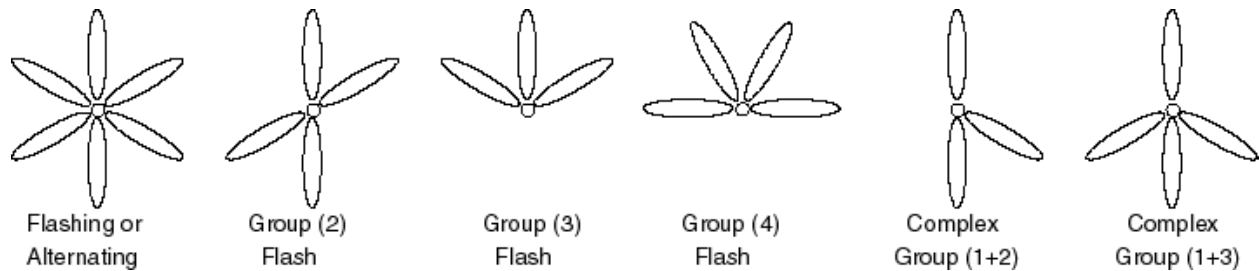


Figure 6-19. Possible Beam Patterns for VRB-25 Rotating Beacon.

- e. Rotation Speed. Rotation rate for a given characteristic may be determined by the following formula:

$$\text{Rotation rate} = \frac{1 \text{ Rev}}{6 \text{ Flashes}} * \frac{1 \text{ Flash}}{\text{Interval (sec)}} * \frac{60 \text{ sec}}{1 \text{ min}} = \text{rpm} \quad \text{Where the } \textit{Interval} \text{ is the period between flashes of the characteristic}$$

- f. Related Equipment. The VRB-25 rotating beacon must be equipped with 12-volt lamps and a six-place lampchanger. The beacon may be wired for *internal control*, with a flasher and Type L daylight control installed, or may be used in conjunction with an SDB and SAC III (*external control*).

- g. Performance Characteristics. The performance characteristics of the VRB-25 rotating beacon are outlined in Table 6-10 (clear lens panels), Table 6-11 (red lens panels) and Table 6-12 (green lens panels). Beacons displaying alternating characteristics shall be rated based on the lowest value obtained.

6.E.16.g. (cont'd)

—White—

Lamp	Rotation Rate (rpm)									
	2/3	1	1-1/3	1-1/2	1-2/3	2	2-1/2	3	4	5
12 V, 0.77 A										
Nominal Range (nm)	15	15	14	14	13	13	13	13	12	11
Flash Length (sec)	.13	.11	.09	.08	.07	.07	.06	.05	.04	.04
12 V, 1.15 A										
Nominal Range (nm)	16	15	15	14	14	14	13	13	13	12
Flash Length (sec)	.12	.09	.08	.07	.07	.06	.05	.05	.04	.03
12 V, 2.03 A										
Nominal Range (nm)	17	17	16	16	16	15	15	15	14	14
Flash Length (sec)	.15	.12	.10	.09	.08	.07	.06	.05	.04	.04
12 V, 3.05 A										
Nominal Range (nm)	18	17	17	17	16	16	16	15	15	14
Flash Length (sec)	.15	.12	.10	.09	.08	.07	.06	.06	.05	.04
12 V, 1.0 A, CC-8										
Nominal Range (nm)	17	16	16	16	15	15	15	14	14	13
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03
12 V, 1.9 A, CC-8										
Nominal Range (nm)	18	18	17	17	17	16	16	16	15	15
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03
12 V, 3.0 A, CC-8										
Nominal Range (nm)	19	19	18	18	18	17	17	16	16	15
Flash Length (sec)	.16	.12	.10	.09	.09	.08	.07	.06	.04	.04
12 V, 35 W, T-H										
Nominal Range (nm)	20	19	19	18	18	18	17	17	16	16
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.04
12 V, 50 W, T-H										
Nominal Range (nm)	20	20	19	19	19	19	18	18	17	17
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.04
12 V, 75 W, T-H										
Nominal Range (nm)	21	21	20	20	20	19	19	18	18	17
Flash Length (sec)	.16	.12	.10	.09	.08	.07	.06	.06	.04	.04
12 V, 100 W, T-H										
Nominal Range (nm)	22	21	21	20	20	20	19	19	19	18
Flash Length (sec)	.16	.12	.11	.10	.09	.08	.07	.06	.05	.05
12 V, 110W, TH										
Nominal Range (nm)	22	21	21	21	20	20	20	19	19	18
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03

Table 6-10. Nominal Range and Apparent Flash Length for a VRB-25 Rotating Beacon

6.E.16.g. (cont'd)

—Red—

Lamp	Rotation Rate (rpm)									
	2/3	1	1-1/3	1-1/2	1-2/3	2	2-1/2	3	4	5
12 V, 0.77 A										
Nominal Range (nm)	13	12	12	11	11	11	11	10	10	9
Flash Length (sec)	.13	.11	.09	.08	.07	.07	.06	.05	.04	.04
12 V, 1.15 A										
Nominal Range (nm)	14	13	13	12	12	12	11	11	10	10
Flash Length (sec)	.12	.09	.08	.07	.07	.06	.05	.05	.04	.03
12 V, 2.03 A										
Nominal Range (nm)	15	14	14	14	14	13	13	13	12	12
Flash Length (sec)	.15	.12	.10	.09	.08	.07	.06	.05	.04	.04
12 V, 3.05 A										
Nominal Range (nm)	16	15	15	14	14	14	14	13	13	12
Flash Length (sec)	.15	.12	.10	.09	.08	.07	.06	.06	.05	.04
12 V, 1.0 A, CC-8										
Nominal Range (nm)	15	14	14	13	13	13	13	12	12	11
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03
12 V, 1.9 A, CC-8										
Nominal Range (nm)	16	15	15	15	15	14	14	13	13	13
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03
12 V, 3.0 A, CC-8										
Nominal Range (nm)	17	16	16	16	15	15	15	14	14	13
Flash Length (sec)	.16	.12	.10	.09	.09	.08	.07	.06	.04	.04
12 V, 35 W, T-H										
Nominal Range (nm)	18	17	16	16	16	16	15	15	14	14
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.04
12 V, 50 W, T-H										
Nominal Range (nm)	18	18	17	17	17	16	16	16	15	14
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.04
12 V, 75 W, T-H										
Nominal Range (nm)	19	18	18	18	17	17	17	16	16	15
Flash Length (sec)	.16	.12	.10	.09	.08	.07	.06	.06	.04	.04
12 V, 100 W, T-H										
Nominal Range (nm)	19	19	18	18	18	18	17	17	16	16
Flash Length (sec)	.16	.12	.11	.10	.09	.08	.07	.06	.05	.05
12 V, 110 W, T-H										
Nominal Range (nm)	20	19	19	18	18	18	17	17	16	16
Flash Length (sec)	.15	.11	.09	.08	.07	.06	.06	.05	.04	.03

Table 6-11. Nominal Range and Apparent Flash Length for a VRB-25 Rotating Beacon

6.E.16.g. (cont'd)

—Green—

Lamp	Rotation Rate (rpm)									
	2/3	1	1-1/3	1-1/2	1-2/3	2	2-1/2	3	4	5
12 V, 0.77 A										
Nominal Range (nm)	12	12	11	11	11	10	10	10	9	9
Flash Length (sec)	.13	.11	.09	.08	.07	.07	.06	.05	.04	.04
12 V, 1.15 A										
Nominal Range (nm)	13	12	12	12	12	11	11	11	10	10
Flash Length (sec)	.12	.09	.08	.07	.07	.06	.05	.05	.04	.04
12 V, 2.03 A										
Nominal Range (nm)	15	14	14	13	13	13	12	12	11	11
Flash Length (sec)	.15	.12	.10	.09	.08	.07	.06	.05	.04	.04
12 V, 3.05 A										
Nominal Range (nm)	15	15	14	14	14	13	13	13	12	12
Flash Length (sec)	.15	.12	.10	.09	.08	.07	.06	.06	.05	.04
12 V, 1.0 A, CC-8										
Nominal Range (nm)	14	14	13	13	13	12	12	12	11	11
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03
12 V, 1.9 A, CC-8										
Nominal Range (nm)	16	15	14	14	14	14	13	13	12	12
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.03
12 V, 3.0 A, CC-8										
Nominal Range (nm)	16	16	15	15	15	15	14	14	13	13
Flash Length (sec)	.16	.12	.10	.09	.09	.08	.07	.06	.04	.04
12 V, 35 W, T-H										
Nominal Range (nm)	17	16	16	16	15	15	15	14	14	13
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.04
12 V, 50 W, T-H										
Nominal Range (nm)	18	17	17	16	16	16	15	15	14	14
Flash Length (sec)	.14	.11	.09	.08	.08	.07	.06	.05	.04	.04
12 V, 75 W, T-H										
Nominal Range (nm)	18	18	17	17	17	16	16	16	15	15
Flash Length (sec)	.16	.12	.10	.09	.08	.07	.06	.06	.04	.04
12 V, 100 W, T-H										
Nominal Range (nm)	19	18	18	18	17	17	17	16	16	15
Flash Length (sec)	.16	.12	.11	.10	.09	.08	.07	.06	.05	.05
12 V, 110 W, T-H										
Nominal Range (nm)	19	19	18	18	18	17	17	17	16	15
Flash Length (sec)	.16	.12	.10	.09	.09	.08	.06	.06	.05	.04

Table 6-12. Nominal Range and Apparent Flash Length for a VRB-25 Rotating Beacon

6.E.16.h.

- h. Dimensions. The VRB-25 rotating beacon has a height of 26" (661mm), without the bird spike. The overall height of the beacon will depend on how high it is mounted on the three mounting rods, and whether or not the bird spike is employed. The weight of the beacon is approximately 48 lbs (22kg).

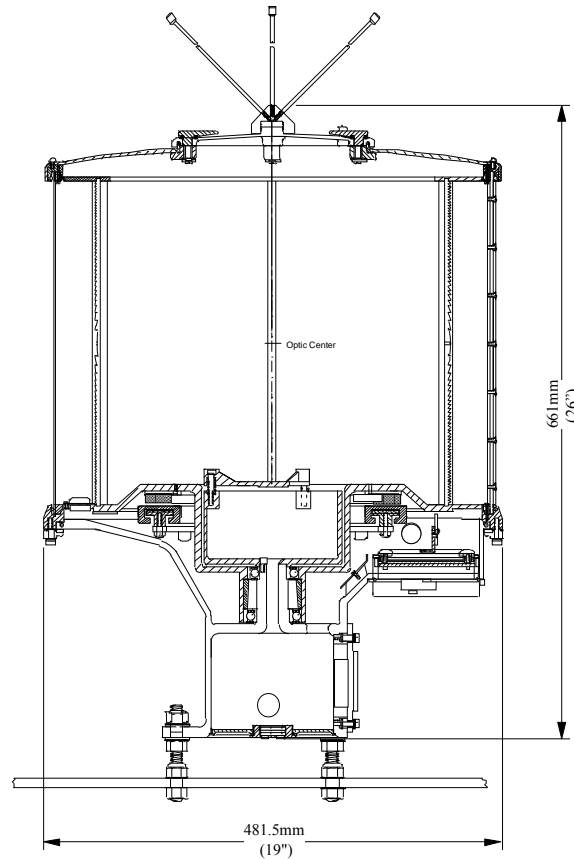


Figure 6-20. Overall Dimensions of the VRB-25 Rotating Beacon.

- i. Additional Data. Additional information on the VRB-25 rotating beacon may be found in the *Installation and Instruction Manual* that comes with the beacon, and the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series). The VRB-25 rotating beacon is stocked at Engineering Logistics Center, Baltimore, in Project 98A. Also stocked is a Spare Parts Kit, containing a motor controller, motor stator, tachometer, turntable bearing sets, two input-protection capacitors, and auto reset device and lightning protection device (consult Commandant (CG-432A) for specifics). Additional spares in the SFLC Supply Fund include lens panels (clear, red, and green, and blanking panels), glazing assemblies, and a bearing puller/installer. Requests for VRB-25 rotating beacons and spare parts kits should be addressed to Commandant (CG-432A). The beacons are delivered with six clear lens panels, and set with a rotation rate of 1 rpm. Mouser Electronics, (800) 346-6873 has an acceptable input protection capacitor; 50V, 2200 microfarad, high-temperature, radial, electrolytic capacitor, part number 140-HTRL50V2200.

6.E.17.

17. DCB-24 (shown) & DCB-224 Rotating Beacons



- a. **Function.** The DCB-24 and DCB-224 were the Coast Guard's standard 120-volt rotating beacons for landfall lights. These optics are used for lights that require effective intensities in excess of 40,000 candela, where 120VAC power is available. The DCB-24 and DCB-224 rotating beacons emit one and two pencil beams using one or two drums, respectively, which sweep the horizon. The VRB-25 lantern can replace the DCB-24/224 in most installations.
- b. **Safety Warnings.** USE EXTREME CAUTION WHEN INSTALLING, TESTING, OR SERVICING UNITS WITH 120VAC POWER. THE DCB-24/224 BEACONS DO NOT HAVE A SLIP CLUTCH IN THE DRIVE MECHANISM. BE CAREFUL NOT BE GET CAUGHT BETWEEN ANY ROTATING AND NON-ROTATING PARTS. COMPONENTS IN THE DCB-24/224 BEACONS BECOME VERY HOT. ALLOW THE BEACON TO COOL FOR 15 MINUTES BEFORE OPENING. WEAR A FACE SHIELD OR GOGGLES WHEN HANDLING LAMPS, AND GLOVES AND LONG SLEEVES TO PROTECT AGAINST HEAT.
- c. **Features.**
- (1) Aluminum base and housing.
 - (2) Available with one drum or two drums.
 - (3) Adjustable beam separation permits a variety of group or alternating characteristics.
 - (4) Maintains rated rotation rate in wind speeds of up to 100 knots.
 - (5) Rotation detection signal provided by a magnetic reed switch.
 - (6) Lampchanger provides lampchanger position signal (mode detection) for monitoring.
 - (7) Separate lamp and motor circuits.
 - (8) Uses Class C, 1/4 hp motor, which draws 4.9 A at 120VAC, to drive rotation.
 - (9) Variety of pre-set speed reducers available.
 - (10) Replaceable clear, green, or red cover glasses.
 - (11) Limited to stock on-hand. Replace with the VRB-25 lantern.

6.E.17.d.

- d. Related Equipment. The DCB-24 and DCB-224 shall rotate 24 hours per day. The optics may be daylight controlled using an AC Flash Controller equipped with a Fixed flasher and a Type L daylight control. An Audio-Visual Controller is used to monitor the DCB-24/224 beacons and to interface the main light with an emergency light. The controllers are described in Chapters 8 & 9.

The DCB-24/224 beacons come equipped with the CG-2P lampchanger. A 120-volt, 1000 watt tungsten-halogen lamp with a CC-8 filament and mogul bi-post base is used in the CG-2P lampchanger.

- e. Wiring. Wiring schematics for the DCB-24/224 rotating beacons are provided in the appropriate *24-Inch Rotating Beacon Instruction Book*. The beacons are furnished with all necessary internal wiring. Unmonitored beacons can be wired through a service disconnect or, if daylight controlled, an AC Flash Controller. Monitored beacons are wired to an Audio-Visual Controller.

Wiring used with the DCB-24/224 rotating beacons shall be 12 AWG for the lamp and motor circuits, and 14 AWG for the rotation detector and lampchanger position (if monitored). Wires shall have insulated spring spade lugs. A terminal block is provided for all necessary incoming leads in the base of the beacon. Additional wiring information is included in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series).

- f. Installation. The net weight of the DCB-24 and DCB-224 rotating beacons is 330 lbs and 470 lbs, respectively. Weight handling equipment is required to facilitate installation. Disassembly of the drums from the base may be necessary to maneuver the beacon into place. DCB-24/224 beacons must be mounted on a stable platform. These beacons are top-heavy and may tip over until permanently installed. Use extreme caution when maneuvering a beacon into place. The DCB-24/224 beacons are secured to the lantern deck (platform) using the $\frac{3}{4}$ inch cap screws provided with the beacon. Use the hardware (bolts, flat washers and lock washers) that secured the beacon to the shipping crate. An accurately machined leveling pad is provided on the top of the beacon base. Step by step procedures are outlined in the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series).

- g. Focusing. The optical system of a DCB-24/224 rotating beacon is accurately focused by the manufacturer. Adjustments are not necessary unless the optical system has been changed, such as when a mirror or lampchanger is replaced. Focusing adjustments are NOT required when a lamp is replaced. Follow the procedures in the AC Servicing Guide, in the event that focusing is required.

- h. Performance Characteristics. The effective intensity, divergence, apparent flash length, and nominal range for standard rotation rates are outlined in tables 6-13 and 6-14.

6.E.17.h. (cont'd)

Lamp current (A)	8.3	Vertical divergence (degrees)		Horizontal divergence (degrees)	
Power (W)	1000	50% of peak intensity	+2.3	50% of peak intensity	+0.7
(each drum)		15% of peak intensity	+2.9	15% of peak intensity	+1.1

Table 6-13. Beam Characteristics of the DCB-24 and DCB-224 Rotating Beacons

Speed (rpm)	Apparent Flash Length (sec)	Effective Intensity w/ Clear cover (cd)*	Nominal Range (nmi)	
			White	Red/Green
1	0.63	1,180,000	26	21
2	0.32	860,000	25	21
3	0.21	690,000	24	20
4	0.16	580,000	24	20
5	0.13	510,000	23	19
6	0.11	450,000	23	19
10	0.06	310,000	22	19
12	0.05	270,000	22	18

Table 6-14. Performance Characteristics of the DCB-24 and DCB-224 Rotating Beacons

*The transmittance of the red and green covers relative to the clear cover are both 0.20.

- i. Dimensions. The DCB-24 and DCB-224 rotating beacons are illustrated in figure 6-21 and figure 6-22, respectively.

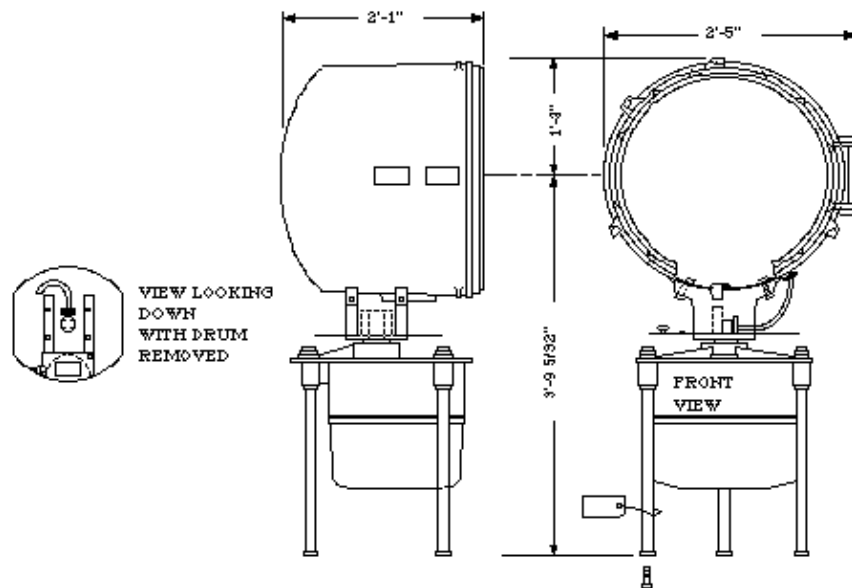


Figure 6-21. Dimensions of the DCB-24 Rotating Beacon.

6.E.17.i. (cont'd)

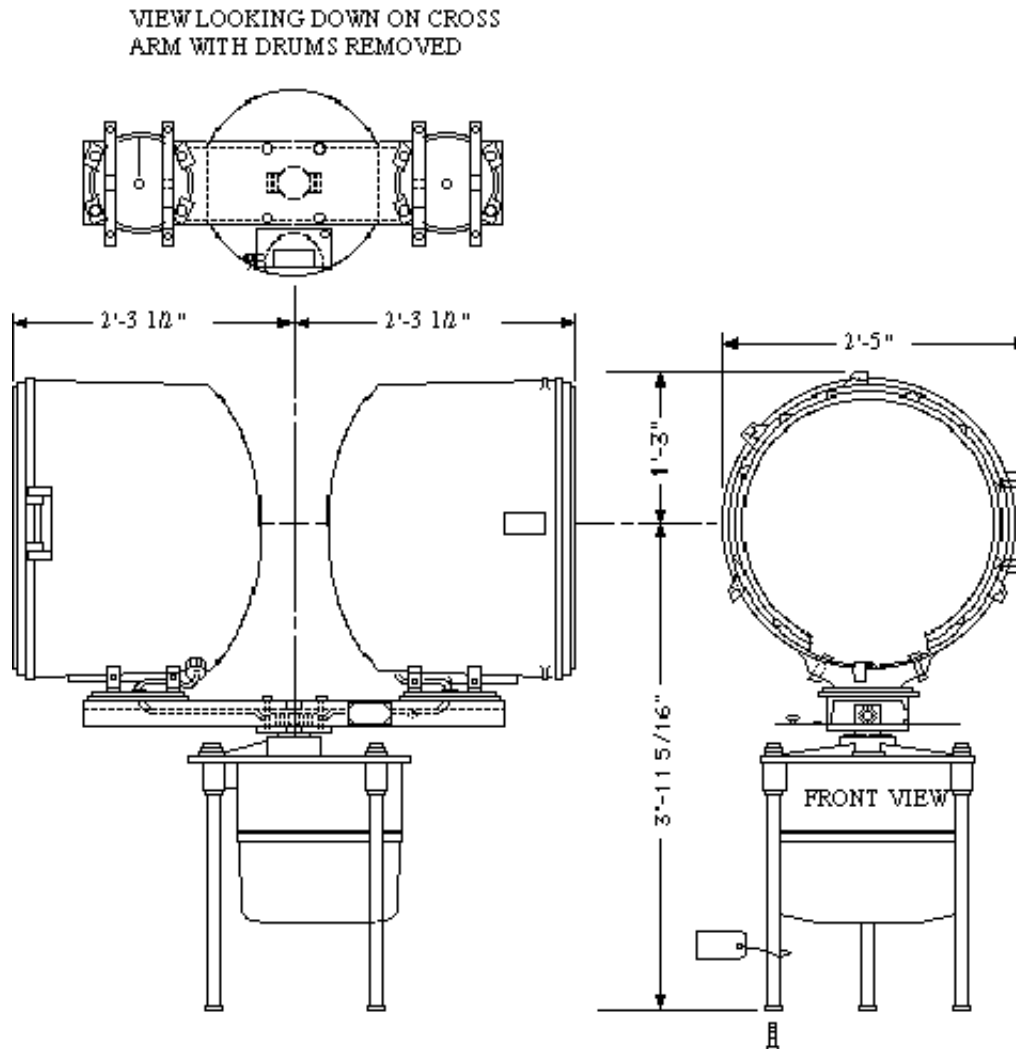
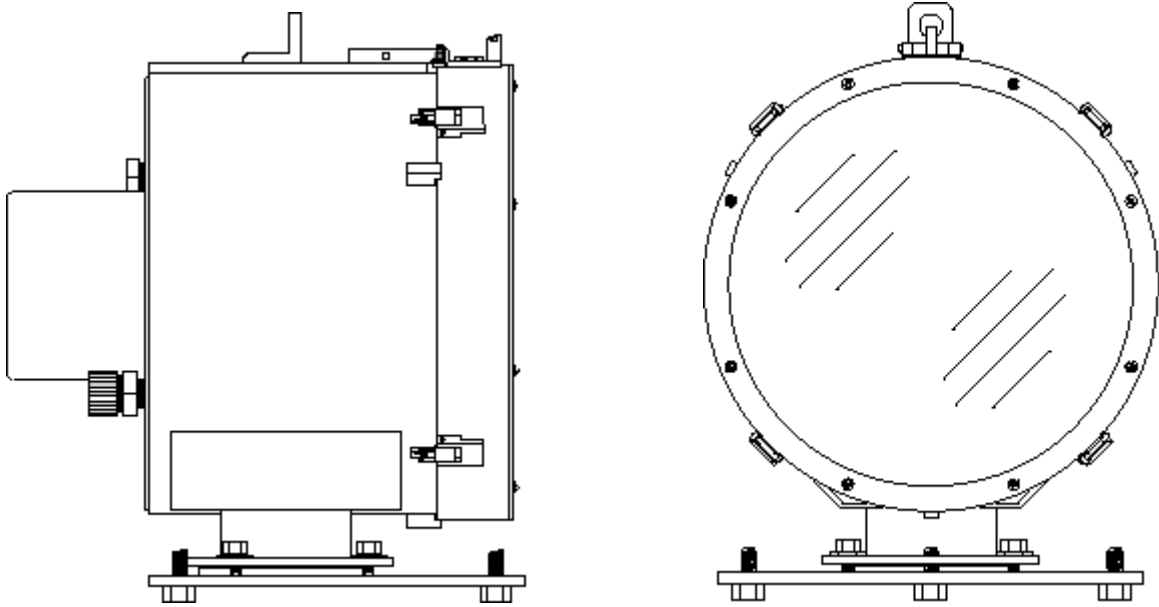


Figure 6-22. Dimensions of the DCB-224 Rotating Beacon.

- j. Additional Data. The DCB-24 rotating beacon and DCB-224 rotating beacon are stocked at SFLC, Baltimore, in Project 98A. Requests for DCB-24 and DCB-224 beacons should be addressed to Commandant (CG-432A). Stock is limited to what is on-hand. Upon failure or when the beacon is no longer serviceable, the waterway should be evaluated to determine if a VRB-25 or high intensity LED lantern meets the needs of the mariner. The manufacturer of the beacons is The Carlisle and Finch Co., (513) 681-6080. Spare parts (mirror, lampchanger, clear cover glass, speed reducers) are available from the manufacturer. Red/Green cover glass is available (in limited quantities) from Commandant (CG-432A).

6.E.18.

18. RL14 Range Lantern



- a. Function. The RL14 range lantern emits a high intensity pencil beam for use as a range light, and may be outfitted with either standard 12-volt or 120-volt lighting hardware. The RL14 range lantern must be installed on a stable platform.
- b. Features.
 - (1) Anodized aluminum housing.
 - (2) Watertight seals.
 - (3) Requires precision leveling.
 - (4) Prefocused for standard 12-volt and 120-volt lamps.
 - (5) Replaceable clear, green, and red transparent cover glasses.
 - (6) Several spread lenses available (clear, green, and red).
- c. Related Equipment. The RL14 range lantern may be outfitted with standard 12-volt or 120-volt ATON hardware. For 12-volt applications the lantern is outfitted with a CG-6P/CG-6PHW lampchanger and CG-181/493/504/CG-481 flasher, or a LED retrofit kit. For 120-volt applications, the lantern may be outfitted with a CG-4P lampchanger (with or without a Type K daylight control) for fixed-on signals, or with a CG-4P lampchanger and FLAC-300 flasher, for flashing signals. A Type L daylight control is used for 12-volt applications, and the Tideland daylight control is used when a FLAC-300 is installed. The Visual Signal Design Manual, COMDTINST M16510.2 (series) provides the performance characteristics of the lantern, the permissible combinations of lantern, lamp and spread lenses.

6.E.18.d.

- d. Cover Glasses. New lanterns are provided with a clear cover glass. A cover glass is also called a flat lens or a 0° spread lens. A cover glass is a flat piece of glass that has no lensing power. Colored cover glasses are available as commercial items from Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113, www.tidelandsignal.com **A RL14 range lantern with a cover glass cannot be used with any C-8 marine signal lamp** (including 0.55, 0.77, 1.15, 2.03 and 3.05 amp lamps). Using a C-8 marine signal lamp in an RL14 lantern with a cover glass is not, and has never been authorized due to “beam wander.”

Used with an *authorized* 12V lamp (a CC-8 or tungsten-halogen lamp), an RL14 with a cover glass has a beam width of about 1° (full width to half the maximum intensity). Used with 120VAC lamps, the full beam widths for an RL14 with a cover glass are 1.2° and 2° for 150W and 250W lamps respectively. LED retrofit kits may be used with or without a spread lens.

- e. Spread Lenses. An RL14 Range Lantern can be equipped with a spread lens to increase the width of the beam. Spread lenses come in 5 sizes: 3°, 8°, 11°, 20° and 28°. The value specifies the full beam width (to half maximum intensity). Spread lenses are clear, yellow, green or red. A spread lens replaces the cover glass that is provided with a new lantern. Spread lenses are available on the GSA Schedule (www.gsaadvantage.gov, keyword: “Tideland”, refine search for “355”) from Tideland Signal Corporation, P.O. Box 52370, Lafayette, LA 70505, (337) 269-9113. Further information on installing a spread lens in an RL14 range lantern can be found in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series).
- f. Additional Data. The RL14 range lantern is stocked at SFLC Baltimore in Commodity 5 (Supply Fund), with NSN 6210-01-GL3-4426. Complete installation instructions are detailed in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series) and the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17 (series).

6.E.18.g.

- g. Dimensions. The overall dimensions of the RL14 range lantern are illustrated in figure 6-23. The RL14 range lantern weighs approximately 36 lbs. (16 kg).

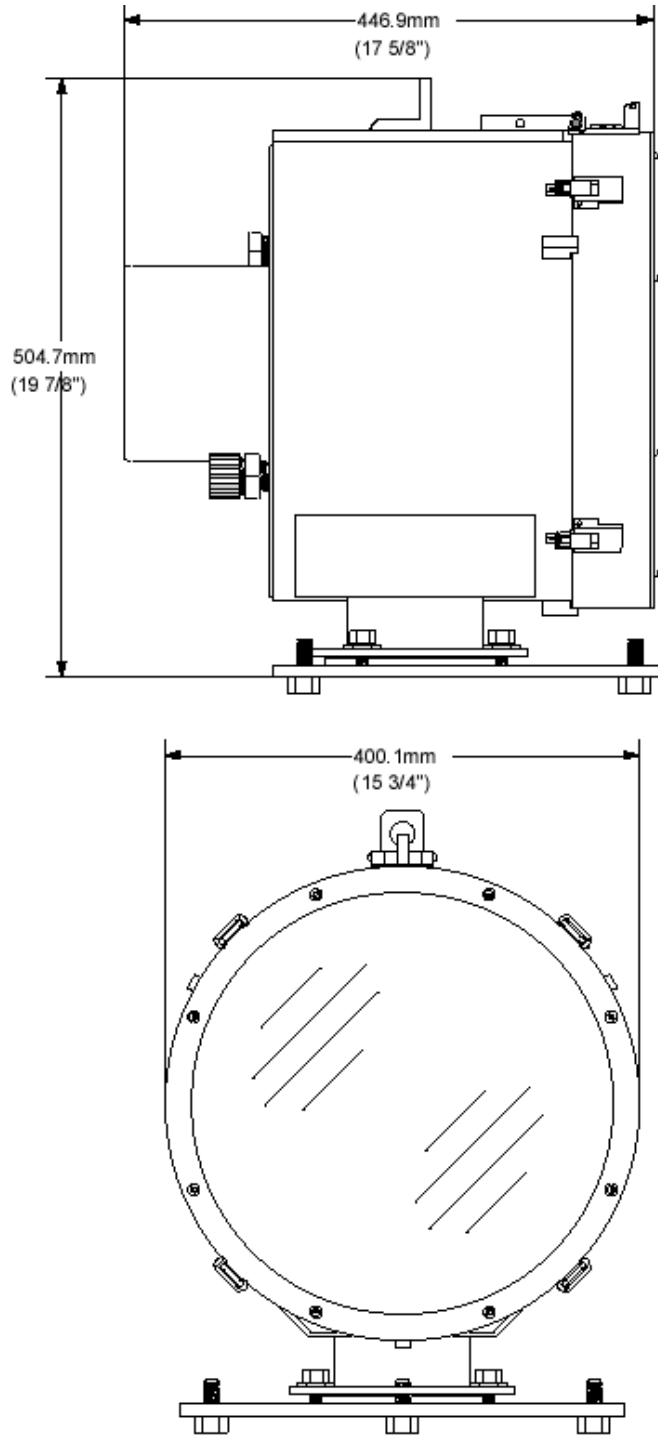


Figure 6-23. Dimensions of the RL14 Range Lantern.

6.E.18.g. (cont'd)

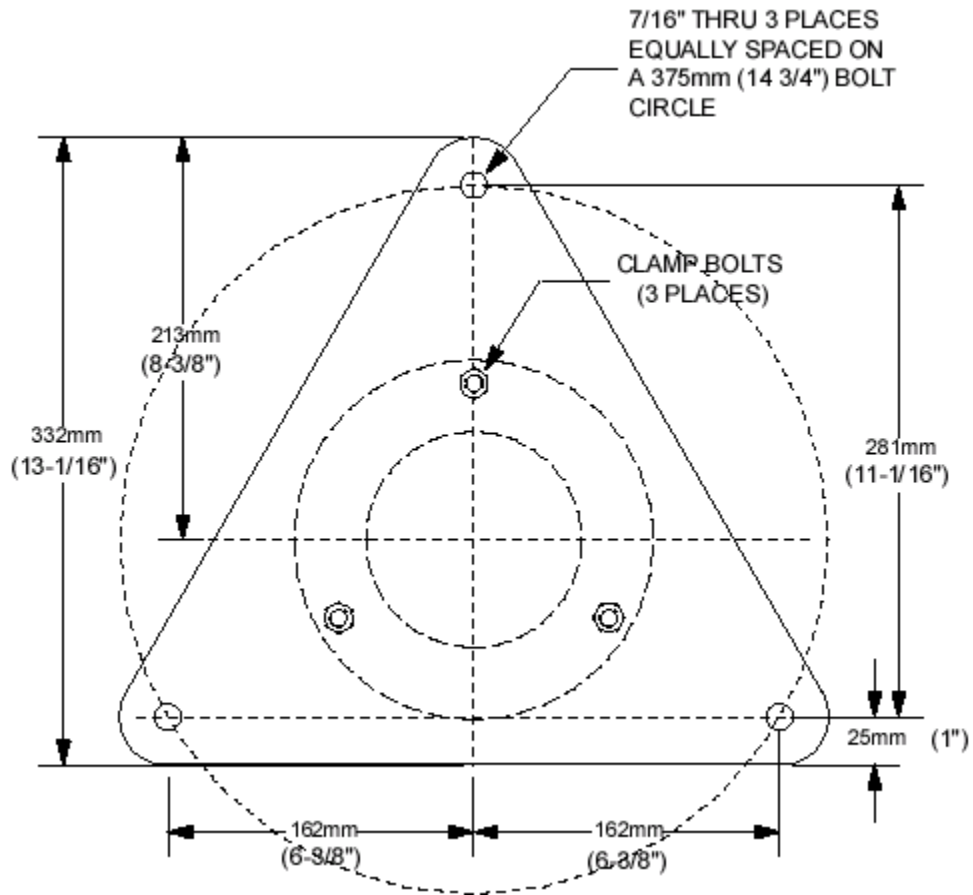


Figure 6-24. RL14 Range Lantern Mounting Pattern.

6.E.18.g. (cont'd)

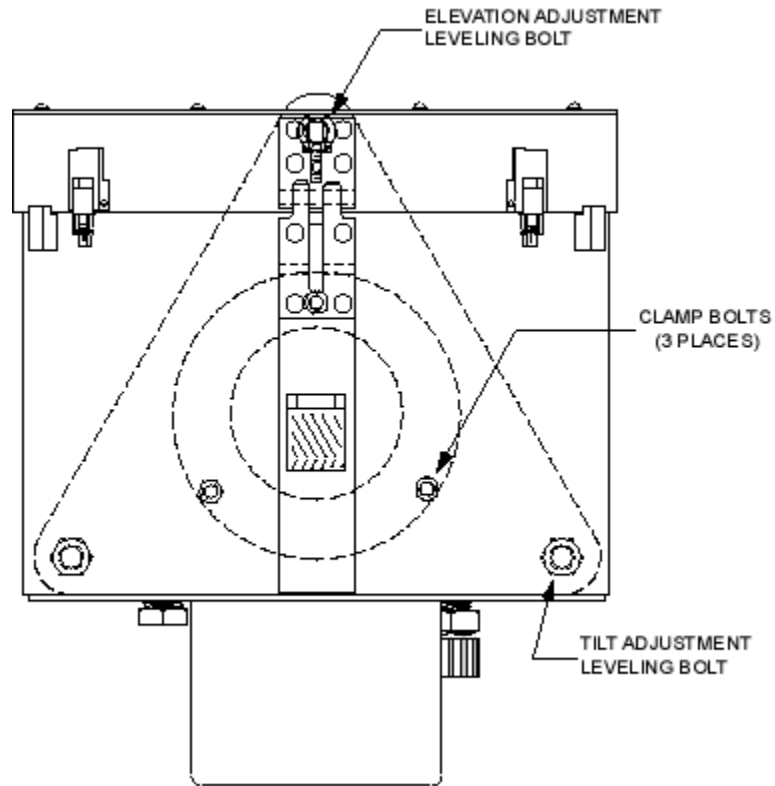


Figure 6-25. Leveling & Alignment Adjustments for RL14 Range Lantern

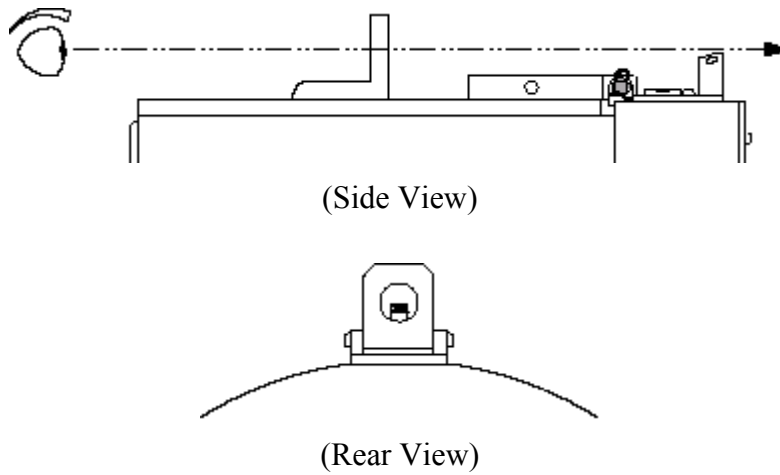
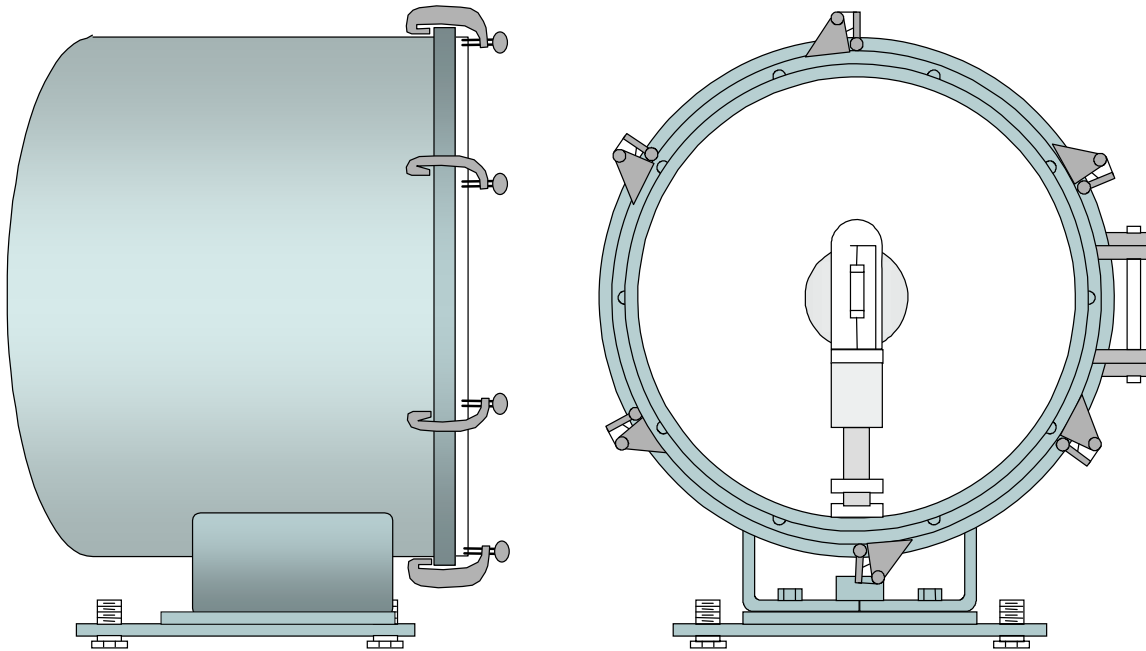


Figure 6-26. Sight Picture for Alignment of the RL14 Range Lantern

6.E.19.

19. RL24 Range Lantern.



- a. Function. The RL24 range lantern emits a high intensity pencil beam for use as a range light. It is outfitted with the 120-volt, 1000 watt tungsten-halogen lamp. The RL24 range lantern must be installed on a stable platform.
- b. Features.
 - (1) Aluminum base and housing.
 - (2) Lampchanger provided.
 - (3) Requires precision focusing and leveling.
 - (4) Replaceable clear, green, or red cover glasses.
- c. Related Equipment. The RL24 range lantern is outfitted with the CG-2P lampchanger and 120-volt, 1000 watt tungsten-halogen lamps. The lantern may be daylight controlled with a Type K daylight control (fixed-on only), or flashed using the AC Flash Controller with the appropriate CG-181/493/504 flasher installed (see Chapter 9). Daylight control of a flashed lantern is performed using a Type L daylight control with the AC Flash Controller.
- d. Wiring & Component Installation. The RL24 range lantern is completely wired internally prior to shipment from the manufacturer. A length of four-conductor cable extends out through a watertight stuffing tube. Wiring the RL24 range lantern merely requires connecting the hot line, neutral, lamp failure indicator (if used), and equipment ground to the end of the power cable.

6.E.19.d. (cont'd)

Note, the procedures listed below are for stand-alone range lanterns. Day/night ranges are controlled by a Range Switch Box-AC (see Chapter 9). The wiring schematic for a 120VAC day/night range system is illustrated in Ocean Engineering Drawing 130503.

- (1) Fixed-on: Stand-alone RL24 range lanterns burning fixed-on, 24 hours per day may be wired through a disconnect to 120VAC power. RL24 range lanterns that have a fixed-on rhythm may be daylight controlled using a Type K daylight control.
- (2) Flashed: RL24 range lanterns that display a flashing rhythm are controlled using an AC Flash Controller. The AC Flash Controller may be daylight controlled using a Type L daylight control.

e. Performance Characteristics. The performance characteristics of the RL24 range lantern are outlined in Table 6-15.

Beam Width: 1.8° (full width to half maximum intensity)

	<u>Effective Intensities (in candela; for 1000 W lamp)</u>		
	Iso 2 / Fl 2.5(1)	Occ 4 / Iso 6	F
Rhythm:			
Contact Closure Time (sec):	1.0	3.0	Fixed
<u>Lens Color</u>			
WHITE	1,700,000	2,300,000	2,500,000
GREEN	350,000	460,000	500,000
RED	380,000	510,000	550,000

Table 6-15. Performance Characteristics of the RL24 Range Lantern.

6.E.19.f.

- f. Dimensions. The basic dimensions of the RL24 range lantern are outlined in figure 6-27. The weight of the lantern (uncrated) is approximately 160 lbs (73kg).

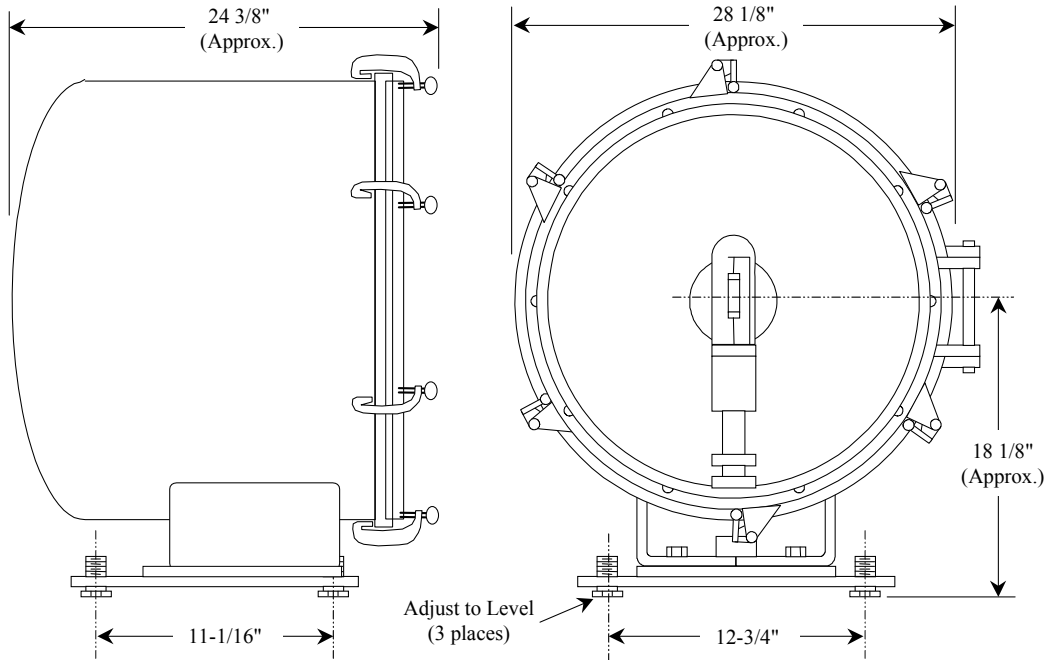


Figure 6-27. RL24 Range Lantern Dimensions.

- g. Additional Data. The RL24 range lantern is stocked at the SFLC Baltimore, in Project 98A. Requests for the RL24 range lantern should be addressed to Commandant (CG-432A). The manufacturer of the lanterns is The Carlisle and Finch Co., (513) 681-6080.

6.E.20.

20. Ice Buoy Lantern



- a. Function. The ice buoy lantern is installed on 7x20 LI ice buoys, to provide a seasonal light signal in waters prone to heavy icing.
- b. Features.
 - (1) LED technology
 - (2) Ice resistant housing eliminates the need for a Lexan ice dome
 - (3) Extremely durable and power efficient
 - (4) Uniform light output down to 10 VDC
 - (5) Daylight control built-in
- c. Related Equipment. The ice buoy lantern is manufactured by Sabik of Finland. The lanterns use a stainless steel adapter plate to mate it to the 7x20 LI buoy, and are powered by the 96 AH lithium ice buoy battery. A gasket is installed between the lantern’s adapter plate and the buoy. The gasket, called a “Gasket Ice Buoy,” is available from the SFLC with stock number 2050-01-132-2310. A spare parts kit shipped to each CGC provides components that are typically lost or consumed during use (o-rings, bird spikes, etc.)
- d. Power System. The power system uses the standard 96 AH lithium ice buoy battery pack. Two battery packs, wired in parallel, are required for Q and Mo(A) flash rhythms. The red, white, green and (yellow) LED lanterns have the following service intervals:

Rhythm	Days	White/Red/Green		Days	Yellow	
		# of Packs	(AH/Day)		# of Packs	(AH/Day)
FL6 (0.6)	256	1	0.374	192	1	0.499
FL4 (0.4)	256	1	0.374	192	1	0.499
FL2.5 (0.3)	214	1	0.449	160	1	0.599
FL 6 (2+1)	171	1	0.561	128	1	0.749
Q	171	2	1.122	128	2	1.497
Mo (A)	171	2	1.122			

Table 6-16. Service Intervals

6.E.20.e.

- e. Performance. The lanterns have a 6-degree total divergence to 50% of peak intensity. The effective intensity and range in nautical miles are tabulated below:

Rhythm	White	Red	Green	Yellow
Fixed	66 (5)	54 (5)	77 (5)	58 (5)
Q, FL(2+1)6, FL2.5(.3)	39 (4)	32 (4)	46 (4)	34 (4)
Mo(A), FL4(.4)	44 (4)	36 (4)	51 (4)	38 (4)
FL6(.6)	49 (4)	40 (4)	57 (5)	43 (4)

Table 6-17. Effective Intensity in candela (*range in nmi*)

- f. Internal Components. The lantern consists of three components; internally the LED circuit board assembly containing the LEDs and daylight control; and externally there is a Sabik LEDFlasher and spun stainless steel can to protect the electronics. The can has a Gore-Tex vent to equalize pressure, a data port for programming and watertight stuffing tube for the cable entrance.
- g. Dimensions. The lantern, excluding the adapter plate and bird spike, is 4” tall, 12” in diameter and weighs approximately 55 lbs.
- h. Wiring and Installation. Unpack the lantern from the shipping container and check for damage. There is a red, green, white or yellow insert on the top of the lantern that indicates the color of the LEDs. All lenses are clear, so it may be worth writing, with an indelible ink marker, the LED color inside the base of the lantern. This will save time later as the lanterns will be stored upside down (see figure 6-28).

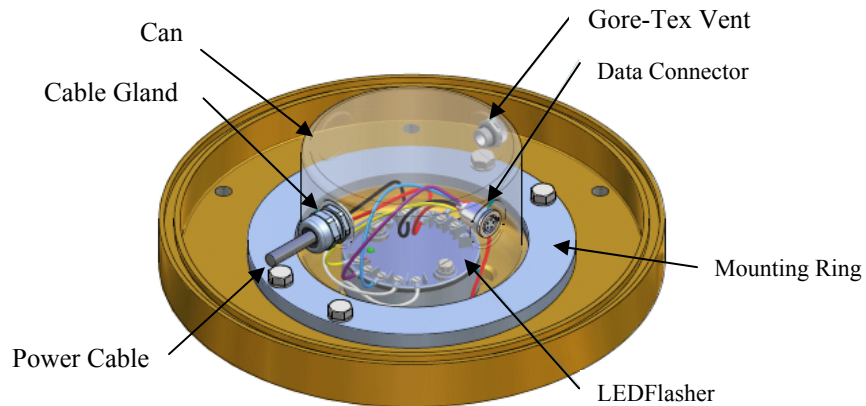


Figure 6-28. MPV-LED Lantern

The lanterns use an integrated LED flasher/driver with protective stainless steel cover over the assembly. The stainless steel cover is secured by a aluminum ring with four hex socket bolts using a 6mm Allen wrench.





6.E.20.h. (cont'd)



Figure 6-29. Sabik Programmer.

The flash rhythm and intensity are selected using the Sabik handheld programmer (Figure 6-29).

Apply 12 VDC to the black (+) and white (-) leads of the lantern and check for proper operation. Since the daylight control is located inside the lens, you will have to wrap a rag around the lens or operate in a darkened room for the light to turn on. NOTE: turn-on may be delayed up to 10 seconds as the flasher “boots up.”

- (1) Connect the programmer to the data port by removing the slotted cover on the side of the “can.” The plug is keyed and can only be inserted in one orientation (power the lantern up first).
- (2) The programmer will power-up and display the flash rhythm. NOTE: if an EPROM failure is displayed the flasher must be replaced. Press the  scroll key until the desired rhythm is displayed.
- (3) Next, press the  mode key until the correct intensity/color is displayed. There are two choices: Red/Green/White 60 cd and Yellow 60 cd. Choose the color that corresponds to the lantern being used (the yellow lantern requires a higher power setting to achieve the desired intensity).
- (4) You will note some other fields when pressing the  mode key. They should read as follows:
Fixed Light: NO
Lantern Mode: Normal
Error Code: No Errors
- (5) Press the  save button to save the settings. The programmer will display “Programming the Flasher,” then “Programming Ready, Press any Key.” Press any numbered key. The lantern should flash at the new programmed setting.
- (6) Unplug the programmer and check for proper operation.
- (7) The rhythm and intensity settings will remain programmed indefinitely.
- (8) If the LED flasher is installed in another lantern, depending on the color, it may have to be reprogrammed as it will retain the settings from the previous lantern.
- (9) To aid in identification next season, write the color and flash rhythm on the bottom of the “can” with an indelible ink marker (Sharpie).

6.E.20.h. (cont'd)

A custom stainless steel adapter plate (shipped separately) was fabricated to mate the lantern to a 7x20LI. The lantern contains an O-ring that seals it to the plate. Additional sealing can be obtained by running a bead of RTV around the base of the lantern, as shown in Figure 6-30. Route the power cable through the plate then angle the plate over the can. Note that the stuffing tube on the can is installed inside-out to obtain clearance (it seals in both directions). The bolts securing the lantern to the plate should be installed with Loctite 242 (blue) thread locker to prevent vibration from the ice flow that may loosen the fasteners. A $\frac{3}{4}$ " socket wrench may be used to tighten the bolts. Due to the difficulty in aligning the lantern to the plate, it is suggested that the lantern and plate be installed as one assembly.

The plate is sealed to the buoy with the gasket referenced in the "Related Equipment" paragraph on the first page of this Data Sheet.

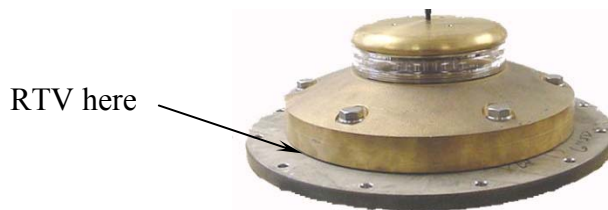


Figure 6-30. RTV Sealing of the Lantern.

Install the battery in the buoy as described in chapter 9. Install a gasket on the mounting studs of the ice buoy. Using a work stand or individual holding the lantern, connect the power leads from the lantern to the battery using wire nuts and electrical tape. Carefully install the lantern on the mounting studs of the buoy. Do not over tighten - if the studs snap they are difficult to replace.

Cover the lens with a jacket and after a delay of up to 10 seconds, the lantern should start flashing on-rhythm.

Install one or more bird spikes in the top of the lantern. These spikes are sacrificial and will break off if the buoy is pulled under the ice. Extra spikes are provided with the lantern and in the spare parts kit. To remove broken spikes, heat the tip of a small screwdriver and press into the plastic to create a slot. When cool, try to remove the broken spike. When cool, try to remove the broken spike. If that doesn't work, then the spike must be drilled out with a $\frac{13}{64}$ " bit and re-tapped with a 6mm – 1.0 hand tap. Bird spikes on new lanterns are stainless steel and attached with hex socket screws (use a 6mm Allen wrench).

- i. Servicing. Servicing is not necessary during a routine ice season. Based on past performance, the operating temperature and the drive current of the LEDs, this lantern can remain in service for at least 20 ice seasons if the lens and housing are still in good condition.

6.E.20.i. (cont'd)

If an unscheduled visit is made to the aid, ensure that the lens is clean. Wipe with a cloth dampened with mild soap and water, if necessary. Cover the lantern with an opaque cloth or jacket to ensure that the lantern flashes on rhythm. Check to be sure all LEDs are lit through the lens of the lantern. Dark sectors indicate that some LEDs have failed and intensity will be reduced in that direction (there is enough overlap between LEDs to provide coverage if a few LEDs fail). If the lantern fails, or if more than 3 adjacent LEDs fail, replace the lantern.

- j. Repair. The MPV-LED lanterns are repairable by replacing the LEDFlasher and a single circuit board located inside the lantern. Spare boards and LEDFlashers were provided to each cutter and instructions to repair the lanterns is available from Commandant (CG-432A).
- k. Troubleshooting.

No light -

- (1) Check battery voltage at the wire nuts. Minimum voltage is 10 volts for the LEDFlasher to operate. No reduction in LED intensity will occur at this voltage. Replace the battery, if necessary.
- (2) Cover the lens. If the light does not turn on remove the can using a 6mm Allen wrench, disconnect one wire from the lantern to the LEDFlasher labeled "LDR". If the light turns on, the daylight control inside the lantern is faulty. Replace the lantern. If the lantern does not turn on, replace the LEDFlasher (programmed to the proper rhythm/color; see below) and retest.
- (3) If a new LEDFlasher does not solve the problem, replace the entire lantern.

Improper rhythm - Reprogram the LEDFlasher or replace if necessary.

LEDs out (dark sectors) - Replace lantern if more than 3 adjacent LEDs have failed.

l. LED Flasher Replacement.

- (1) Remove the four hex socket screws retaining the can using a 6 mm Allen wrench.
- (2) Disconnect the wires from the lantern, data port and power cable. Note where the wires are attached.
- (3) Remove the two lock nuts using a 10mm socket securing the flasher to the lantern. Note the orientation of the flasher.
- (4) Install a new flasher with the same orientation and connect the wires to the appropriate terminals (see Figure 6-31)
- (5) Reinstall the cover and ring being careful to seat the gasket into the flange on the can.
- (6) Apply power to the lantern and program to the correct rhythm/color.

6.E.20.1. (cont'd)

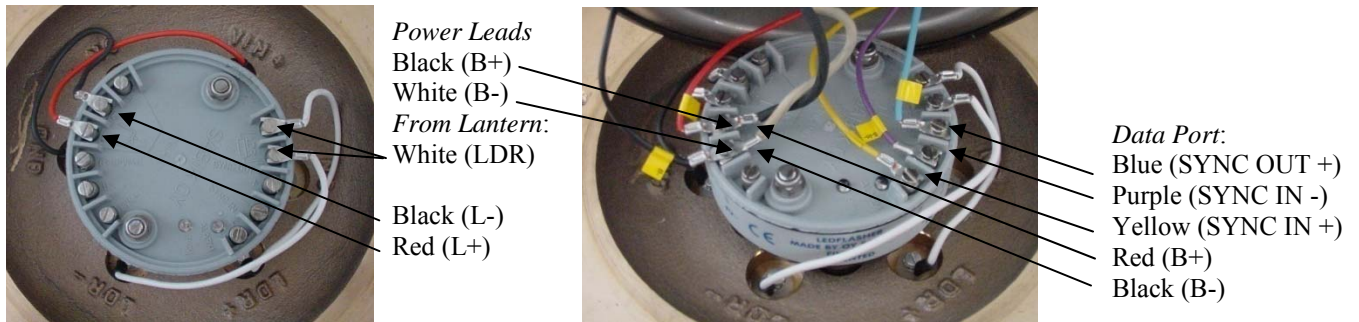


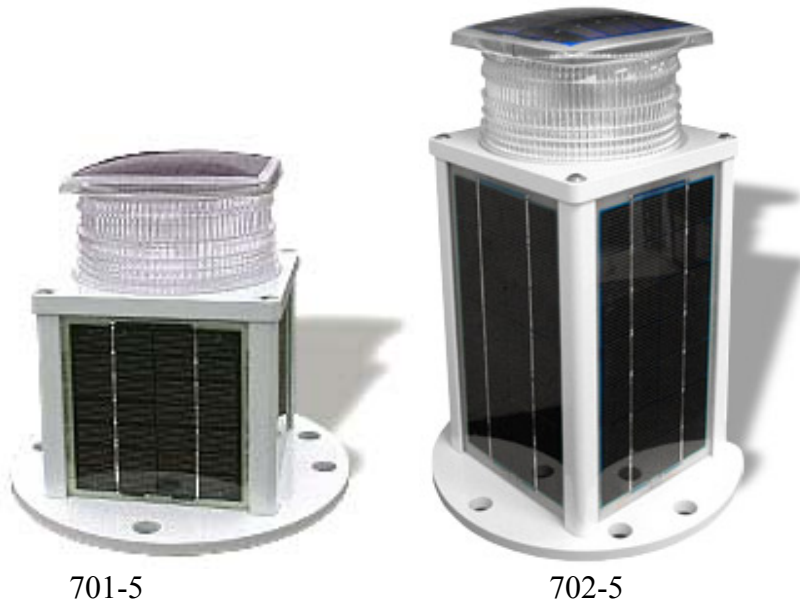
Figure 6-31. LEDFlasher Wiring.

- m. Spare lanterns and spare parts. Spare lanterns and spare parts kits were provided to units that deploy ice buoys during the initial outfitting. Additional spare parts are available from Commandant (CG-432A).

- n. Additional Note. The lanterns used for the 7x20LIR buoy 3-year deployment are physically the same as those used on the 7x20LI, except they operate at reduced intensity. Operational units that deployed the 7x20LIR buoys have programmers that are capable of setting multiple intensities. All other units have programmers capable of setting only one intensity (60 candelas). The correct intensity for 7x20LI buoys is 60 candelas and for 7x20LIR buoys, 40 or 33 candelas, depending on location.

6.E.21.

21. Carmanah 701-5, 702-5 Self Contained LED Lanterns



- a. Function. The Carmanah 700-series lanterns are self-powered, omni-directional LED lanterns. They are specifically adapted for use on a modified 5th class foam buoy; this buoy/lantern combination functions as a replacement for the old lighted discrepancy buoy, which has been discontinued. Use on other platforms and ATON stations is permitted at the discretion of district aids to navigation offices.
- b. Features.
 - (1) Bolts to existing lantern stands sized for 155mm lanterns.
 - (2) Self-contained optic, flasher, battery, solar panels and daylight control.
 - (3) Replaceable components.
 - (4) Authorized as a hot pack (with appropriate notice to mariners, if necessary.)
 - (5) 3 year prorated warranty.
- c. Related Equipment. Carmanah external battery charger, TV remote or Carmanah programmer.
- d. Models. The Carmanah 700-series lanterns are available in two models: the 701-5 and 702-5. Both models produce the same light intensities; the difference is the size of the solar panels and internal battery. The 701-5 has the least capable power system; the 702-5 has the most capable power system. Carmanah did manufacture 701 and 702 version lanterns, but were discontinued in Oct 2008. The replacement for the 701 is the 701-5 and for the 702 is the 701-5 or 702-5 (see Carmanah Sizing Table, Table 6-19).
- e. Light Characteristics. Every lantern has an inherent color. Flash rhythms are programmable.

6.E.21.f.

- f. Performance Characteristics. The performance characteristics of the 701/702 Series LED lanterns are provided in Table 6-18. The old published values (lower intensity) are printed to the right of the new values. Red lanterns purchased after July 2007 produce the higher values. White and Green lanterns purchased after January 2007 produce the higher values. To aid identification, all lanterns purchased after January 2008 will have a “**MOD2**” sticker affixed to its base and produce the higher listed intensities.

Characteristic:	<u>FL 2.5 (0.3)</u>	<u>FL 4</u>	<u>FL 6</u>	<u>FL (2) 5</u>	<u>FL (2+1) 6</u>	<u>Mo(A)</u>	<u>Q</u>
Effective Intensity (red):	20/15	22/17	25/19	22/17	20/15	-	17/13
Effective Intensity (green):	28/15	31/17	35/19	31/17	28/15	-	23/13
Effective Intensity (white):	21/15	21/17	26/19	23/17	21/15	19/14	18/13
Effective Intensity (yellow):	11	11	14	12	11	10	9

Table 6-18. Performance Characteristics – Carmanah 701, 701-5, 702, 702-5
LED Lanterns Effective Intensity in Candela (New/Old)

Vertical Divergence (to 50% of maximum intensity):

Green lanterns: ±3.5° Red lanterns: ±2.8°

Nominal Range: 10 to 23 candela →3 nautical miles; 24 to 53 candela →4 nautical miles.

- h. Selection Criteria - Intensity. At the discretion of the district aids to navigation office, Carmanah lanterns can be used to replace 155mm lanterns on select aids to navigation. Replacing a 155mm with a Carmanah may result in a decrease in intensity, and therefore a reduction in service to the mariner. It is important that Districts carefully evaluate the reduction in intensity prior to authorizing a change. This is particularly important for white and yellow lights because of the very large intensity differences between Carmanah and 155mm lanterns for these colors. To determine the intensity requirements for any aid, Districts use the standard procedures for selecting an ATON light signal as prescribed at the beginning of this Chapter (page 6-1) and in the Visual Signal Design Manual, COMDTINST M16510.2 (series) (Chapter 3). These references describe how operational range, luminous range, light color, light characteristic, background lighting, and meteorological visibility are used to calculate intensity needs.
- i. Selection Criteria – Solar Sizing. **If**, and only if the District has determined that a Carmanah will provide an intensity that meets the operational needs for a specific aid, **then** the next step is to choose a Carmanah model that has a power system matched to the aid location and flash characteristic. Use Table 6-19 to select a Carmanah model. Note that the green lanterns are sized differently than the red, white or amber (yellow). Note also that some location/flash- characteristic combinations have an “N/A” (particularly in Districts 13 and 17). “N/A” means that no Carmanah model can be used because the power system cannot power the aid with the available solar radiation. For seasonal aids, consult our website (<http://www.uscg.mil/hq/cg4/cg432/>) for the Carmanah sizing program.

6.E.21.i. (cont'd)

Color:	Green	Red White Yellow	Green	Red White Yellow	Green	Red White	Green	Red White Yellow
Characteristic:	FL 4 FL 6	FL 4 FL 6	FL 2.5 (0.3s)	FL 2.5 (0.3s)	FL(2+1)6	FL(2+1)6 FL (2) 5	Q	Q Mo (A)
Portland, ME	701	701	701	701-5	701	702	702	702-5
Boston, MA	701	701	701	701-5	701	702	702	702-5
Providence, RI	701	701	701	701-5	701	702	701-5	702-5
Bridgeport, CT	701	701	701	701-5	701	702	702	702-5
New York, NY	701	701	701	701-5	701	702	702	702-5
Albany, NY	701	701	701	701-5	701	702	702	N/A
Burlington, VT	701	701	701	702	701	702	702	N/A
Newark, NJ	701	701	701	701-5	701	702	701-5	702-5
Atlantic City, NJ	701	701	701	701	701	701-5	701-5	702
Wilmington, DE	701	701	701	701	701	701-5	701-5	702
Philadelphia, PA	701	701	701	701	701	701-5	701-5	702
Baltimore, MD	701	701	701	701	701	701-5	701-5	702
Sterling, VA	701	701	701	701	701	701-5	701-5	702
Norfolk, VA	701	701	701	701	701	701-5	701-5	702
Cape Hatteras, NC	701	701	701	701	701	701	701	702
Wilmington, NC	701	701	701	701	701	701	701	702
Charleston, SC	701	701	701	701	701	701	701	702
Savannah, GA	701	701	701	701	701	701	701	702
Jacksonville, FL	701	701	701	701	701	701	701	702
Daytona Beach, FL	701	701	701	701	701	701	701	701-5
West Palm Beach, FL	701	701	701	701	701	701	701	701-5
Miami, FL	701	701	701	701	701	701	701	701-5
San Juan, PR	701	701	701	701	701	701	701	701-5
Key West, FL	701	701	701	701	701	701	701	701-5
Tampa, FL	701	701	701	701	701	701	701	701-5
Tallahassee, FL	701	701	701	701	701	701	701	702
Mobile, AL	701	701	701	701	701	701	701	702
New Orleans, LA	701	701	701	701	701	701	701	702
Port Arthur, TX	701	701	701	701	701	701	701	702
Houston, TX	701	701	701	701	701	701	701	702
Corpus Christi, TX	701	701	701	701	701	701	701	702
Brownsville, TX	701	701	701	701	701	701	701	702
Little Rock, AR	701	701	701	701	701	701-5	701	702
Fort Smith, AR	701	701	701	701	701	701	701	702

- Notes: 1. Numbers in table refer to Carmanah Model number.
2. "N/A" means that no Carmanah can provide the desired characteristic.
3. If a 701 lantern is specified, a 701-5, 702 or 702-5 may be used. If a 701-5 lantern is specified, a 702 or 702-5 may be used. If a 702 lantern is specified, a 702-5 may be used.
4. For flash rhythms not listed, contact Ocean Engineering (CG-432A).

Table 6-19. Carmanah Solar Sizing Table

6.E.21.i. (cont'd)

Color:	Green	Red White Yellow	Green	Red White Yellow	Green	Red White	Green	Red White Yellow
Characteristic:	FL 4 FL 6	FL 4 FL 6	FL 2.5 (0.3s)	FL 2.5 (0.3s)	FL(2+1)6	FL(2+1)6 FL (2) 5	Q	Q Mo (A)
Oklahoma City, OK	701	701	701	701	701	701	701	702
Memphis, TN	701	701	701	701	701	701-5	701-5	702
Huntsville, AL	701	701	701	701	701	701-5	701-5	702
Chattanooga, TN	701	701	701	701	701	701-5	701-5	702
St Louis, MO	701	701	701	701	701	701-5	701-5	702
Kansas City, MO	701	701	701	701	701	701-5	701-5	702
Moline, IL	701	701	701	701-5	701	702	702	702-5
Minneapolis, MN	701	701	701	701-5	701	702	702	N/A
Evansville, IN	701	701	701	701	701	701-5	701-5	702
Indianapolis, IN	701	701	701	701-5	701	702	702	702-5
Louisville, KY	701	701	701	701-5	701	702	701-5	702-5
Cincinnati, OH	701	701	701	701-5	701	702	702	702-5
Pittsburgh, PA	701	701-5	701	702	701	702	702	N/A
Massena, NY	701	701-5	701	702	701	702	702	N/A
Rochester, NY	701	701-5	701	702	701-5	702	702	N/A
Buffalo, NY	701	701-5	701	702	701-5	702	702	N/A
Erie, PA	701	701-5	701	702	701-5	702	702	N/A
Cleveland, OH	701	701-5	701	702	701-5	702	702	N/A
Toledo, OH	701	701-5	701	701-5	701	702	702	N/A
Detroit, MI	701	701-5	701	702	701-5	702	702	N/A
Alpena, MI	701	701-5	701	702	701-5	702	702	N/A
Traverse City, MI	701	701-5	701	702	701-5	702	702	N/A
Muskegon, MI	701	701-5	701	702	701-5	702	702	N/A
Chicago, IL	701	701-5	701	701-5	701	702	702	N/A
Milwaukee, WI	701	701-5	701	701-5	701	702	702	N/A
Green Bay, WI	701	701	701	701-5	701	702	702	N/A
Sault Ste Marie, MI	701	701-5	701	702	701-5	702	702	N/A
Houghton, MI	701	702	702	702	702	702-5	702-5	N/A
Duluth, MN	701	701-5	701	701-5	701	702	702	N/A
Internat'l Falls, MN	701	701-5	701	702	701-5	702	702	N/A
Salt Lake City, UT	701	701	701	701-5	701	702	702	702-5
Reno, NV	701	701	701	701	701	701-5	701	702
Las Vegas, NV	701	701	701	701	701	701	701	701-5
San Diego, CA	701	701	701	701	701	701	701	701-5

- Notes:
1. Numbers in table refer to Carmanah Model number.
 2. "N/A" means that no Carmanah can provide the desired characteristic.
 3. If a 701 lantern is specified, a 701-5, 702 or 702-5 may be used. If a 701-5 lantern is specified, a 702 or 702-5 may be used. If a 702 lantern is specified, a 702-5 may be used.
 4. For flash rhythms not listed, contact Ocean Engineering (CG-432A).

Table 6-19. Carmanah Solar Sizing Table (continued)

6.E.21.i. (cont'd)

Color:	Green	Red White Yellow	Green	Red White Yellow	Green	Red White	Green	Red White Yellow
Characteristic:	FL 4 FL 6	FL 4 FL 6	FL 2.5 (0.3s)	FL 2.5 (0.3s)	FL(2+1)6	FL(2+1)6 FL (2) 5	Q	Q Mo (A)
Long Beach, CA	701	701	701	701	701	701	701	702
Los Angeles, CA	701	701	701	701	701	701	701	702
Santa Maria, CA	701	701	701	701	701	701	701	701-5
San Francisco, CA	701	701	701	701	701	701-5	701-5	702
Arcata, CA	701	701	701	701-5	701	702	702	702-5
North Bend, OR	701	701-5	701	702	701	702	702	N/A
Astoria, OR	701	702	701-5	702	702	N/A	702-5	N/A
Portland, OR	701	702	701-5	702	702	N/A	N/A	N/A
Pendleton, OR	701	701-5	701	702	701-5	702	702	N/A
Quillayute, WA	701	702	701-5	702	702	N/A	N/A	N/A
Seattle, WA	701	702	701-5	702	702	N/A	N/A	N/A
Annette, AK	702	N/A	702	N/A	N/A	N/A	N/A	N/A
Yakutat, AK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Anchorage, AK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kodiak, AK	702	N/A	702	N/A	N/A	N/A	N/A	N/A
Cold Bay, AK	702	N/A	702	N/A	N/A	N/A	N/A	N/A
King Salmon, AK	702	N/A	702-5	N/A	N/A	N/A	N/A	N/A
Bethel, AK	702-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nome, AK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hilo, HI	701	701	701	701	701	701	701	701-5
Kahului, HI	701	701	701	701	701	701	701	701-5
Honolulu, HI	701	701	701	701	701	701	701	701-5
Lihue, HI	701	701	701	701	701	701	701	701-5
Guam	701	701	701	701	701	701	701	701-5

- Notes: 1. Numbers in table refer to Carmanah Model number.
 2. "N/A" means that no Carmanah can provide the desired characteristic.
 3. If a 701 lantern is specified, a 701-5, 702 or 702-5 may be used. If a 701-5 lantern is specified, a 702 or 702-5 may be used. If a 702 lantern is specified, a 702-5 may be used.
 4. For flash rhythms not listed, contact Ocean Engineering (CG-432A)

Table 6-19. Carmanah Solar Sizing Table (continued)

- j. Lantern Service Life. Lanterns may be kept in service as long as they provide an acceptable signal to the mariner. Signs of crazing of the lens, deterioration of the housing or evidence of failed LEDs are grounds for removal.
- k. Battery Service Life. The expected battery life is highly dependent on temperature. The higher the temperature the shorter the expected battery life. Battery recharge intervals range from 4 years in hot climates to 10 years in cold climates. Field units should recharge (replace) batteries at intervals as shown in the LED instructions available at <http://www.uscg.mil/hq/cg4/cg432/>.

6.E.21.1.

1. Dimensions and Weights. The overall dimensions of the 701, 702 and 702-5 lanterns are illustrated in figure 6-32. The weight is approximately 12 lbs for the 701 and 701-5 lanterns and 17 lbs for the 702 and 702-5.

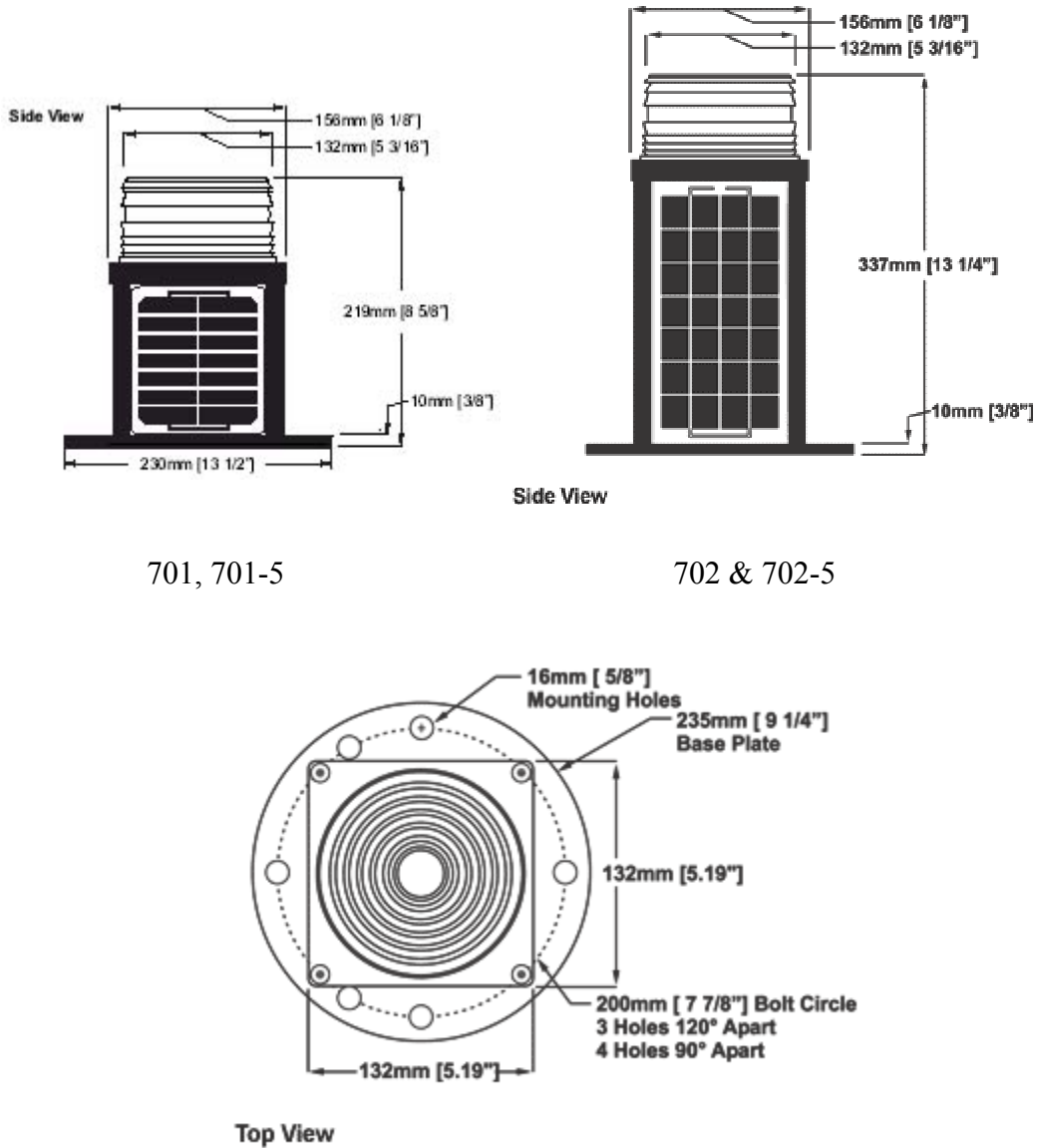


Figure 6-32. 701, 701-5, 702 and 702-5 Carmanah Lanterns

6.E.21.m.

- m. Hot Pack Use. The Carmanah 701, 701-5, 702 and 702-5 may be used to temporarily light an aid that is discrepant. If the advertised nominal range is lower, it shall be published in a Notice to Mariners. If the Carmanah lantern chosen for use as a hot pack is not an authorized combination, as indicated in Table 6-19, installation shall be limited to the following number of days:

Rhythm	701, 701-5		702, 702-5	
	RWY*	G*	RWY	G
FL2.5(.3)	15	26	25	62
FL4(.4), FL6(.6)	18	31	30	49
Q, Mo(A)	6	12	10	20

*RWY refers to Red, White, Yellow; G refers to Green

Table 6-20. Carmanah Hot Pack Installation Limits, in Days

Lanterns shall be fully charged (90% or greater state of charge) prior to deployment and shall be recharged immediately after retrieval. Table 6-20 assumes no solar panel input. Use the Carmanah sizing program available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Pubs/Software” in the seasonal mode to determine how long the lantern will safely operate. Contact Commandant (CG-432A) for assistance.

- n. Charging, Programming, Installation and Maintenance. Information on charging, programming, installing and maintaining the Carmanah lanterns can be found in the Carmanah 701-5 and 702-5 instructions which is available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Products and Services.”
- o. Procurement. Carmanah 700-series LED Lanterns are manufactured by Carmanah Technologies Inc., Building 4, 203 Harbor Road, Victoria, British Columbia, Canada V9A 3S2, Website: <http://www.carmanah.com>. The buyer determines the model number (701-5 or 702-5) using the Carmanah Solar Sizing Table in this Data Sheet or the Carmanah Sizing Program mentioned above. Coast Guard units should buy Carmanah products using a General Services Administration (GSA) contract via their regional sales representative. Details of the contract, including prices and ordering information are specified in the Carmanah 701-5/702-5 LED instructions which is available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Products and Services.” The buyer specifies the color (red, green, white or yellow), depending on the intended location. An optional bird spike may be purchased for 701-5 and 702-5 lanterns (specify when ordering). The clamp-on bird spike can be retrofitted on existing lanterns.

6.E.22.

22. Carmanah 704-5 Self Contained LED Lantern



- a. Function. The Carmanah 704-5 lantern is a self-powered, omni-directional LED lantern. It is suitable for use on any platform, fixed or floating, at the discretion of district aids to navigation offices. This lantern provides greater intensity than the 701/702 series lanterns in the high intensity setting.
- b. Features.
 - (1) Bolts to existing lantern stands sized for 155mm lanterns.
 - (2) Self-contained optic, flasher, battery, solar panels and daylight control.
 - (3) Adjustable Intensity (high/low)
 - (4) Replaceable components.
 - (5) Authorized as a hot pack.
 - (6) 3 year prorated warranty.
- c. Related Equipment. TV remote or Carmanah programmer.
- d. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). Flash rhythms and intensity are programmable.
- e. Performance Characteristics. The performance characteristics of the 704-5 LED lantern is provided in Table 6-21.

6.E.22.e. (cont'd)

RED

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
704-5 (Low)	18	704-5 (Low)	20	704-5 (Low)	23
704-5 (High)	42	704-5 (High)	47	704-5 (High)	53

GREEN

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
704-5 (Low)	21	704-5 (Low)	23	704-5 (Low)	26
704-5 (High)	54	704-5 (High)	60	704-5 (High)	68

WHITE

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
704-5 (Low)	17	704-5 (Low)	19	704-5 (Low)	21
704-5 (High)	41	704-5 (High)	45	704-5 (High)	51

YELLOW

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
704-5 (Low)	20	704-5 (Low)	22	704-5 (Low)	25
704-5 (High)	42	704-5 (High)	47	704-5 (High)	53

Note: (Low) means low intensity setting. (High) means high intensity setting.

Table 6-21. Effective Intensity Tables for Carmanah 704-5 in Candela

Vertical Divergence (to 50% of maximum intensity): $\pm 5^\circ$

Nominal Range: 10 to 23 candela → 3 nautical miles;
 24 to 53 candela → 4 nautical miles;
 54 to 107 candela → 5 nautical miles.

- f. Selection Criteria - Intensity. The Carmanah 704-5 is an authorized replacement for a 155mm lantern on either a buoy or a fixed aid if it provides an acceptable effective intensity and if its solar system is sufficiently capable. At the high intensity setting, the effective intensity of a red or green Carmanah 704-5 falls between the intensity of a 155mm with 1.15 amp lamps and a 155mm with 2.03 amp lamps (see Intensity Tables for specifics). At the low intensity setting, the effective intensity of a red or green Carmanah 704-5 is approximately that of a 155mm with 0.55 amp lamps. The effective intensity of a white or yellow Carmanah is less than that of a 155mm lantern (all lamps). A white or yellow 704-5 shall not be used to replace a 155mm lantern unless District has determined that a drop in intensity is acceptable.

6.E.22.f. (cont'd)

To determine the intensity requirements for any aid, Districts shall use the standard procedures for selecting an ATON light signal as prescribed in Chapter 6, Section 6.B, page 6-1 of this Manual and the Visual Signal Design Manual COMDTINST M16510.2 (series) (Chapter 3). These references describe how operational range, luminous range, light color, light characteristic, background lighting, and meteorological visibility are used to calculate intensity needs. A less desirable, but quicker method is to replace a 155mm with a Carmanah 704-5 if the 704-5 provides an effective intensity that is equal to, or greater than the effective intensity of the 155mm that it will replace.

- g. Selection Criteria – Solar Sizing. If the District has determined that a Carmanah 704-5 will provide an intensity that meets the operational needs for a specific aid, then the next step is to see if the 704-5’s solar system is capable of maintaining an acceptable battery state-of-charge (for the desired location, flash characteristic, and intensity setting). Because the 704-5 comes with one-sized solar system, use Table 6-22 to make a “GO” vs “NO GO” determination for year-round aids with standard flash characteristics. If a desired characteristic is not listed, or for sizing seasonal aids use the Carmanah sizing program available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Pubs/Software.”

Characteristic:	High Intensity Setting				Low Intensity Setting			
	FL 4 FL 6	FL 2.5 (0.3s)	FL(2+1)6 FL (2) 5	Q Mo (A)	FL 4 FL 6	FL 2.5 (0.3s)	FL(2+1)6 FL (2) 5	Q Mo (A)
Portland, ME	✓	✓	-	-	✓	✓	✓	✓
Boston, MA	✓	✓	-	-	✓	✓	✓	✓
Providence, RI	✓	✓	-	-	✓	✓	✓	✓
Bridgeport, CT	✓	✓	-	-	✓	✓	✓	✓
New York, NY	✓	✓	-	-	✓	✓	✓	✓
Albany, NY	✓	-	-	-	✓	✓	✓	-
Burlington, VT	✓*	-	-	-	✓	✓	✓	-
Newark, NJ	✓	✓	-	-	✓	✓	✓	✓
Atlantic City, NJ	✓	✓	✓*	-	✓	✓	✓	✓
Wilmington, DE	✓	✓	-	-	✓	✓	✓	✓
Philadelphia, PA	✓	✓	-	-	✓	✓	✓	✓
Baltimore, MD	✓	✓	✓*	-	✓	✓	✓	✓
Sterling, VA	✓	✓	✓*	-	✓	✓	✓	✓

- Notes: 1. ✓ means that the Carmanah 704-5 will work at that location for the specified flash characteristic.
 2. ✓* means that the 704-5 should only be used at that location if there is **no guano** (i.e., there is an expectation that the top solar panel will produce power)
 3. " - " means that the 704-5 should not be used.

Table 6-22. Carmanah 704-5 Solar Sizing Table

6.E.22.g. (cont'd)

Characteristic:	High Intensity Setting				Low Intensity Setting			
	FL 4 FL 6	FL 2.5 (0.3s)	FL(2+1)6 FL (2) 5	Q Mo (A)	FL 4 FL 6	FL 2.5 (0.3s)	FL(2+1)6 FL (2) 5	Q Mo (A)
Norfolk, VA	✓	✓	✓	-	✓	✓	✓	✓
Cape Hatteras, NC	✓	✓	✓	-	✓	✓	✓	✓
Wilmington, NC	✓	✓	✓	-	✓	✓	✓	✓
Charleston, SC	✓	✓	✓	-	✓	✓	✓	✓
Savannah, GA	✓	✓	✓	-	✓	✓	✓	✓
Jacksonville, FL	✓	✓	✓	-	✓	✓	✓	✓
Daytona Beach, FL	✓	✓	✓	-	✓	✓	✓	✓
West Palm Beach, FL	✓	✓	✓	-	✓	✓	✓	✓
Miami, FL	✓	✓	✓	-	✓	✓	✓	✓
San Juan, PR	✓	✓	✓	-	✓	✓	✓	✓
Key West, FL	✓	✓	✓	-	✓	✓	✓	✓
Tampa, FL	✓	✓	✓	-	✓	✓	✓	✓
Tallahassee, FL	✓	✓	✓	-	✓	✓	✓	✓
Mobile, AL	✓	✓	✓	-	✓	✓	✓	✓
New Orleans, LA	✓	✓	✓	-	✓	✓	✓	✓
Port Arthur, TX	✓	✓	✓	-	✓	✓	✓	✓
Houston, TX	✓	✓	✓	-	✓	✓	✓	✓
Corpus Christi, TX	✓	✓	✓	-	✓	✓	✓	✓
Brownsville, TX	✓	✓	✓	-	✓	✓	✓	✓
Little Rock, AR	✓	✓	✓	-	✓	✓	✓	✓
Fort Smith, AR	✓	✓	✓	-	✓	✓	✓	✓
Oklahoma City, OK	✓	✓	✓	-	✓	✓	✓	✓
Memphis, TN	✓	✓	✓*	-	✓	✓	✓	✓
Huntsville, AL	✓	✓	✓*	-	✓	✓	✓	✓
Chattanooga, TN	✓	✓	✓*	-	✓	✓	✓	✓
St Louis, MO	✓	✓	-	-	✓	✓	✓	✓
Kansas City, MO	✓	✓	✓*	-	✓	✓	✓	✓
Moline, IL	✓	✓*	-	-	✓	✓	✓	✓*
Minneapolis, MN	✓	✓*	-	-	✓	✓	✓	✓*
Evansville, IN	✓	✓	-	-	✓	✓	✓	✓
Indianapolis, IN	✓	✓*	-	-	✓	✓	✓	✓*
Louisville, KY	✓	✓	-	-	✓	✓	✓	✓
Cincinnati, OH	✓	✓*	-	-	✓	✓	✓	✓*

- Notes: 1. ✓ means that the Carmanah 704-5 will work at that location for the specified flash characteristic.
2. ✓* means that the 704-5 should only be used at that location if there is **no guano** (i.e., there is an expectation that the top solar panel will produce power).
3. " - " means that the 704-5 should not be used.

Table 6-22. Carmanah 704-5 Solar Sizing Table (cont'd)

6.E.22.g. (cont'd)

Characteristic:	High Intensity Setting				Low Intensity Setting			
	FL 4 FL 6	FL 2.5 (0.3s)	FL(2+1)6 FL (2) 5	Q Mo (A)	FL 4 FL 6	FL 2.5 (0.3s)	FL(2+1)6 FL (2) 5	Q Mo (A)
Pittsburgh, PA	✓	-	-	-	✓	✓	✓	-
Massena, NY	✓*	-	-	-	✓	✓	✓	-
Rochester, NY	✓*	-	-	-	✓	✓	✓	-
Buffalo, NY	✓*	-	-	-	✓	✓	✓	-
Erie, PA	✓*	-	-	-	✓	✓	✓	-
Cleveland, OH	✓*	-	-	-	✓	✓	✓	-
Toledo, OH	✓	-	-	-	✓	✓	✓	-
Detroit, MI	✓*	-	-	-	✓	✓	✓	-
Alpena, MI	✓*	-	-	-	✓	✓	✓	-
Traverse City, MI	-	-	-	-	✓	✓	✓	-
Muskegon, MI	-	-	-	-	✓	✓	✓	-
Long Beach, CA	✓	✓	✓	-	✓	✓	✓	✓
Los Angeles, CA	✓	✓	✓	-	✓	✓	✓	✓
Santa Maria, CA	✓	✓	✓	-	✓	✓	✓	✓
San Francisco, CA	✓	✓	✓*	-	✓	✓	✓	✓
Arcata, CA	✓	✓*	-	-	✓	✓	✓	✓*
North Bend, OR	✓	-	-	-	✓	✓	✓	-
Astoria, OR	-	-	-	-	✓	✓	✓	-
Portland, OR	-	-	-	-	✓	✓	✓	-
Pendleton, OR	✓*	-	-	-	✓	✓	✓	-
Quillayute, WA	-	-	-	-	✓	✓	✓*	-
Seattle, WA	-	-	-	-	✓	✓	✓*	-
Annette, AK	-	-	-	-	✓	-	-	-
Yakutat, AK	-	-	-	-	-	-	-	-
Anchorage, AK	-	-	-	-	-	-	-	-
Kodiak, AK	-	-	-	-	✓*	-	-	-
Cold Bay, AK	-	-	-	-	✓	-	-	-
King Salmon, AK	-	-	-	-	✓*	-	-	-
Bethel, AK	-	-	-	-	-	-	-	-
Nome, AK	-	-	-	-	-	-	-	-
Hilo, HI	✓	✓	✓	-	✓	✓	✓	✓
Kahului, HI	✓	✓	✓	-	✓	✓	✓	✓
Honolulu, HI	✓	✓	✓	-	✓	✓	✓	✓
Lihue, HI	✓	✓	✓	-	✓	✓	✓	✓
Guam	✓	✓	✓	-	✓	✓	✓	✓

Notes: 1. ✓ means that the Carmanah 704-5 will work at that location for the specified flash characteristic.

2. ✓* means that the 704-5 should only be used at that location if there is **no guano** (i.e., there is an expectation that the top solar panel will produce power).

3. " - " means that the 704-5 should not be used.

Table 6-22. Carmanah 704-5 Solar Sizing Table (cont'd)

6.E.22.h.

- h. Lantern Service Life. Lanterns may be kept in service as long as they provide an acceptable signal to the mariner. Signs of crazing of the lens, deterioration of the housing or evidence of failed LEDs are grounds for removal.
- i. Battery Service Life. The expected battery life is highly dependent on temperature. The higher the temperature the shorter the expected battery life. Battery recharge intervals range from 4 years in hot climates to 10 years in cold climates. Field units should recharge (replace) batteries at intervals as shown in Carmanah 704 LED instructions which is available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Products and Services.”
- j. Dimensions and Weight. The overall dimensions of the 704-5 lantern is illustrated in figure 6-33. The weight is 26 lbs.

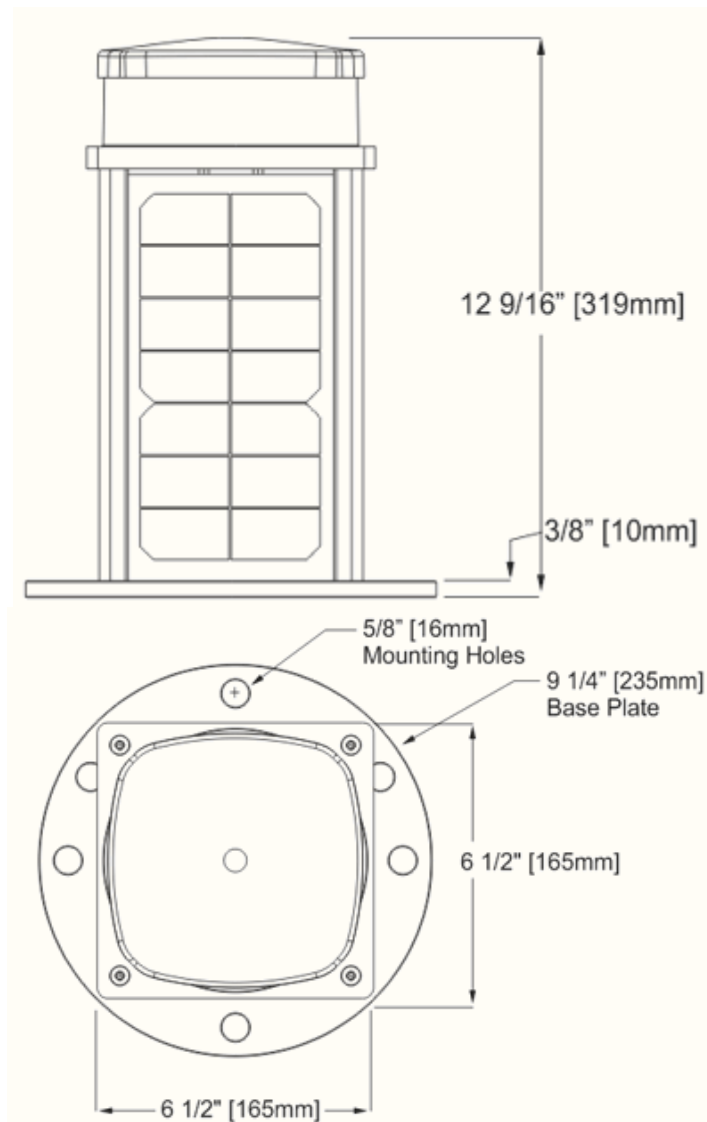


Figure 6-33. Carmanah 704-5 Dimensions

6.E.22.k.

- k. Hot Pack Use. The Carmanah 704-5 may be used to temporarily light an aid that is discrepant. If the advertised nominal range is lower, it shall be published in a Notice to Mariners. If the Carmanah lantern chosen for use as a hot pack is not an authorized combination, as indicated in Table 6-22, installation shall be limited to the following number of days based on the intensity setting:

<u>Rhythm</u>	<u>704-5 Low</u>	<u>704-5 High</u>
FL2.5(.3)	62	26
FL4(.4), FL6(.6)	74	31
Q, Mo(A)	25	10

Table 6-23. Carmanah Hot Pack Installation Limits, in Days

Lanterns shall be fully charged (90% or greater state of charge) prior to deployment and shall be recharged immediately after retrieval. Table 6-23 assumes no solar panel input. Use the Carmanah sizing program available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Pubs/Software” in the seasonal mode to determine how long the lantern will safely operate. Contact Commandant (CG-432A) for assistance.

- l. Charging, Programming, Installation and Maintenance. Information on charging, programming, installing and maintaining the Carmanah lanterns can be found in the Carmanah 704-5 instructions which is available on the Ocean Engineering website: (<http://www.uscg.mil/hq/cg4/cg432/>) under Products and Services.
- m. Procurement. Carmanah 700-series LED Lanterns are manufactured by Carmanah Technologies Inc., Building 4, 203 Harbor Road, Victoria, British Columbia, Canada V9A 3S2, Website: <http://www.carmanah.com>. Coast Guard units should buy Carmanah products using a General Services Administration (GSA) contract via their regional sales representative. Details of the contract, including prices and ordering information are specified in the Carmanah 704-5 LED instructions which is available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under “Products and Services.” The buyer specifies the color (red, green, white or yellow), depending on the intended location. An optional bird spike may be purchased for the 704-5 lantern (specify when ordering). The bird spike can be retrofitted on existing lanterns.

6.E.23.

23. Carmanah 708 Self Contained LED Lantern



- a. Function. The Carmanah 708 lantern is a self-powered, omni-directional LED lantern. It is suitable for use on any platform, fixed or floating, at the discretion of district aids to navigation offices. This lantern provides higher and selectable intensity over the 701/702/704 series lanterns.
- b. Features.
 - (1) Bolts to existing lantern stands sized for 155mm lanterns.
 - (2) Self-contained optic, flasher, battery, solar panels and daylight control.
 - (3) Adjustable Intensity (high/medium/low)
 - (4) Replaceable components.
 - (5) Authorized as a hot pack.
 - (6) 3 year prorated warranty.
- c. Related Equipment. TV remote or Carmanah programmer.
- d. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). Flash rhythms and intensity are programmable.
- e. Performance Characteristics. The performance characteristics of the 708 LED lantern is provided in Table 6-24.

6.E.23.e. (cont'd)

RED

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
708 (Low)	20	708 (Low)	22	708 (Low)	25
708 (Medium)	48	708 (Medium)	53	708 (Medium)	60
708 (High)	98	708 (High)	109	708 (High)	122

GREEN

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
708 (Low)	16	708 (Low)	18	708 (Low)	20
708 (Medium)	36	708 (Medium)	40	708 (Medium)	45
708 (High)	84	708 (High)	93	708 (High)	105

WHITE

Q, FL 2.5 & FL (2+1)6		FL 4 & FL (2) 5		FL 6	
Lantern	Eff Int	Lantern	Eff Int	Lantern	Eff Int
708 (Low)	22	708 (Low)	25	708 (Low)	28
708 (Medium)	48	708 (Medium)	53	708 (Medium)	60
708 (High)	95	708 (High)	105	708 (High)	119

YELLOW

The Carmanah 704-5 outperforms the 708 for all flash rhythms and intensity settings in yellow.

Note: (Low) means low intensity setting. (Medium) means medium intensity setting. (High) means high intensity setting.

Table 6-24. Effective Intensity Tables for Carmanah 708 in Candela

Vertical Divergence (to 50% of maximum intensity): $\pm 3.5^\circ$

Nominal Range: 10 to 23 candela → 3 nautical miles;
 24 to 53 candela → 4 nautical miles;
 54 to 107 candela → 5 nautical miles
 108 to 203 candela → 6 nautical miles.

- f. Selection Criteria - Intensity. The Carmanah 708 is an authorized replacement for a 155mm lantern on either a buoy or a fixed aid if it provides an acceptable effective intensity and if its solar system is sufficiently capable. To determine the intensity requirements for any aid, Districts shall use the standard procedures for selecting an ATON light signal as prescribed in Chapter 6, Section 6.B, page 6-1 of this Manual and the Visual Signal Design Manual COMDTINST M16510.2 (series) (Chapter 3). These references describe how operational range, luminous range, light color, light characteristic, background lighting, and meteorological visibility are used to calculate intensity needs.

6.E.23.f. (cont'd)

A less desirable, but quicker method is to replace a 155mm with a Carmanah 708 if the 708 provides an effective intensity that is equal to, or greater than the effective intensity of the 155mm that it will replace. Note: that the less expensive 701-5, 702-5 and 704-5 will outperform the 708 for all but the high intensity setting. The 708 does provide more autonomy and solar panel area and may be suitable for use in locations where the 701-5, 702-5 and 704-5 will not perform.

- g. Selection Criteria – Solar Sizing. If the District has determined that a Carmanah 708 will provide an intensity that meets the operational needs for a specific aid, then the next step is to see if the 708's solar system is capable of maintaining an acceptable battery state-of-charge (for the desired location, flash characteristic, and intensity setting). Because the 708 comes with one-sized solar system, solar sizing ultimately comes down to "GO" or "NO GO."

The number of intensity settings, colors and different flash rhythms precluded the development of tables. Solar sizing is accomplished by using the Carmanah Solar Sizing program available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under Pubs/Software.

- h. Lantern Service Life. Lanterns may be kept in service as long as they provide an acceptable signal to the mariner. Signs of crazing of the lens, deterioration of the housing or evidence of failed LEDs are grounds for removal.
- i. Battery Service Life. The expected battery life is highly dependent on temperature. The higher the temperature the shorter the expected battery life. Battery recharge intervals range from 4 years in hot climates to 10 years in cold climates. Field units should recharge (replace) batteries at intervals as shown in Carmanah 708 LED instructions which is available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under "Products and Services.
- j. Charging, Programming, Installation and Maintenance. Information on charging, programming, installing and maintaining the Carmanah lanterns can be found in the Carmanah 708 instructions which is available on the Ocean Engineering website: (<http://www.uscg.mil/systems/gse/gse2>) under Products and Services, LED Instructions.
- k. Procurement. Carmanah 700-series LED Lanterns are manufactured by Carmanah Technologies Inc., Building 4, 203 Harbor Road, Victoria, British Columbia, Canada V9A 3S2, Website: <http://www.carmanah.com>. Coast Guard units should buy Carmanah products using a General Services Administration (GSA) contract via their regional sales representatives. Details of the contract, including prices and ordering information are specified in the Carmanah 708 LED instructions which is available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under "Products and Services." The buyer specifies the color (red, green, white or yellow), depending on the intended location. A bird spike is included with the lantern.

6.E.23.1.

1. Dimensions and Weight. The overall dimensions of the 708 lantern is illustrated in figure 6-34. The weight is 26 lbs.

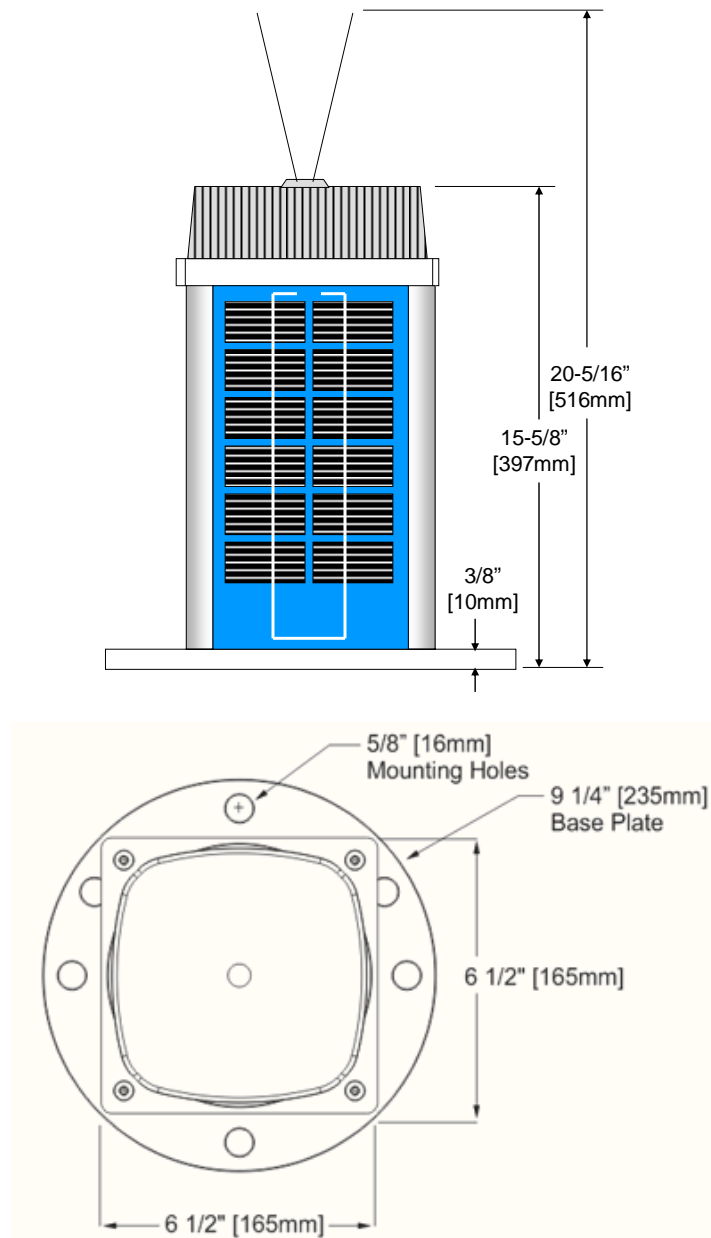


Figure 6-34. Carmanah 708 Dimensions

6.E.24.

24. VEGA VLB-36 SERIES SELF CONTAINED LED LANTERN



- a. Function. The Vega VLB-36 series lanterns are a self-powered, omni-directional LED lanterns. The lanterns have a range of 4-6 nautical miles and are suitable for use on fixed and floating aids replacing the 155mm lantern with 0.55 to 2.03 amp lamps, at the discretion of district aids to navigation offices.
- b. Features.
- (1) Bolts to existing lantern stands sized for 155mm lanterns.
 - (2) Self-contained optic, flasher, battery, solar panel and daylight control.
 - (3) Multiple user-selected effective intensity options.
 - (4) Effective intensity remains the same regardless of color and flash rhythm.
 - (5) Lightweight plastic housing.
 - (6) Programmed with a Vega infrared programmer or universal TV remote control.
- c. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). This lantern has a unique feature where the effective intensity is the same regardless of color or flash rhythm. Flash rhythms are programmable. Early versions used a tap switch. Production versions require an infrared programmer (TV remote) to set the intensity and flash rhythm. Early lanterns for fixed aids have 2 solar panels (in lieu of 3), however all current production lanterns have 3 solar panels for use on both fixed and floating aids.
- d. Performance Characteristics. Table 6-25 lists the standard intensities available for the Vega lanterns. Consult our website (<http://www.uscg.mil/hq/cg4/cg432/>) or contact Commandant (CG-432A) for higher values that may be available as the technology progresses. Lanterns purchased after 1 Sep 2008 are considered “late” series lanterns and produce higher intensities. Consult with our website for the intensities of older lanterns.

6.E.24.d. (cont'd)

VLB-36 lanterns have the following effective intensity selections (all colors & rhythms, except as noted):

21 cd	54 cd	83 cd	150 cd	240 cd*
29 cd	66 cd	109cd	161 cd*	290 cd*
39 cd	77cd	131 cd	205 cd*	

Table 6-25. Vega VLB-36 Intensity Data

*The maximum effective intensity for red/green lanterns is 240 cd; white is 240 or 290 cd (depending on LED version) and yellow is 150 cd. Use the “Vega VLB-36 Sizing Program” on our website: <http://www.uscg.mil/hq/cg4/cg432/publications.asp> to determine if a color/rhythm/effective intensity setting is achievable.

Nominal Range: 10 to 23 candela → 3 nautical miles;
 24 to 53 candela → 4 nautical miles;
 54 to 107 candela → 5 nautical miles;
 108 to 203 candela → 6 nautical miles;
 204 to 364 candela → 7 nautical miles.

- e. Dimensions and Weight. The overall dimensions of the lanterns are shown in figure 6-36. The weights are 18, 24 and 42 lbs for the small, medium and large lanterns, respectively.

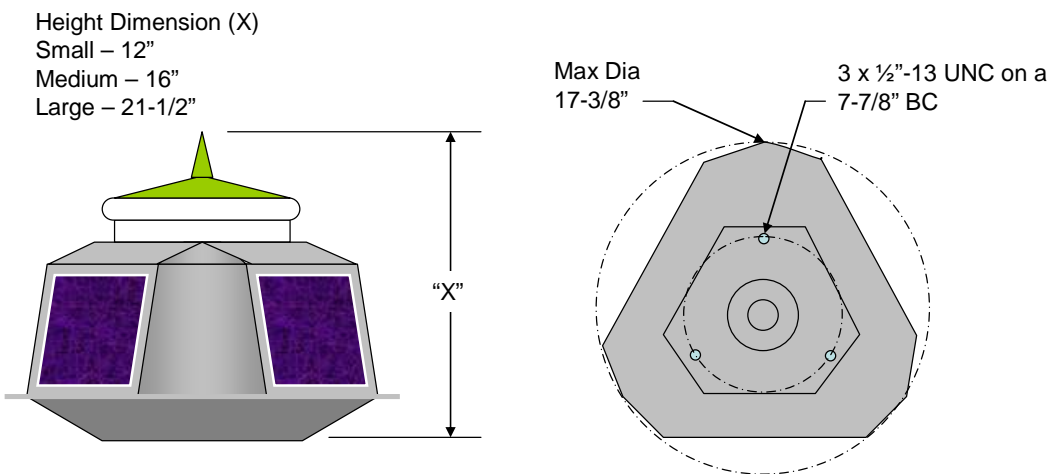


Figure 6-36. VLB-36 Dimensions.

- f. Selection Criteria - Solar Sizing. – The Vega VLB-36 Solar Sizing Program available on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Pubs/Software is used to properly size the lantern on buoys and structures. The lantern is available in three sizes, small, medium and large. These sizes refer to the power generating capabilities and battery capacity of the lanterns. The goal is to choose the smallest lantern that meets the intensity requirements, minimum state of charge and autonomy for the specific aid location.

6.E.24.g.

- g. Programming and Installation. Programming instructions are detailed on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Products and Services, LED Lantern Instructions. Installation, servicing and troubleshooting instructions are covered in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series).
- h. Lantern Service Life. Lanterns may be kept in service as long as they provide an acceptable signal to the mariner. Signs of crazing of the lens, deterioration of the housing or evidence of failed LEDs are grounds for removal.
- i. Battery Service Life. The expected battery life is 6 years.
- j. Procurement. Vega lanterns are purchased via a 5 year term contract awarded in 2008. Contact your district (DPW) office or Commandant (CG-432A) for a copy. Orders are placed through:

Vega Industries Limited
Heriot Drive
Porirua, New Zealand
Tel: 64-4-237-4393 (16 hours ahead from EST)
Email: sales@vega.co.nz
Website: <http://www.vega.co.nz/>

6.E.25.

25. SEALITE SL-125 LED LANTERN



- a. Function. 4-6 nautical mile LED lantern suitable for use on fixed and floating aids replacing the 155mm lantern and 250mm lantern with incandescent lamps. Similar to the Tideland MLED-120 lantern, it is available with up to 4 tiers and four signal colors and approved for use on aids requiring a legacy power system (solar panel and battery) where a self contained lantern is not viable.
- b. Features.
 - (1) Bolts to existing lantern stands sized for 155mm and 250mm lanterns.
 - (2) Available with up to 4 tiers of LEDs and 4 power settings.
 - (3) Replaceable power cord.
 - (4) Lightweight plastic housing.
 - (5) Spacers available from the manufacturer to raise lantern on buoys.
- c. Models. The SL-125 is the only model approved for use.
- d. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). Flash rhythms and power settings are programmable.
- e. Performance Characteristics. Table 6-26 lists the standard intensities available from the Sealite lanterns. Consult our website or contact Commandant (CG-432A) for values not listed here (yellow) and for higher values that may be available as the technology progresses.

Rhythm	1 Tier		2 Tiers		3 Tiers		4 Tiers	
	Red & White	Green	Red & White	Green	Red & White	Green	Red & White	Green
Fixed	136	86	264	168	387	249	519	329
Iso6, Oc 4	127	81	248	158	363	234	487	309
Iso 2	113	72	220	140	322	207	432	274
FL6(.6)	102	65	198	126	290	187	389	247
FL4(.4), MoA	91	57	176	112	258	166	346	219
FL2.5(.3), Q	82	52	158	101	232	149	311	197

Table 6-26. Sealite SL-125 Intensity Data (candelas)

6.E.25.e. (cont'd)

Nominal Range: 24 to 53 candela → 4 nautical miles;
 54 to 107 candela → 5 nautical miles;
 108 to 203 candela → 6 nautical miles;
 204 to 364 candela → 7 nautical miles;
 365 to 632 candela → 9 nautical miles.

This lantern also has variable power and intensity settings of 25%, 50%, 75% and 100%. The values in Table 6-30 are the 100% intensity values. For values other than 100%, multiply the intensities by 0.25, 0.50 or 0.75.

- f. Dimensions and Weight. The overall dimensions of the lanterns are detailed below. The weight is approximately 2 pounds, depending on the number of tiers.

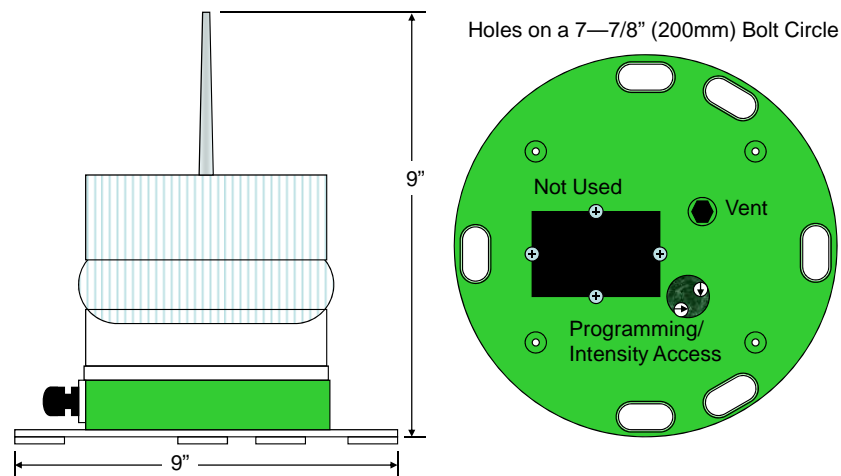


Figure 6-37. Sealite SL-125 Dimensions

- g. Selection Criteria - Solar Sizing. – The Solar Programs available on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Pubs/Software are used to properly size the lantern on buoys and structures.
- h. Programming and Installation. The flash rhythm and intensity settings are programmed by removing the access plug in the base of the lantern (see above). The intensity settings are programmed via dip switches (figure 6-38) located near two rotary switches used to program the flash rhythm. Use a ballpoint pen to change the dip switch settings. “ON” (closest to the lens is consider to be “1” and the lower setting is OFF or “0”).

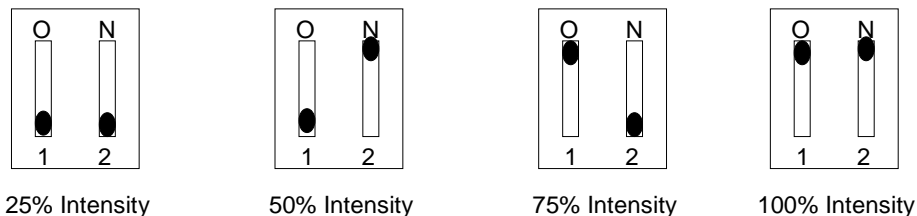


Figure 6-38. Intensity Settings.

6.E.25.h. (cont'd)

The flash rhythm is set using the two rotary switches accessible through the plug. Each switch has a selector with a pointer on it to indicate position. Use a small screwdriver to turn the rotary dial to align the arrow with the proper letter/number. Switches are labeled “A” and “B” on the circuit board, as shown in figure 6-39:

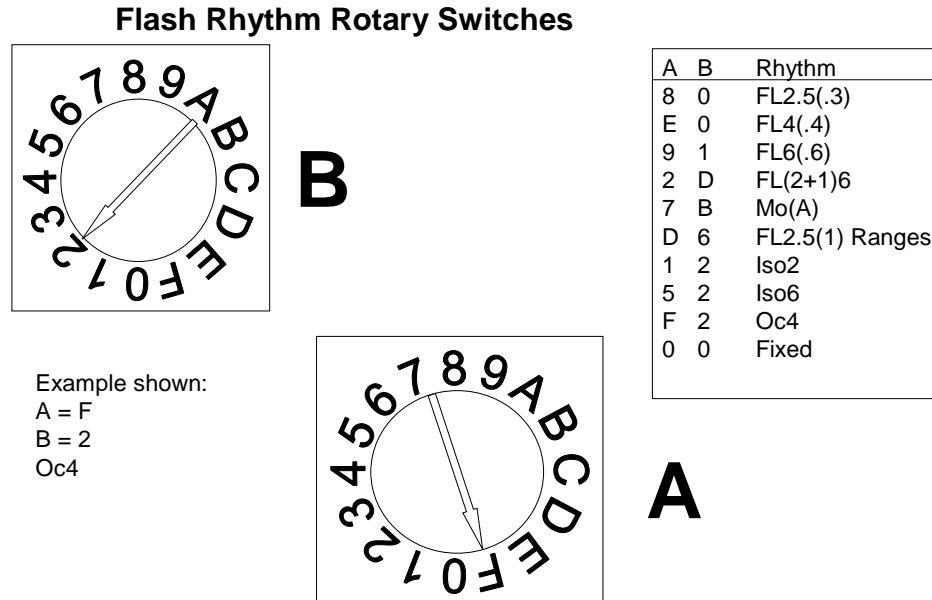


Figure 6-39. Rhythm Selection.

Additional flash rhythms are available. Contact Commandant (CG-432A) for details. Installation, servicing and troubleshooting instructions are covered in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series).

- i. Cable Replacement. The cable can be replaced, but it should be done at a facility that has soldering equipment. Instructions are available on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Products and Services, LED Lantern Instructions.
- j. Procurement. Lanterns are on GSA schedule: www.gsaadvantage.gov, enter “Sealite” as a keyword, then refine search with “SL-125” Lanterns destined for buoys require a spacer kit to elevate the lens above the lantern ring, otherwise the light may be obstructed. Specify the desired cable length required when ordering.

Watermark Navigation Systems, LLC
29 Gilford East Drive
Gilford, CT 03249
603-524-6066, 8100 FAX
GSA Schedule – GF-07F-6000R
Websites – <http://www.sealite.com.au/index.php> (Sealite),
<http://www.navbuoy.com/> (Watermark).

6.E.26.

26. TIDELAND MLED-120 LED LANTERN



- a. Function. 4-6 nautical mile LED lantern suitable for use on fixed and floating aids replacing the 155mm lantern and 250mm lantern with incandescent lamps. Similar to the Sealite SL-125 lantern, it is available with up to 4 tiers and four signal colors and approved for use on aids requiring a legacy power system (solar panel and battery) where a self contained lantern is not viable.
- b. Features.
 - (1) Bolts to existing lantern stands sized for 155mm and 250mm lanterns.
 - (2) Available with up to 4 tiers of LEDs.
 - (3) Replaceable power cord.
 - (4) Lightweight plastic housing, improved sealing gasket.
 - (5) Spacers available from the manufacturer to raise lantern on buoys.
- c. Models. The MLED-120 is the only model approved for use.
- d. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). Flash rhythms are programmable.
- e. Performance Characteristics. Table 6-27 lists the standard intensities available from the Tideland lanterns. Consult our website for higher values that may be available as the technology progresses.

Rhythm	1 Tier		2 Tiers		3 Tiers			4 Tiers		
	Red	Green	Red	Green	White	Red	Green	White	Red	Green
Fixed	38	60	70	125	112	80	195	145	112	255
FL6(.6)	25	45	52	93	86	90	146	108	124	191
FL4(.4)	25	40	46	83	77	80	130	96	110	170
FL2.5(.3)	23	36	44	75	69	72	117	87	99	153
Q	22	36	42	75	67	67	117	87	91	153

Table 6-27. Tideland MLED-120 Intensity Data (candelas)

Data Sheet 6.E.26. Tideland MLED-120 LED Lantern

6.E.26.e. (cont'd)

Nominal Range: 24 to 53 candela → 4 nautical miles;
54 to 107 candela → 5 nautical miles;
108 to 203 candela → 6 nautical miles;
204 to 364 candela → 7 nautical miles.

Intensities for white 1 and 2 tier and yellow lanterns are available, but generally not used. All color/tier combinations are on the solar sizing programs available on the Ocean Engineering Website (<http://www.uscg.mil/hq/cg4/cg432/>) under Pubs/Software.

- f. Dimensions and Weight. The overall dimensions of the lanterns are detailed below. The weight is approximately 3 pounds, depending on the number of tiers.

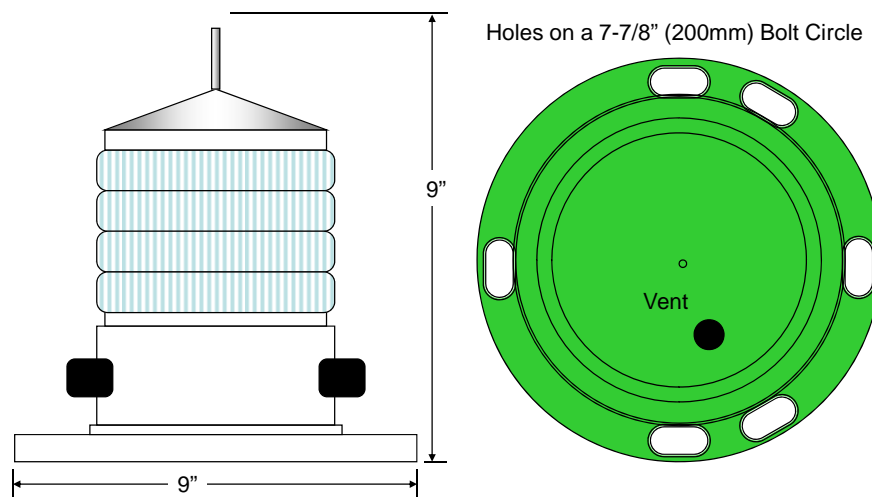


Figure 6-40. Tideland MLED-120 Dimensions

- g. Selection Criteria - Solar Sizing. – The Solar Programs available on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Pubs/Software is used to properly size the lantern on buoys and structures and provide effective intensities.
- h. Programming and Installation. The flash rhythm is programmed by removing the base of the lantern. Remove the locking screw on the base of the lantern with a Phillips screwdriver (Figure 6-39). Use the screwdriver, as shown in figure 6-41, to pry the lantern counter clockwise to loosen the base. Align the tabs with the slots and separate the lantern from the base.

6.E.26.h. (cont'd)

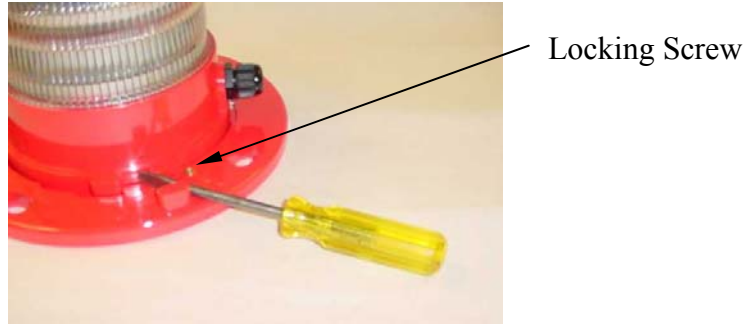


Figure 6-41.

The flash rhythm must be set using the two rotary switches (labeled S2 and S1; see Figure 2) on the bottom circuit board. Each switch has a clear cover over the numbers/letters and a slot aligned with the “arrow” molded into the knob. Align the arrow or window to the desired character. The first code character refers to S1 and the second to S2. Set the rhythm by turning the knob to the desired code setting according to Table 6-28:

Rhythm	Code Setting		Rhythm	Code Setting	
	S1	S2		S1	S2
FL2.5 (0.3)	1	C	Q	9	9
FL4 (0.4)	0	9	Mo(A)	E	6
FL6 (0.6)	1	D	Iso 2	5	1
Iso 6	5	5	FL (2) 6	2	3
FL (2+1) 6	4	B	Oc 4	9	0
FL (2) 5	8	D	Fix	0	0

Table 6-28. Flash Rhythms

The power cords for the Tideland lanterns may be shipped to your unit/cutter separately. Longer power cords must not exceed 11/32” diameter (0.345”). Suggested sources are: 18/2 AWG Neoprene Rubber Jacket, 600 VAC Type SOOW McMaster Carr 7081K11 or equivalent. 18AWG wire is sufficient for these lanterns. Remove the stuffing tube nut and feed the end of the power cord, one lug at a time, through the stuffing tube until the black outer jacket just protrudes inside the lantern. Be sure that the packing gland (rubber sleeve) remains in the stuffing tube. Slide the stuffing tube nut up the cable and secure to the stuffing tube. Attach the black wire to the PWR+ terminal and the white wire to the PWR- terminal. The yellow wires attached to the SS+ and SS- terminals are for the Tideland daylight control, as shown in figure 6-42.

6.E.26.h. (cont'd)

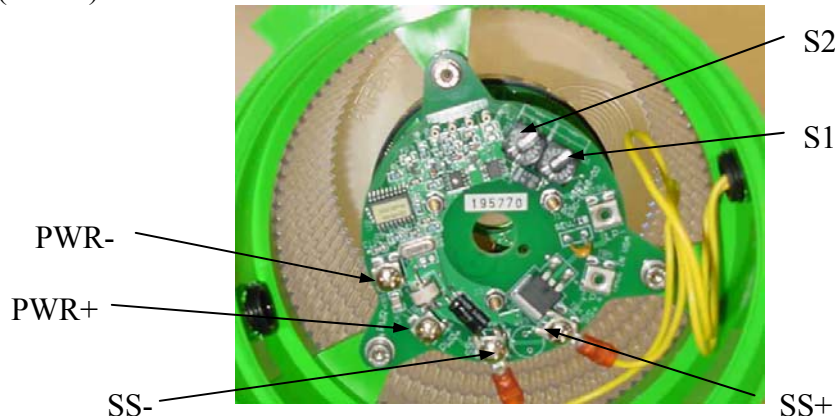


Figure 6-42. Flash Rhythm Selection.

Close the lantern by aligning the tabs in the slots and turning clockwise. Use the screwdriver, as shown in Figure 41, to securely lock the lantern in place. Reinstall the locking screw, if rough surf conditions exist and/or to discourage vandalism.

Additional flash rhythms are available. Contact Commandant (CG-432A) for details. Installation, servicing and troubleshooting instructions are covered in the Short Range Aids to Navigation Servicing Guide , COMDTINST M16500.19 (series).

- i. Procurement. Lanterns are on GSA schedule: www.gsaadvantage.gov, enter “Tideland” as a keyword, then refine search with.”12E/DA-65”. Lanterns destined for buoys require a spacer kit to elevate the lens above the lantern ring, otherwise the light may be obstructed. An eight-foot cable is available as an option.

Tideland Signal Corporation
PO Box 52370, OCS
Lafayette, LA 70505-2370
337-269-9113
Rachael Herbert
GSA Schedule – GS-07F-6104P
Website – www.tidelandsignal.com

6.E.27.

27. SABIK LED-350 FIXED AID LANTERN



- a. Function. 12 VDC 10+ nautical mile LED lantern for use on stable fixed structures and lighthouses. The LED-350 replaces 250mm, 300mm lanterns and small classical lenses. Up to 7 tiers can be added to increase intensity. This lantern requires an external power system; commercial stepped down to 12 VDC using the high wattage ATON power supply or a solar power system.
- b. Features.
 - (1) Bolts to existing stands sized for 155mm, 250mm, 300mm and VRB-25 lanterns.
 - (2) Low power consumption.
 - (3) Narrow divergence (2.5 degrees) suitable for lighthouses and stable fixed structures.
- c. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). Flash rhythms are programmable using the Sabik Programmer.
- d. Performance Characteristics. Table 6-29 lists the intensities available from the Sabik lantern. Consult our website (<http://www.uscg.mil/hq/cg4/cg432/>) for higher values that may be available as the technology progresses.

<u>Rhythm</u>	<u>White</u>	<u>Red</u>	<u>Green</u>
Fixed	1400	800	900
FL6(.6)	1050	600	675
FL4(.4)	933	533	600
FL2.5(.3), Q	840	480	540
ISO2, FL4(1), FL2.5(1)	1167	667	750
ISO6, OC4	1313	750	844

Table 6-29 Intensity (candelas) per tier

6.E.27.d. (cont'd)

As an example, a 5 tier LED-350 flashing on a FL W 4(.4) rhythm is 933 candela x 5 tiers = 4665 candela or 13 nautical miles. If in a lantern room, the intensity will be reduced by 12% to 4105 candela or 12 nautical miles.

- e. Dimensions and Weight. The overall dimensions of the lanterns are detailed below. The weight is 17 lbs for a single tier lantern; add 4.4 lbs per additional tier.

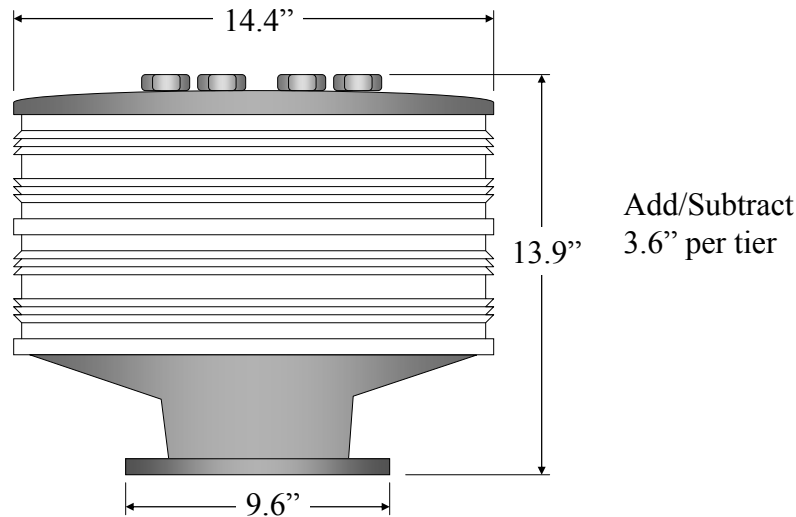


Figure 6-43. LED-350 Dimensions.

- f. Selection Criteria - Solar Sizing. The Fixed Aid Solar Program available on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Publications/Software has the Sabik lantern listed in the pull down menu on the LED sheet. Use this program to properly size the solar power system on structures and confirm effective intensity values for the lantern.
- g. Programming and Installation. Programming instructions are detailed in the manufacturer's instruction manual. Installation, servicing and troubleshooting instructions are available on our website: <http://www.uscg.mil/hq/cg4/cg432/>, under Products/Services, LED Lantern Instructions.
- h. Procurement. The Vega VLB-44 now matches the performance of the Sabik LED-350 and can be purchased via a 5 year requirements contract. The Sabik LED-350 can be purchased for new installations or to support existing installations.

Light Wave Options
35 Country Club Place
Brockville, Ontario K6V 6T6 Canada
Phone: 613-342-0618
Ron Bryenton
Website – <http://www.sabik.com/>

6.E.28.

28. VEGA VLB-44 LED LANTERN



- a. Function. 4 to 14 nautical mile LED lantern suitable for use on fixed and floating aids. This lantern is a further refinement of the discontinued VLB-38 lantern and is available in three vertical divergences, 10 degrees for buoys, 5 degrees for fixed aids and 2.5 degrees for rigid structures (lighthouses or platforms). Up to 8 tiers can be stacked to increase the output of the lantern. These lanterns require an external power system; commercial stepped down to 12 VDC using the high wattage ATON power supply or a solar power system.
- b. Features.
 - (1) Bolts to existing lantern stands sized for 155mm, 300mm and VRB-25 lanterns.
 - (2) Low power consumption.
 - (3) Three divergences available for lighthouses, structures and buoys.
 - (4) Optional tall base for buoy applications.
 - (5) Replaceable bird spikes.
 - (6) Through hole for topmark stand or pole mount.
- c. Light Characteristics. Every lantern has an inherent color (red, green, white or yellow). Flash rhythms are programmable using the Vega infrared remote or any TV remote control.
- d. Performance Characteristics. The VLB-44 has very complex performance characteristics. The intensity remains the same for all flash rhythms. Intensities range from 27 candela to 9190 candela. Multiple tiers are used to increase the intensity; in general use the least number of tiers that satisfy the solar sizing program constraints. Additional tiers can be used to reduce power consumption at increased lantern cost. Intensities and number of tiers are detailed in the Fixed Aid Solar Program on our website (<http://www.uscg.mil/hq/cg4/cg432/>).

6.E.28.e.

- e. Dimensions and Weight. The overall dimensions of the lanterns are detailed in Figure 6-44. The weight is 8 lbs for a single tier lantern; add 2.6 lbs per additional tier.

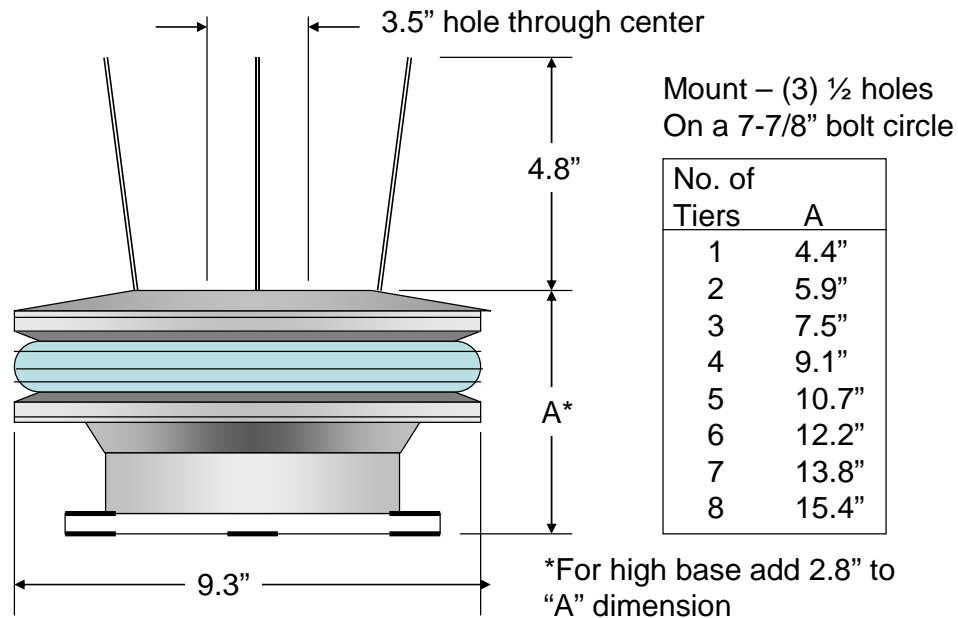


Figure 6-44. VLB-44 Dimensions.

- f. Selection Criteria - Solar Sizing. The Fixed Aid Solar Program and Buoy Solar Sizing Program available on our website (<http://www.uscg.mil/hq/cg4/cg432/>) under Publications/Software have the Vega lanterns listed in the pull down menu for lantern type. Use this program to properly size the solar power system and select the correct intensity for the light in lighthouses, on structures and buoys.
- g. Programming and Installation. Programming instructions are detailed in the manufacturer's instruction manual and on our website <http://www.uscg.mil/hq/cg4/cg432/> under Products/Services, LED Instruction Manuals. Installation, servicing and troubleshooting instructions are covered in the Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19 (series).
- h. Procurement. Vega lanterns are purchased via a 5 year term contract awarded in 2008. Contact your district (DPW) office or Commandant (CG-432A) for a copy. Orders are placed through:

Vega Industries Limited
 Heriot Drive
 Porirua, New Zealand
 Tel: 64-4-237-4393 (16 hours ahead from EST)
 Email: sales@vega.co.nz

6.E.29.

29. LED RANGE LIGHT CONVERSIONS



- a. Function. LED conversion kit for the RL14 range lanterns (FA-240 to follow). This kit replaces all of the optical components (flasher, lampchanger, lamps and mirror) with a LED assembly that shines through the existing spread lens. Intensities of up to 95,000 candela are possible through the existing 3 degree spread lens.
- b. Features.
 - (1) No focusing necessary.
 - (2) Bolt-in replacement of existing components.
 - (3) Adjustable intensity settings.
 - (4) Very low power consumption.
- c. Performance Characteristics. Due to the numerous lantern combinations, intensities are posted in the instructions (LED Instructions-Range Lanterns) posted on the Commandant (CG-432) website (<http://www.uscg.mil/hq/cg4/cg432/>) under Products/Services. Consult this website for the latest intensity offerings.
- d. Solar Sizing. A pull-down menu in the Ranges Solar Sizing Program on our website lists all of the intensity/lens/color/flash rhythm combinations.
- e. Programming and Installation. Programming and installation instructions are detailed in the LED Instructions-Range Lanterns posted on the Commandant (CG-432) website.
- f. Procurement.

Tideland Signal Corporation
PO Box 52370, OCS
Lafayette, LA 70505-2370
337-269-9113 Rachael Herbert
GSA Schedule – GS-07F-6104P
Website – www.tidelandsignal.com

6.E.30.

30. OBSOLETE LANTERNS. The following lanterns were used for field tests or for special applications and are obsolete. They can be kept in service as long as they provide an adequate signal to the mariner, however Headquarters no longer supports them. Alternatives to these lanterns are listed below.

- a. API STABRITE 1x4 and 3x4 LED LANTERN. Used during a field test as replacements for 155mm lanterns using 0.55a lamps (3x4 array) and replacement of 155mm lanterns using 0.25a lamps (1x4 array).

Suitable replacements: Carmanah 701-5, 702-5, 704-5, Sealite SL-125, Tideland MLED-120, Vega VLB-36, Vega VLB-44, 155mm with conventional (0.55a) lamps.



- b. VEGA VLB-38 LED LANTERN. Used during a field test as replacements for 155mm lanterns using 0.55a lamps.

Suitable replacements: Carmanah 704-5, Sealite SL-125, Tideland MLED-120, Vega VLB-36, Vega VLB-44, 155mm with conventional (0.55a) lamps.



- c. ZENI ZL-LS100M LED LANTERN. Used during a field test as replacements for 155mm lanterns using 0.55a lamps.

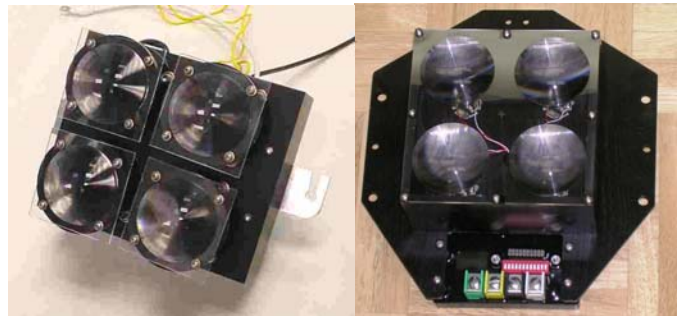
Suitable replacements: Carmanah 704-5, Sealite SL-125, Tideland MLED-120, Vega VLB-36, Vega VLB-44, 155mm with conventional (0.55a) lamps.



6.E.30.d.

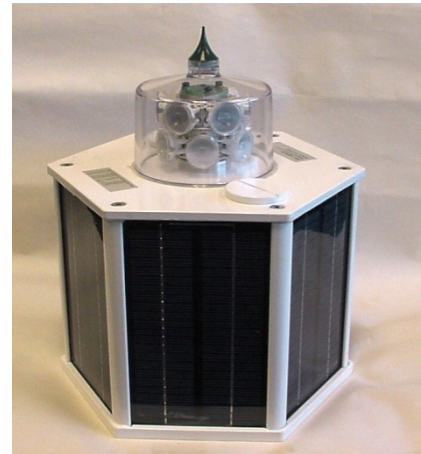
- d. CR CONTROL SYSTEMS AND BWT LIGHTING RANGE LANTERN INSERTS. Used during the conversion of 0.25 amp lamp conversions to LEDs.

Suitable replacement: Tideland LED range lantern insert.



- e. BWT LED Lantern. Self contained LED lantern used on fixed and floating aids.

Suitable replacement: Vega VLB-36, Carmanah 704-5, Carmanah 708.



- f. Information regarding the performance, installation and operation of these lanterns will be retained on our website (<http://www.uscg.mil/hq/cg4/cg432/>) as long as possible and will be available from Commandant (CG-432A) indefinitely.

CHAPTER 7. SOUND SIGNALS

A. Introduction.

Electronic sound signals and related equipment are described in this chapter. Wave-actuated sound signals are covered in Chapter 2.

A sound signal, consisting of an emitter and a power supply, is selected according to the timing characteristics desired and the specific use--fixed or on a buoy. Fixed installations must consider location, adjacent structures, foundations, horizontal alignment, noise pollution, and nearest residences. Buoy installations are on either standard buoys or large navigational buoys (LNB) and must consider location, noise pollution, and nearest residences.

Sound signals have varying ranges (in nautical miles) and give directional or omnidirectional coverage. The ELG-300/02, ELG-300/04, ELG-500/02 and ELG-500/04 are directional only; the FA-232, FA-232/02, and SA-3C are omnidirectional, but can be made directional with plugs; and the SA-850, SA-850/02, and AB-860 are omnidirectional only.

The power supplies for FA-232, FA-232/02, SA-3C, SA-850, SA-850/02, and AB-860 sound signals are mounted within the emitter housing. Power supplies for the ELG-300/02, ELG-300/04, ELG-500/02, and ELG-500/04 are located in wall-mounted enclosures.

A temperature-controlled power factor corrector and a baffle are standard sound signal accessories. The temperature-controlled power factor corrector can be used to automatically change (according to variations in temperature) the power factor capacitors associated with the ELG emitters. The baffle can be used on any of the directional signals to help reduce noise pollution.

The definition of dBC, as used on the data sheets, is that specified by the American National Standards Institute (*Specification for Sound Level Meters*, S1.4-1971). All sound pressure levels are measured with a reference pressure of 20 micropascals.

7.B. Selection Guide.

1. Timing Characteristics. The timing characteristics for any Coast Guard sound signal can be selected from the list of characteristics shown below. When two signals are in close proximity, their timing characteristics should be different.

<u>Duty Cycle</u>	<u>Characteristic</u>
10%	1(s)bl-9(s)si 3(s)bl-27(s)si 3(s)bl-3(s)si-3(s)bl-51(s)si
13.3%	2(s)bl-13(s)si 2(s)bl-2(s)si-2(s)bl-24(s)si
20%	2(s)bl-2(s)si-2(s)bl-14(s)si
Bells	Characteristic
Fixed	one strike every 10 sec one strike every 15 sec
Buoy	random

2. Use--Fixed or on Buoys. Sound signals within the Coast Guard aids to navigation system are classified for use in two broad areas--fixed or on buoys. For the given operational requirements, the choice of sound signal can be made using Table 7-1.

*Note: s=second, bl=blast, si=silence

Sound Signal Selection Guide

		INPUT VOLTAGE										
		12 Vdc					120 Vac					
		6		7		3,4,6		3,7				
		SA-850		SA-850/02		FA-232		FA-232/02		SA-3C		
		AB-860		CG-1000		ELG-500/02		CG-1000		ELG-500/04		
		CG-1000		ELG-300/02		TWO CG-1000#		ELG-300/04				
		USUAL RANGE 5 (nmi)		FREQUENCY (Hz)		WAVE ACTUATED						
FIXED	1/4	390						OD-D				
	1/2	390						OD-D				
	1	390						OD-D				
	2	645								OD		
		390								OD		
		300									D	
		500									D	
	3	8	300								D	
		500									D	
	4	300									D	
	FLBY	1/4	OTHER	OD								
		850		OD								
1/2		850		OD								
1		850			OD							
FLBN	1	850			OD							

KEY: OD = omnidirectional. Use omnidirectional only if 360-degree coverage is required.

D = directional.
A baffle can be used with any of the directional signals.

REFERENCE NOTES

- Higher frequencies cause greater noise pollution. Signals of 500 Hz should be used as fixed signals only where a closely adjacent 300-Hz signal causes an operational need for a signal with a different tone.
- These 12-Vdc signals can be made to operate on 120 Vac with the addition of a 120-Vac to 12-Vdc converter.
- FA-232 signals are made directional by the additional of plugs.
- FA-232 signals can be converted to a bell tone having a usual range of 1/4 nmi.
- Usual range of a sound signal is the distance at which, in foggy weather, an observer has a 50 percent probability of hearing a sound signal when he is situated on the wing of a ship's bridge in an ambient noise level which is equal to or greater than that found on 50 percent of large merchant vessels, propagation between the sound signalling apparatus and the observer being affected in relatively calm weather, with no intervening obstacles (from *International Dictionary of Aids to Marine Navigation*, Chapter 3, IALA, 1970).
- On SA-850's and FA-232's, a 6-db switch is used to change usual range from 1/2 to 1/4 nmi.
- Usual range cannot be changed on the FA-232/02 and SA-850/02.
- There is no longer a general requirement for sound signals with a range greater than two nautical miles. Any signals of greater range are considered non-standard and are not centrally supported. (from Chapter 4, C.7.i of COMDTINST M16500.7, *Aids to Navigation Manual-Administration*.)

7.C. Preparation and Installation.

1. Equipment Inspection. All components of sound signal systems shall be inspected for damage upon receipt. Make a written record (with photographs) of any damage and notify the supplier, carrier, and other interested parties.
2. Emitter Installation.
 - a. Acoustic Axis Orientation. Emitters must be mounted so that the acoustic axis* is parallel to the ground. For this reason, the emitter mounting surface shall be within 2.5 degrees of true horizontal. Emitters are free-standing and must be firmly attached to the mounting surface.
 - b. Fixed Installations.
 - (1) Location. When the sound from a signal must travel over land, it may be attenuated and distorted as a result of vegetation or irregularities in the surface; thus, sound signals shall be placed as near to the water as possible, consistent with the need to protect the emitter from storm damage. As a general guide, emitters should not be more than 100 ft from the water and should be located above the highest water that can be expected in the 10-yr storm.
 - (2) Adjacent Structures. Emitters shall be located at least four wavelengths (Table 7-2) away from any large reflecting surface, such as a wall (Figure 7-1). Any structural member in the arc of propagation must not exceed the size shown in Table 7-2 and Figure 7-1. Emitters shall not be placed in locations where weeds, tall grass, trees, or other vegetation are likely to attenuate or distort the signal.
 - (3) Foundations. Sound signal emitters are electromechanical vibrators. If mounted directly on a concrete foundation, the concrete must be reinforced with the equivalent of 6-by 6-in., 10/10 welded wire fabric.

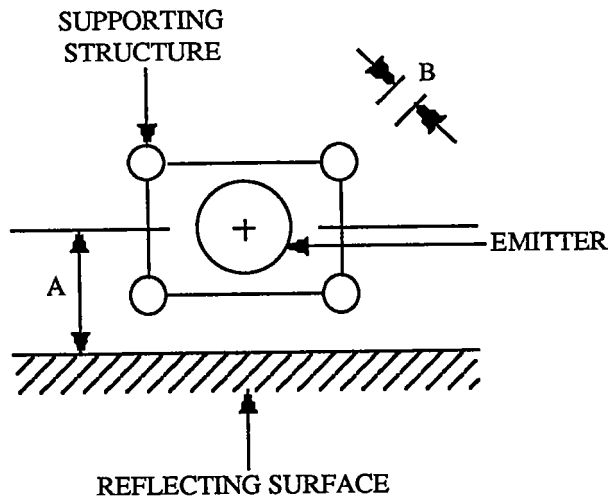
*On directional signals, the acoustic axis is a line; on omnidirectional signals, it is a horizontal plane.

7.C.2.b. (4) Horizontal Alignment. The acoustic axis of a directional signal shall be horizontally aligned in accordance with the operational requirements of the signal. The FA-232 and FA-232/02 emitters can be converted to directional signals (Data Sheet 7-E(1), Figure 7-18) by the installation of plugs (Figure 7-19), which are available from the manufacturer. These plugs shall be installed as shown in Figure 7-2. CAUTION: The acoustic axes of all emitters used to make up a dual or multiple array must be parallel.

Table 7-2
Emitter, Frequency, and Wavelength Chart

Emitter	Frequency (Hz)	Wavelength (In.)	Minimum Distance (A)* to Large Reflecting Surface (e.g., wall), (In.)	Maximum Horizontal Width of Structural Member in the Propagation Path (In.)
FA-232, SA-3C	390	34	136	3.5
SA-850	850	16	64	2.5
ELG-300	300	45	180	4.0
ELG-500	500	27	108	2.5
AB-860	645	21	84	2.5

*See Figure 7-1.



Note: "A" is the minimum distance that the emitter is to be placed from a major reflecting surface, and "B" is the maximum dimension, measured radially, of the supporting structure.

Figure 7-1. Emitter location and structural dimensions.

7.C.2. c. Buoy Installations.

- (1) Standard Buoys. Only those signals listed in Table 7-3 are authorized for installation on buoys. The drawings listed in the table are available upon request. Deviations from these drawings are prohibited unless approved by Commandant (G-ECV). After conversion, buoy designations shall be changed from "L" or "LR" to "LH" or "LHR."
- (2) LNB's. The SA-850/02 is the only sound signal authorized for installation on an LNB.

3. Power Supply Installation.

a. Mechanical Installation.

- (1) FA-232, SA-3C, SA-850. The power supplies for the FA-232, FA-232/02, SA-3C, SA-850, and SA-850/02 sound signals are physically mounted within the emitter housing, as shown in Figures 7-3(a) and (b).

When converting the FA-232 pure tone to an FA-232 bell tone, the pure tone power supply and driver must be replaced by the bell tone generator and its accompany driver (Figure 7-4).

- (2) CG-1000 Power Supply. The CG-1000 power supply and its accessories are contained in a NEMA*-type wall-mounted enclosure. This cabinet is designed to be wall-mounted and, because of its weight, it must be attached to a structural element of the signal control standard volume. The power supply and its accessories shall be mounted inside this signal control standard volume. Chapter 7 of COMDTINST M16500.8, *Automation Technical Guidelines*, gives further details on installation.

Mechanical installation of the temperature-controlled power factor corrector requires: (1) the removal of the power factor capacitors from the power supply and their placement in the power factor

*National Electrical Manufacturers Association.

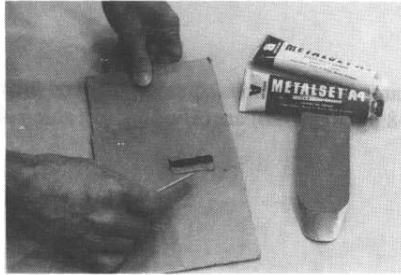
7.C.3.b.(1).

7.C.3.a.(2) corrector cabinet, and (2) the addition of a thermistor within the emitter junction box (Figure 7-5). If the inside temperature is not within about 5 degrees of the outside temperature, the thermistor must be placed outside. (The waste heat from generators must be considered--it may cause a significant rise in the inside temperature.)

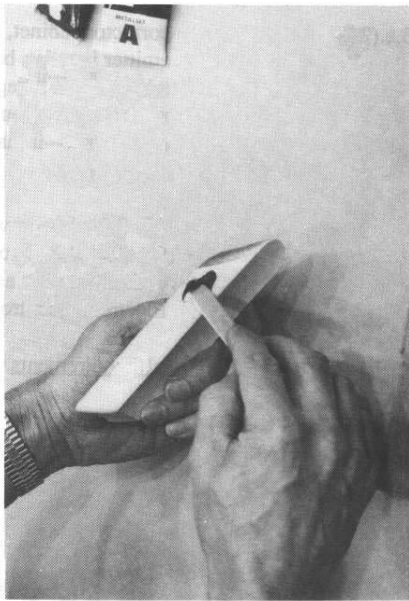
(3) AB-860. The power supply (ECU-645-A Electronic Control Unit) for the AB-860 sound signal is physically mounted within the emitter housing as shown in Figure 7-6. The ECU-645-A Electronic Control Unit is shown in Figure 7-7.

b. Electrical Requirements.

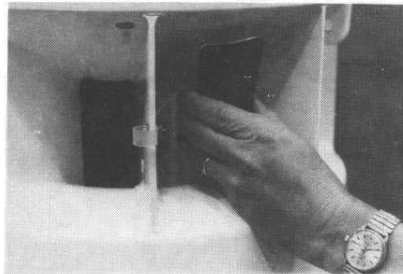
(1) General. Wiring diagrams for the various sound signals and their accessories (Figures 7-8 through 7-20) are called out in Table 7-4.



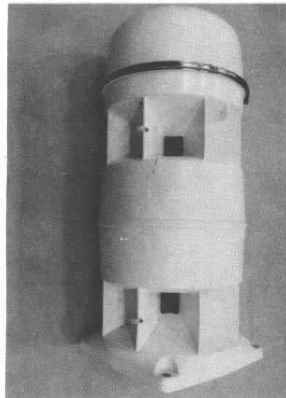
(a) Mix epoxy.



(b) Apply epoxy.



(c) Insert plug.



(d) Plugs are inserted in both ends.

Figure 7-2. Installation of plugs in the FA-232.

7.C.3.b.(1).

Table 7-3
Buoy Sound Signal Installation

<u>Signal</u>	<u>Buoy Types</u>	<u>Applicable Commandant (G-ECV) Drawing</u>
SA-850	6X20 L or LR	No. 120320
	7X17 L or LR	No. 120321
	8X26 L or LR	No. 120322
SA-850/02	8X26 L or LR	No. 120077

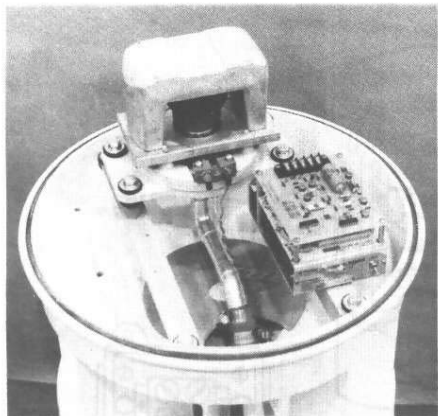


Figure 7-3(a). FA-232, SA-3C power supply installation.

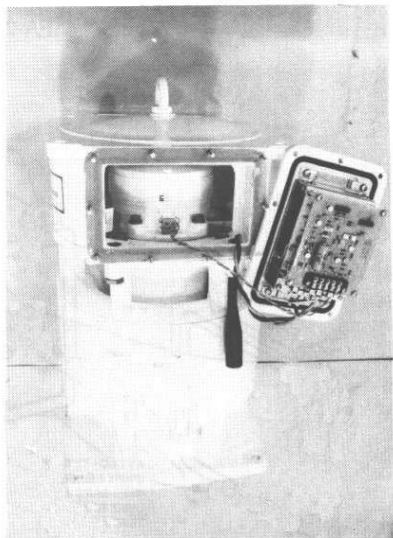


Figure 7-3(b). SA-850 supply installation.

7.C.3.b.(1).

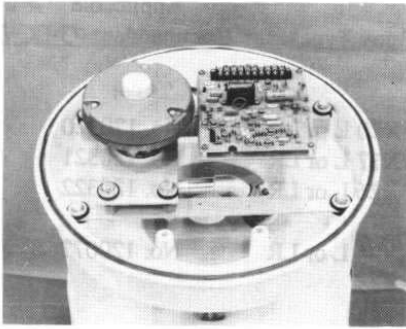
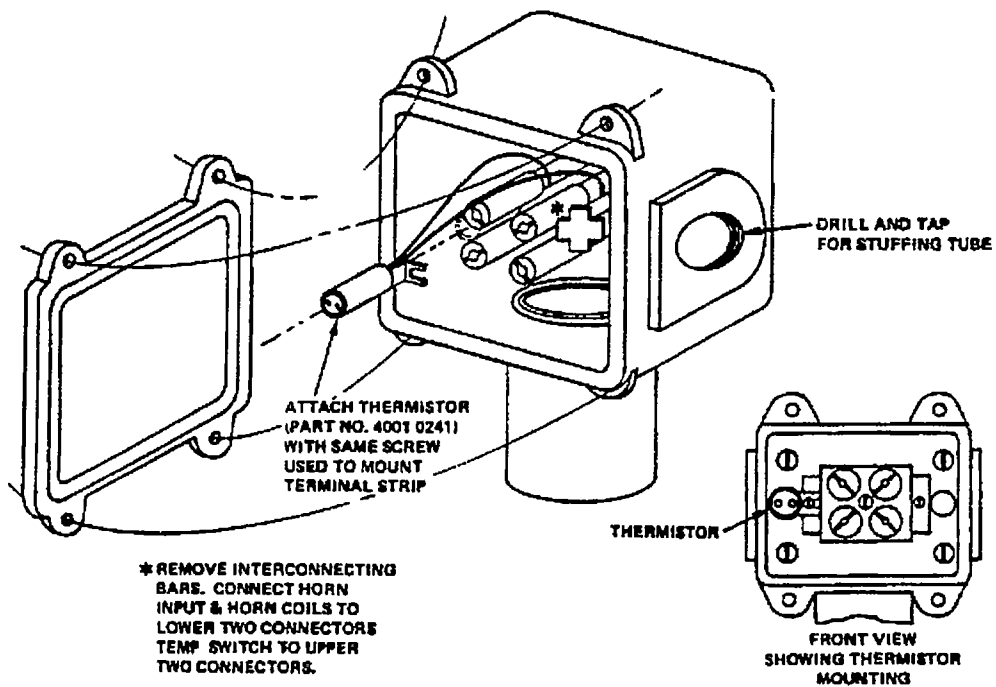


Figure 7-4. FA-232 bell tone installation.



Modification of the emitter junction box to accommodate the thermistor.

7.C.3.b.(1).

TYPE OF SIGNAL			ACCESSORIES			
			TEMPERATURE-CONTROLLED POWER FACTOR CORRECTOR	AUDIO-VISUAL CONTROLLER	REMOTE CONTROL	STEP UP/STEP DOWN TRANSFORMER
FA-232	SINGLE DUAL BELL	FIGURE 7-8 FIGURE 7-9 FIGURE 7-10	N/A N/A N/A	N/A N/A N/A	FIGURE 7-19 FIGURE 7-19 N/A	N/A N/A N/A
850 SA-860	SINGLE DUAL	FIGURE 7-8 FIGURE 7-9	N/A N/A	N/A N/A	FIGURE 7-19 *	N/A N/A
CG-1000**	SINGLE DUAL	FIGURE 7-12 AND FIGURE 7-13 FIGURE 7-14	FIGURE 7-16 *	† †	FIGURE 7-20 *	FIGURE 7-18 *
AB-860		FIGURE 7-11	N/A	N/A	N/A	N/A
SA-3C		FIGURE 7-15	N/A	N/A	FIGURE 7-19	N/A

Sound Signal Wiring Diagram

*The wiring diagram for the single accessory system, plus the interconnecting wiring for the dual signal, should be used when accessories are used with dual signals; for example, when remote controlling the dual CG-1000, each power supply must be connected as shown for the signal supply (Figure 7-20).

**For minimum wire sizes, see Table 7-5.

+See Table 7-6.

Table 7-5
Minimum Wire Sizes for CG-1000 Power Supply

Location of Connection	Wire Size	Maximum Cable Length (Ft)
AC input	#12	20
DC input (if used)	#8	20
Interconnect (dual operation)	#14	20
Emitter	#10	200*

*See Figure 7-18

7.C.3.b.(1).

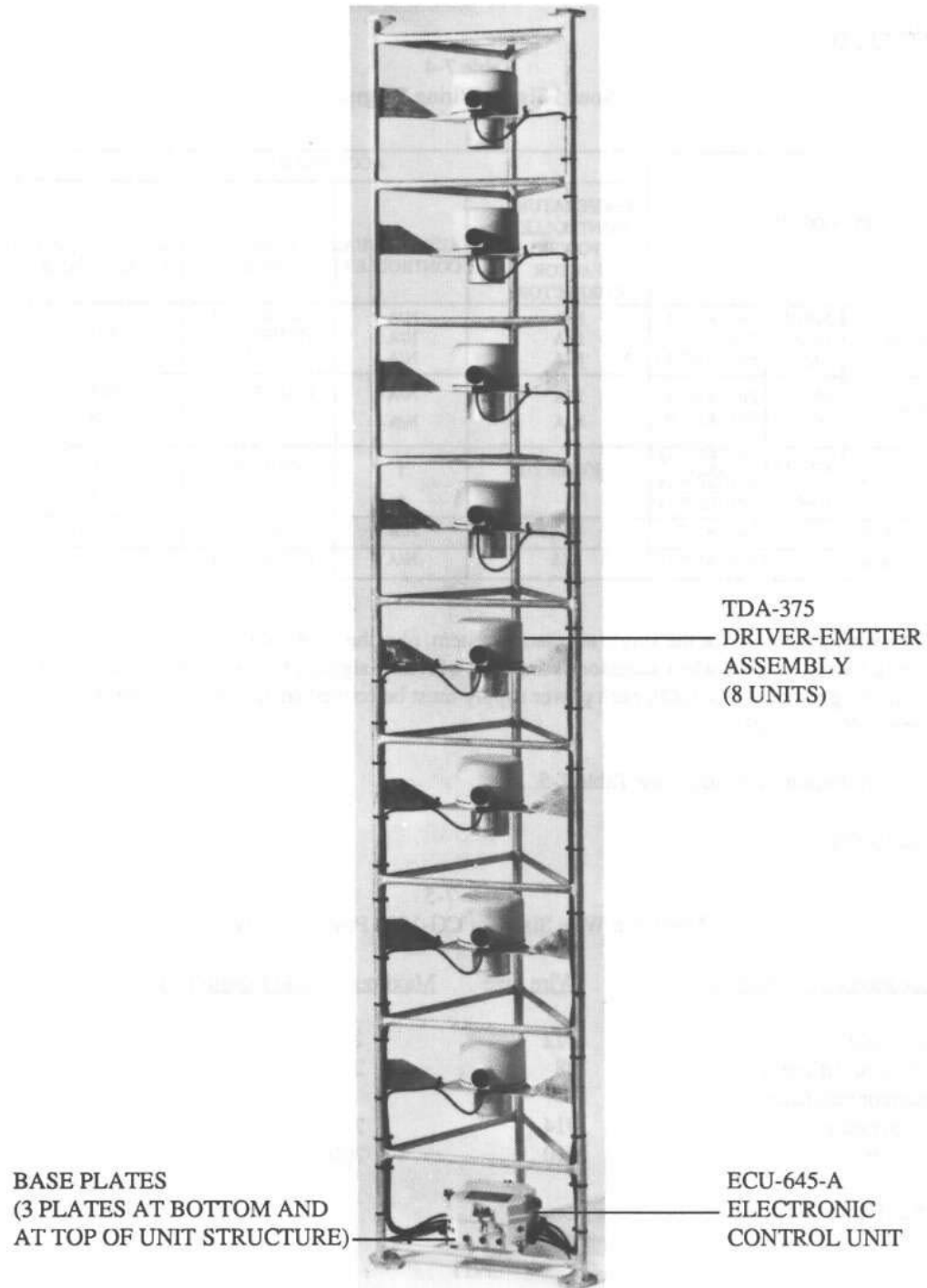
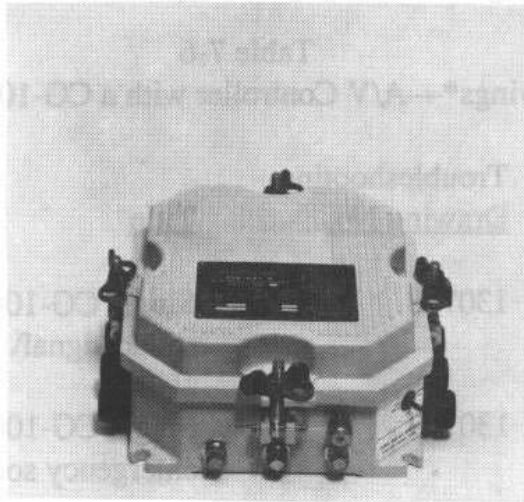
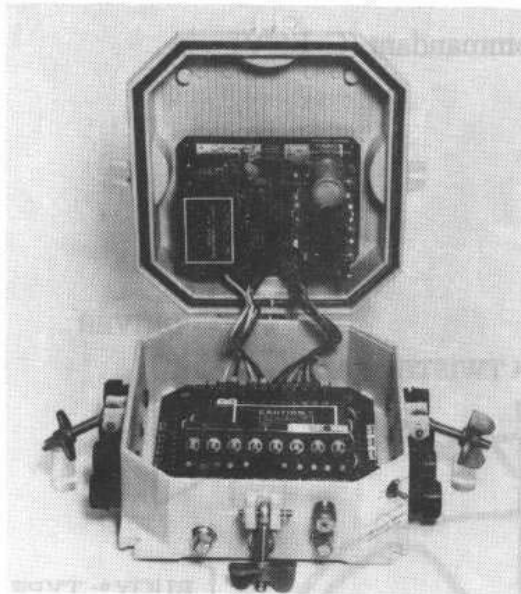


Figure 7-6. AB-860 power supply installation.

7.C.3.b.(1).



**ECU-645 CLOSED AND SECURED WITH 4 WING NUTS
(NOTE POWER REQUIREMENT GRAPH ON LID.)**



**ECU-645-A WITH OPEN LID
(NOTE PLUG-IN CIRCUITS.)**

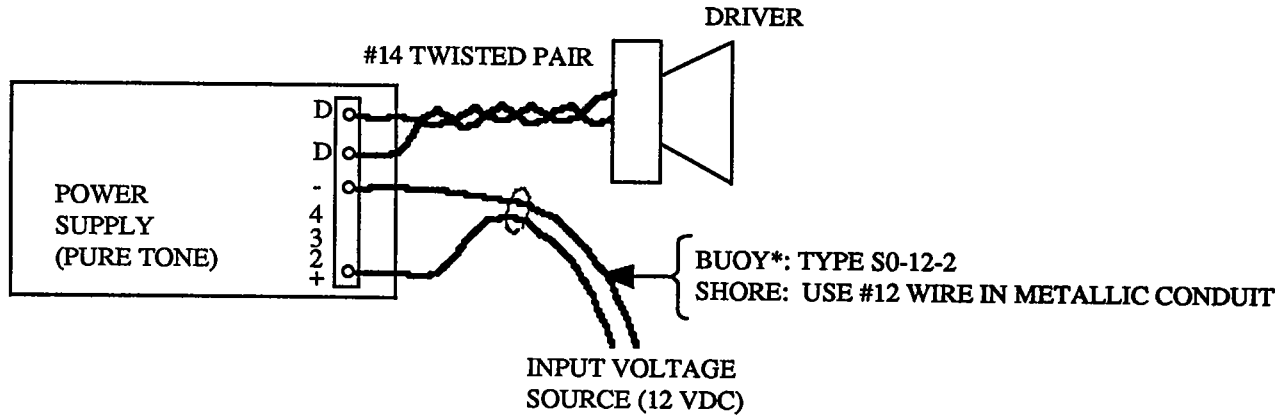
Figure 7-7. Electronic Control Unit.

7.C.3.b.(1).

Table 7-6
Standard Drawings*--A/V Controller with a CG-1000 Sound Signal

<u>Installation Drawing No.</u>	<u>Troubleshooting Drawing No.</u>	<u>Title</u>
130408	130708	Single CG-1000 with an emergency sound signal\
130409	130709	Single CG-1000 without an emergency sound signal
130410	130710	Dual CG-1000 with an emergency sound signal

*Drawings available from Commandant (G-ECV)



Wiring diagram for the FA-232 and the SA-850.

*Refer to Chapter 2 of this manual for buoy wiring instructions.

7.C.3.b.(1).

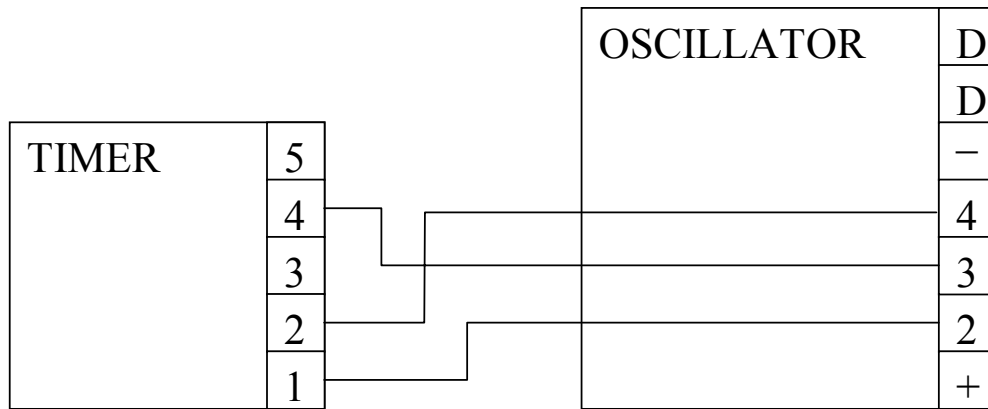
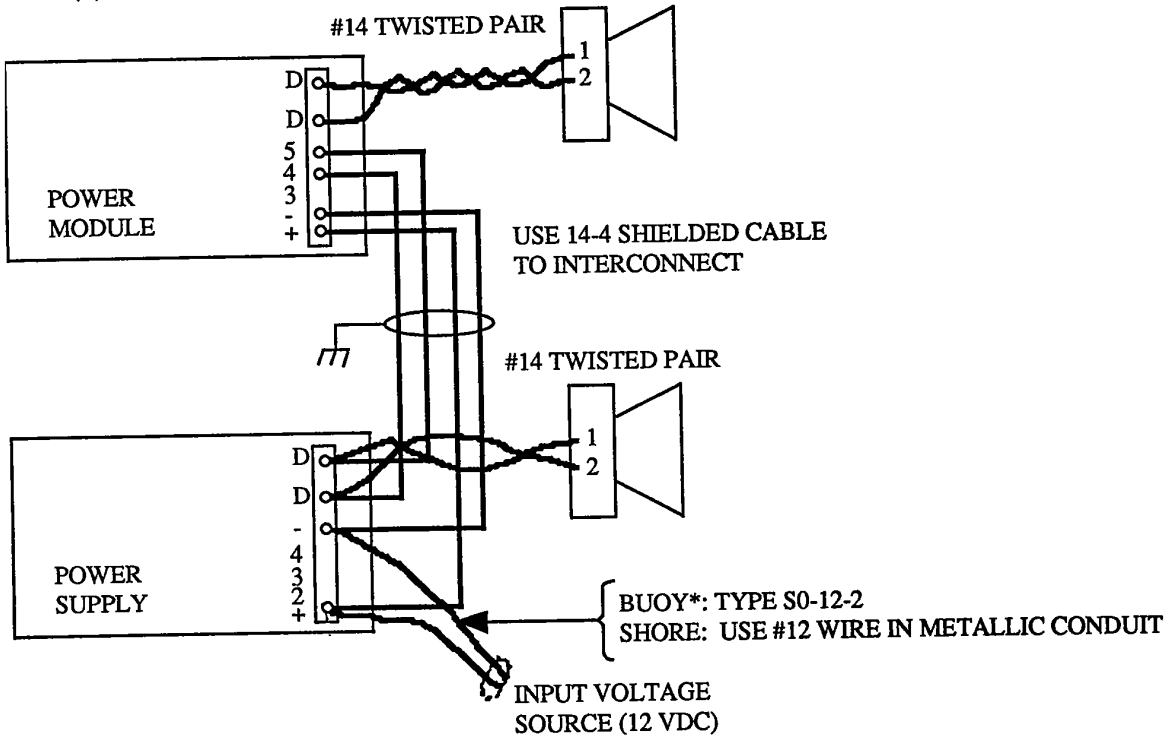


Figure 7-8A. Wiring diagram for the FA-232/SA-850 Timer and Oscillator.

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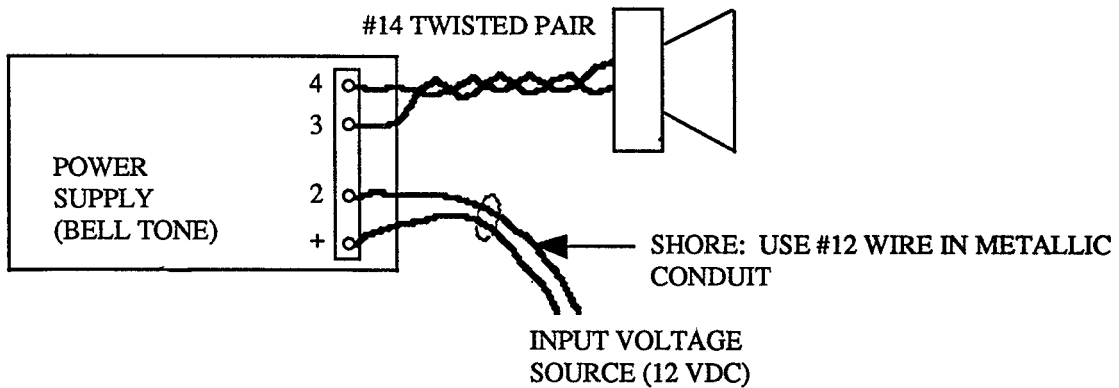
7.C.3.b.(1).



Wiring diagram for the FA-232/02 and the SA-850/02.

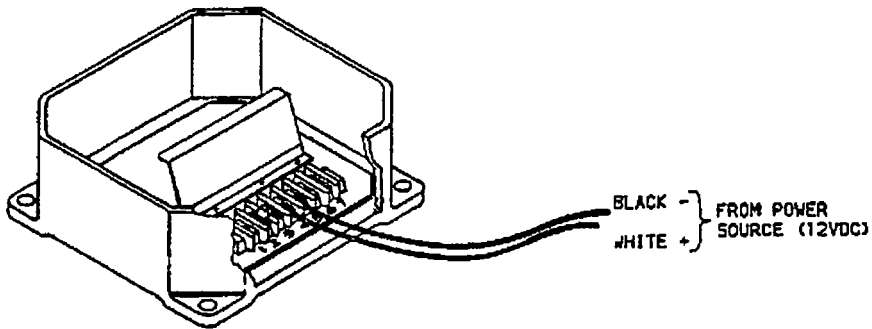
Note: The polarity of the interconnections and connections must be observed so that proper output can be obtained.

*Refer to Chapter 2 of this manual for buoy wiring instructions.

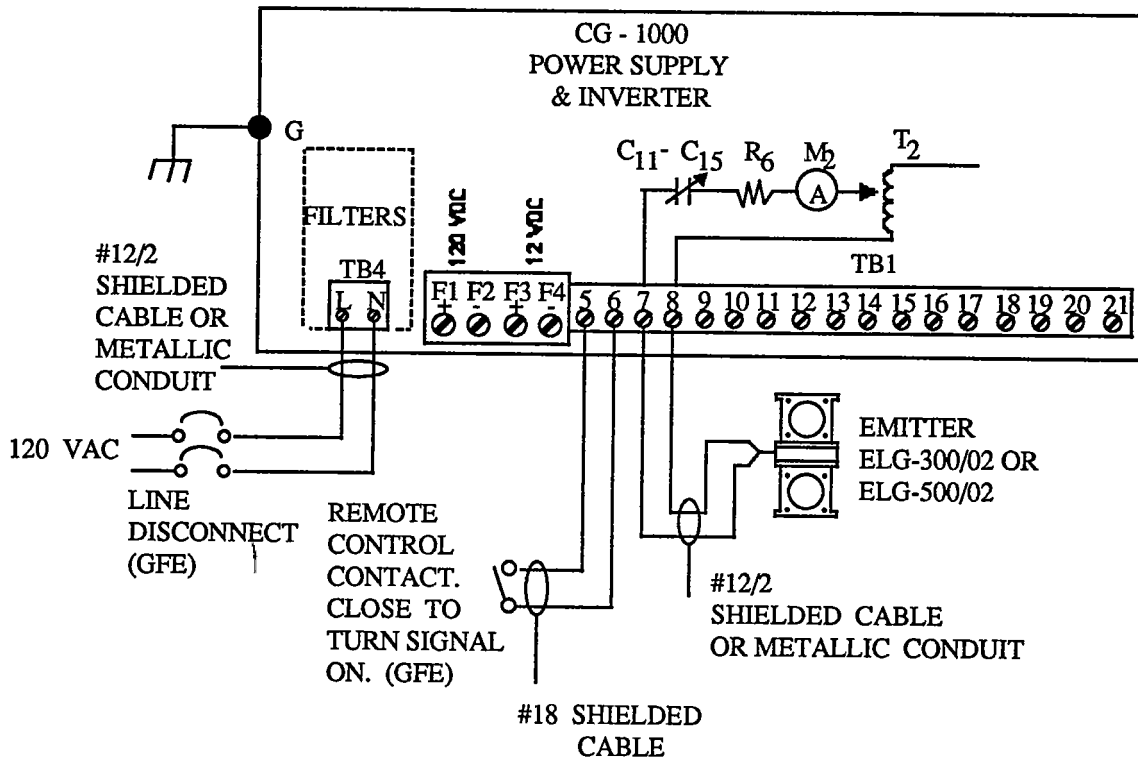


Wiring diagram for the FA-232 bell tone.

7.C.3.b.(1).

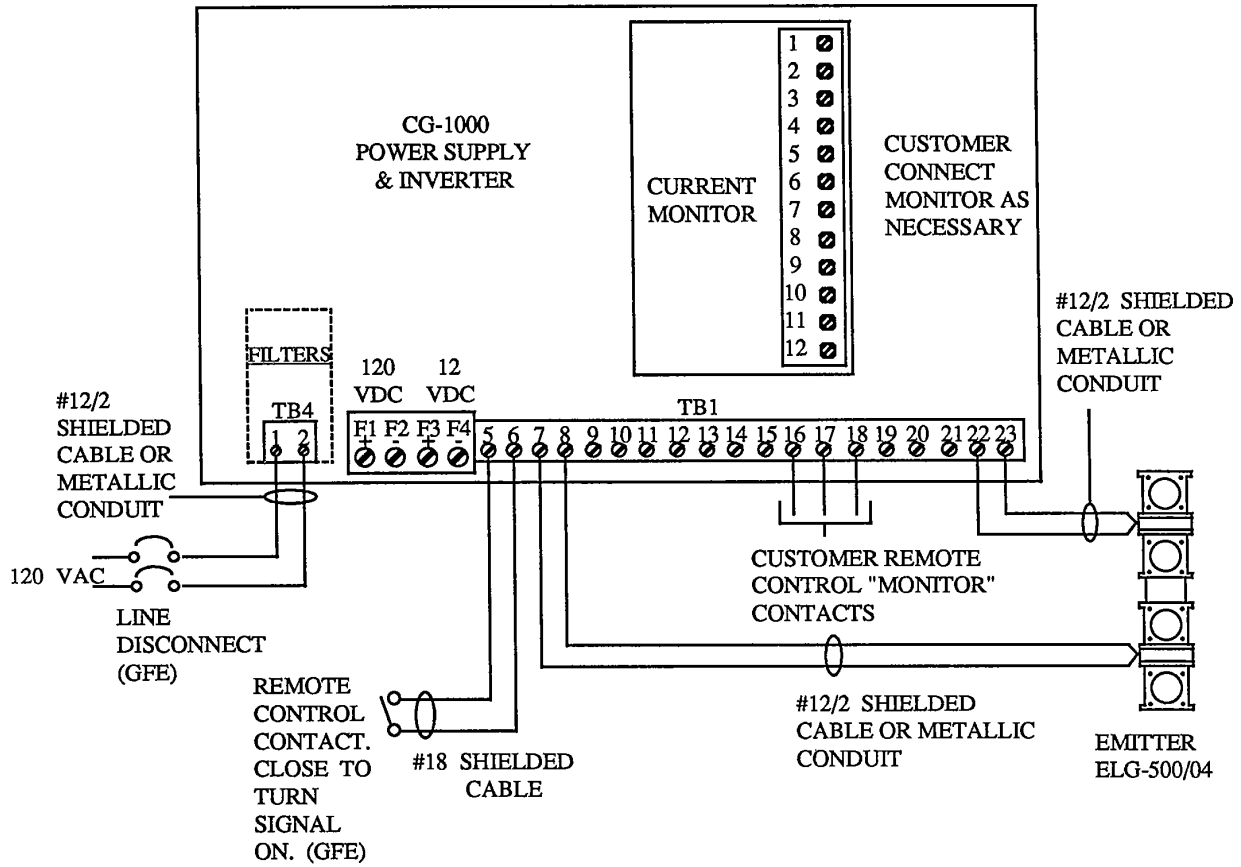


Wiring diagram for the AB-860.



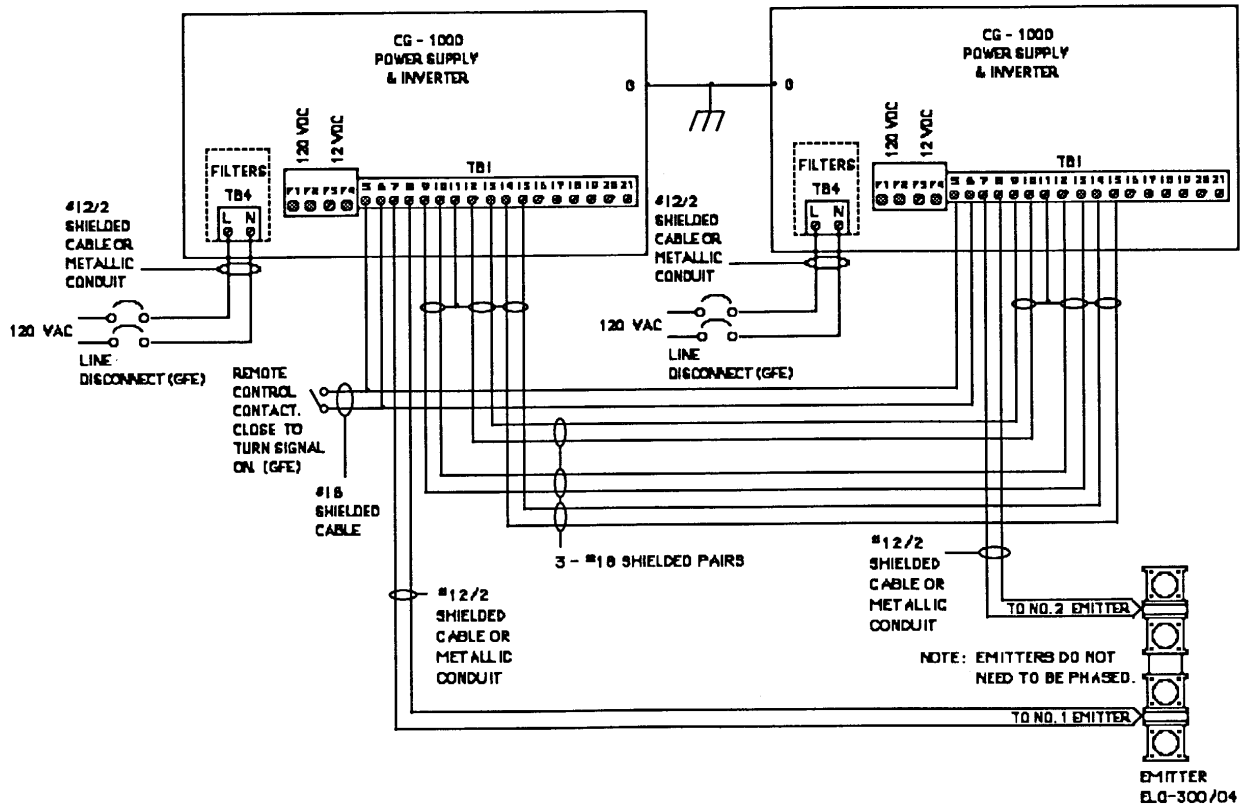
Wiring diagram for the single CG-1000, ELG-300/02 or ELG-500/02.

7.C.3.b.(1).



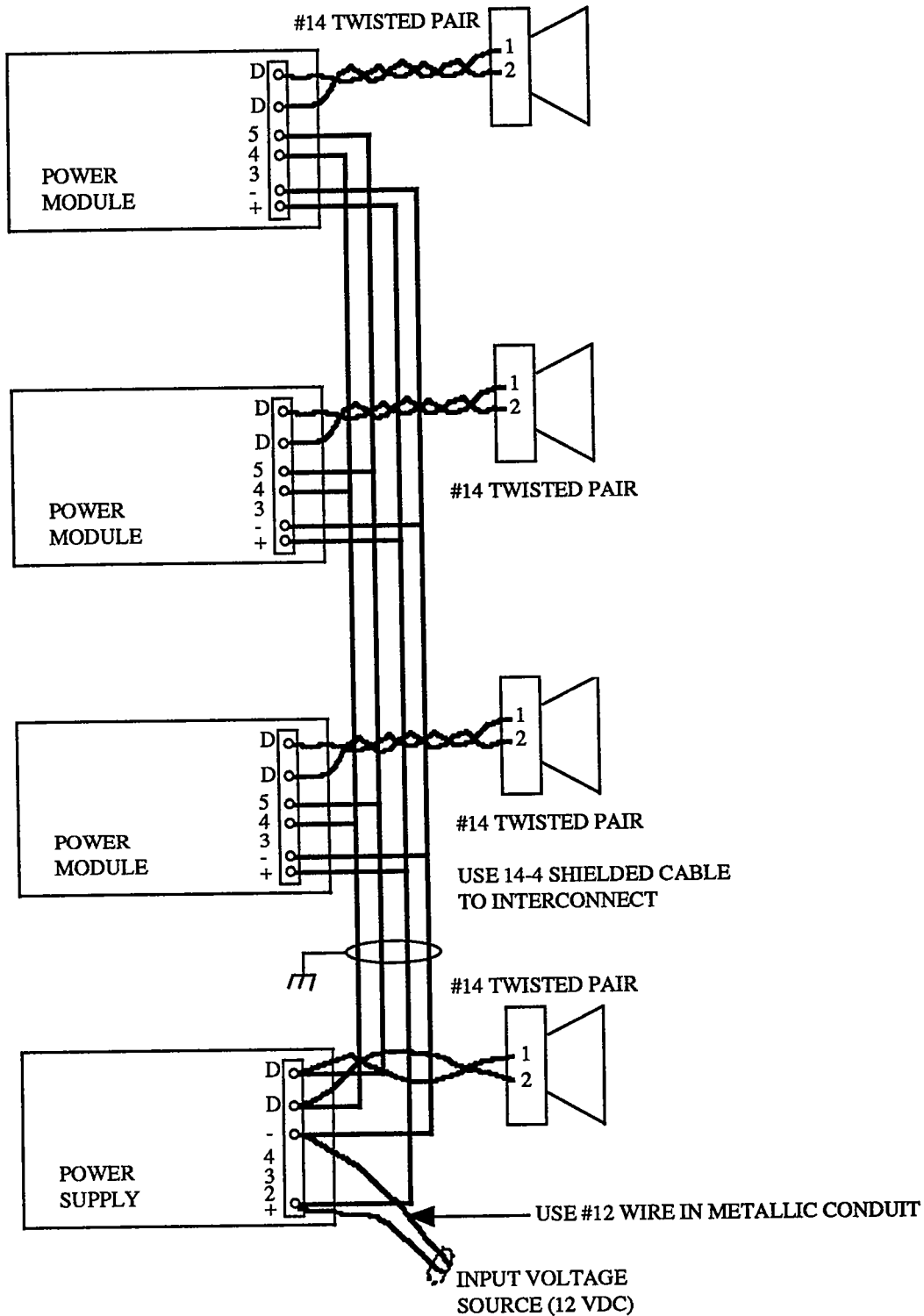
Wiring diagram for the single CG-1000, ELG-500/04.

7.C.3.b.(1).



Wiring diagram for the dual CG-1000, ELG-300/04.

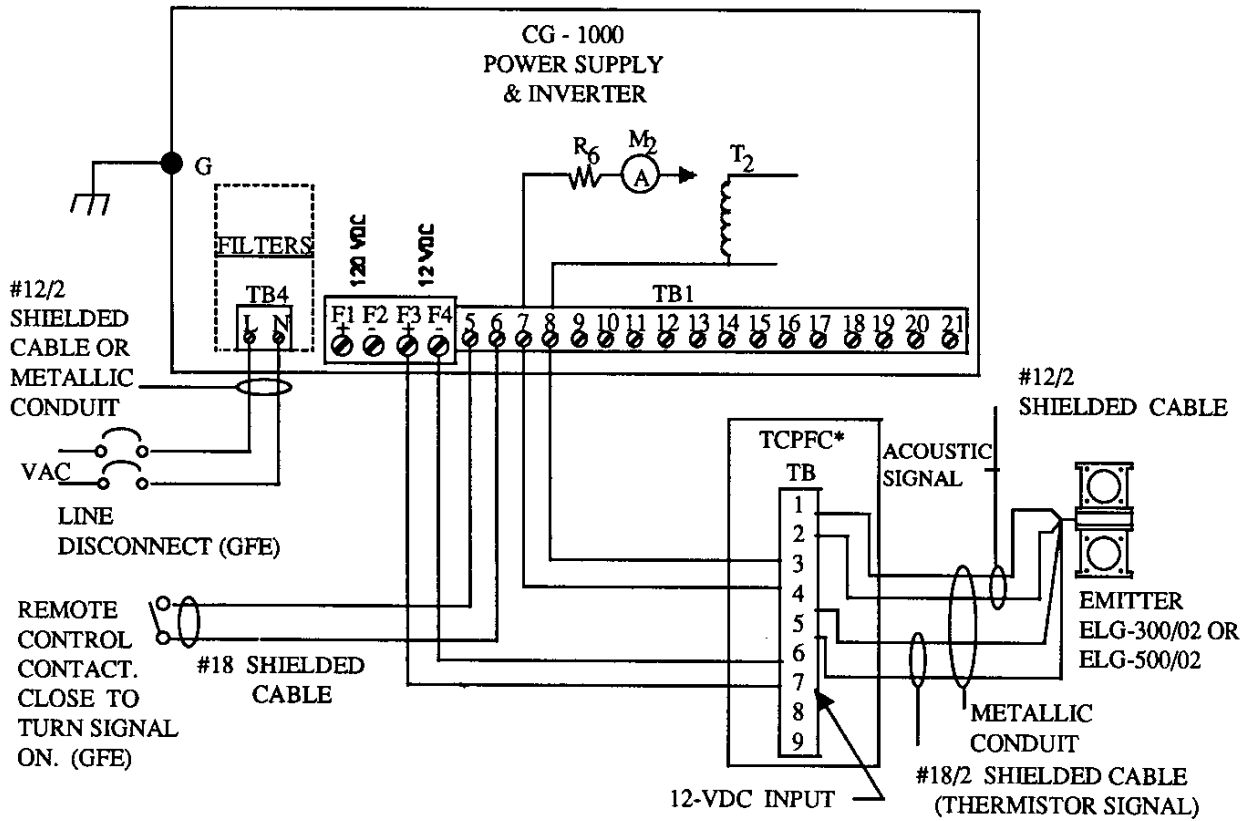
7.C.3.b.(1).



Wiring diagram for the SA-3C.

Note: The polarity of the interconnections and connections must be observed so that proper output can be obtained.

7.C.3.b.(1).

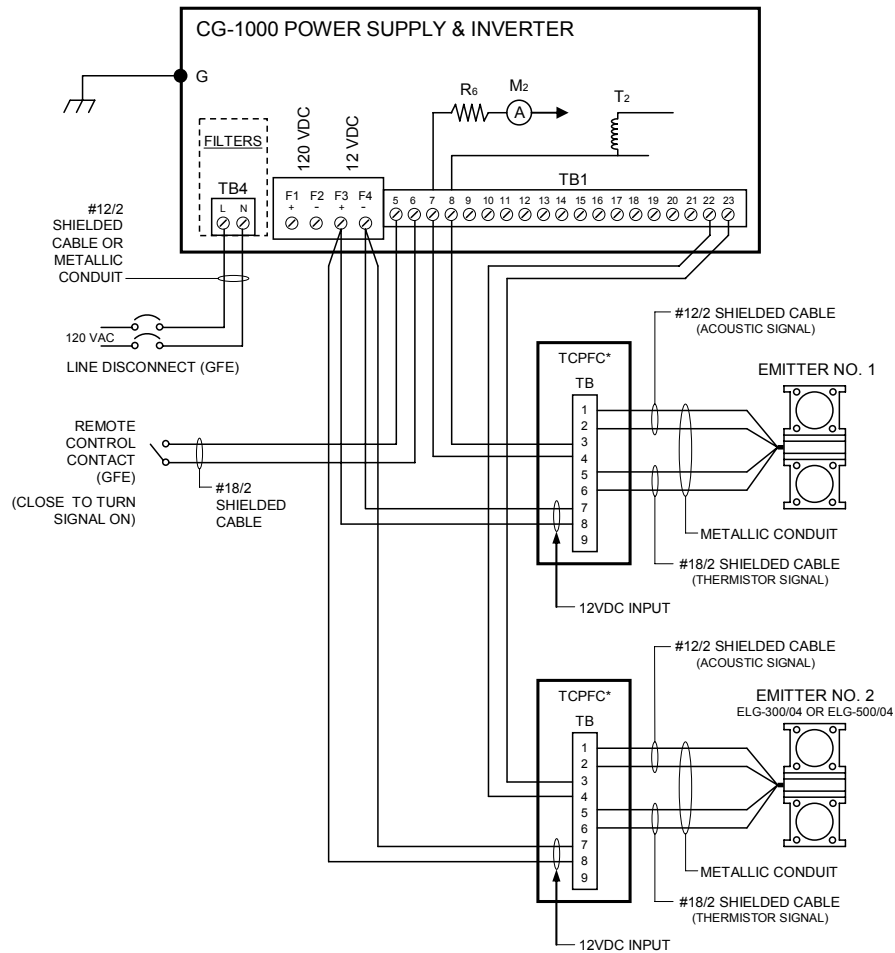


Wiring diagram for the temperature-controlled power factor corrector added to the CG-1000 system for the ELG-300/02 or ELG-500/02.

Note: When using the temperature-controlled power factor corrector, remove the power factoca-pacitors from the CG-1000 power supply and put them into the power factor corrector cabinet.

*Temperature-controlled power factor corrector.

7.C.3.b.(1).

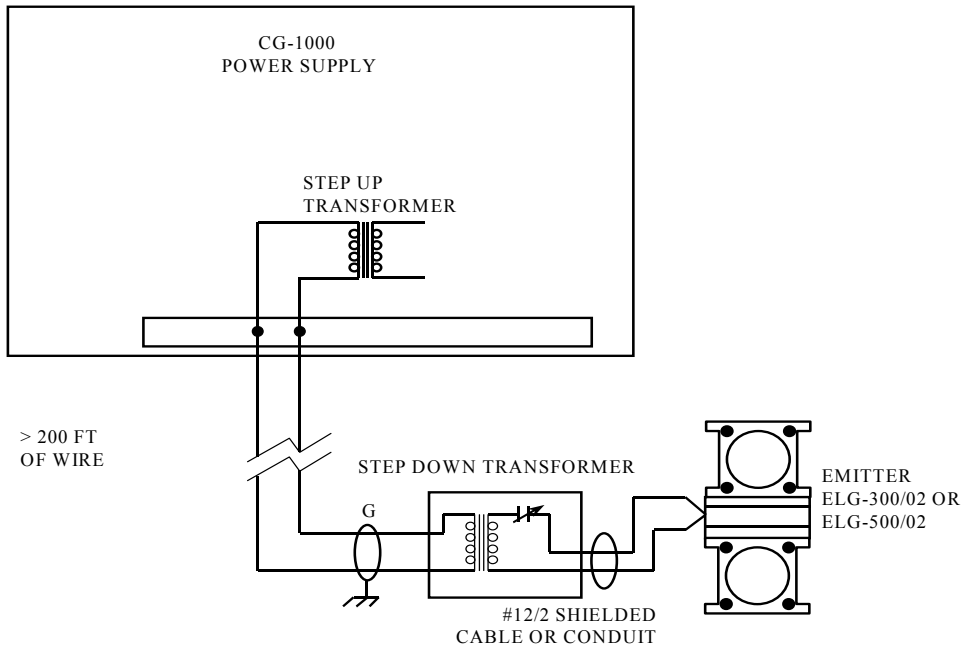


Note: When using the temperature-controlled power factor corrector, remove the power factor capacitors from the CG-1000 power supply and put them into the power factor corrector cabinet.

*Temperature-controlled power factor corrector.

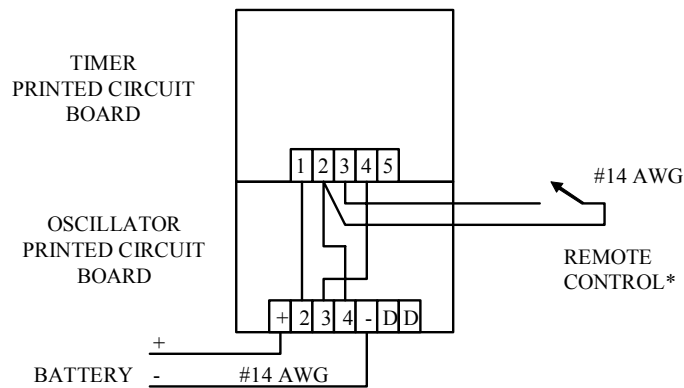
Figure 7-17. Wiring diagram for the temperature-controlled power factor corrector added to the CG-1000 system for the ELG-300/04 or ELG-500/04.

7.C.3.b.(1).



Note: When these transformers are used, the power factor capacitors must be moved from the power supply location to the emitter location. A watertight NEMA enclosure shall be used for this purpose.

Figure 7-18. Wiring diagram for a step up/step down transformer pair.

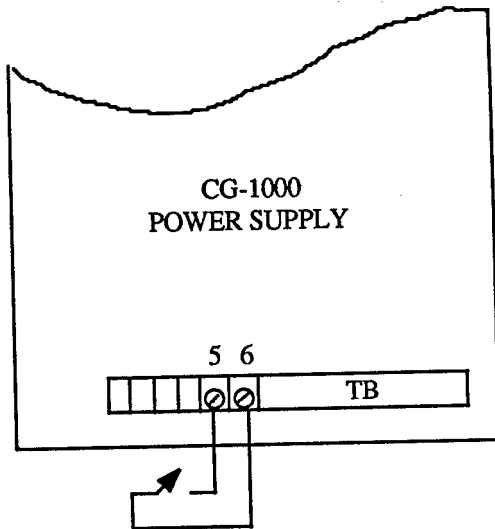


*Close contact to turn signal off.

Note: If continuous operation is desired, the remote control switch must be normally open.

Figure 7-19. Remote control connections for the FA-232 (puretone), SA-3C and the SA-850.

7.C.3.b.(1)



REMOTE CONTROL*

Remote control connections for the CG-1000 power supply.

*A NORMALLY CLOSED switch is required for continuous operation. An open switch causes the power supply to cease operation.

- (2) Remote Control. All sound signal systems described in this manual have two basic modes of operation--continuous or remote control. Remote control is defined as any external switch that activates or deactivates the signal, such as a fog detector, telephone-controlled relay, or a radio link. Each signal is provided with a pair of terminals that is used for remote control connections.

c. Characteristic Timing.

- (1) FA-232, SA-3C, SA-850. The timing characteristic for the FA-232, the SA-3C, the SA-850, the FA-232/02, or the SA-850/02 can be changed at the time of installation, if necessary. In order to obtain the correct characteristic, the appropriate diodes and jumper wires must be installed in accordance with the information supplied in the manufacturer's instruction book. Units manufactured after 1984 can have their timing characteristic changed by ordering the desired PROM from the manufacturer and installing the PROM on the Timer PC board.

- 7.C.3.c. (2) CG-1000 Supply. The characteristic timing of the CG-1000 power supply can be changed by replacing the coding time.
- (3) AB-860. The AB-860 uses one of two timers which determine the code characteristic. For simple on-off codes the Standard Timer is used; for any complex mode (including any Morse Code character), the Universal Timer is used. To obtain the correct characteristic, the potentiometers on the timer circuit card must be adjusted in accordance with the information supplied in the manufacturer's instruction book.

d. Output Level.

- (1) FA-232, SA-3C, SA-850. At the time of installation, the output sound pressure level can be lowered by 6 dB by placing the output level switch in the "LOW" position. This reduces the usual range of these signals from 1/2 nmi to 1/4 nmi. This level (or usual range) is to be set as specified by ATONIS. When installing either the FA-232/02, the SA-3C, or the SA-850/02, the level switch of the power supply must be left in the "HIGH" position.
- (2) CG-1000 System. The "horn level" control and the power factor capacitors require special adjustments during installation. The horn level control adjusts the output current, which ultimately sets the range of the signal (Data Sheet 7-E(3), Figure 7-30; Data Sheet 7-E(4), Figure 7-34).

This current is to be set as specified by ATONIS.

Power factor correction is usually set at the factory, but power factor adjustment is required when the emitter tone warbles, when the adjustment of the output level control will not maintain the proper output current, or when the voltages shown in Table 7-7 cannot be obtained.

- (3) AB-860. Under normal circumstances, testing of the output sound pressure level upon unit installation should not be necessary. If components have been damaged during shipment, refer to manufacturer's instruction book for adjustments.

7.C.3.d.

Table 7-7
CG-Power Factor Voltages

	<u>CG-1000</u> <u>ELG-500/02</u>	<u>CG-1000</u> <u>ELG-500/04*</u>	<u>CG-1000</u> <u>ELG-300/02</u>
Power factor	0.8	0.8	0.8
Emitter voltage	350-400	350-400	350-400
Capacitor voltage	325-375	325-375	325-375
Voltage difference	35-55	35-55	35-55
∇^{**}	20	20	20

*The voltages shown are applicable for each emitter being driven by the power supply.

**This voltage is the number of volts that will be added or subtracted with a 1F change to the power factor capacitor bank.

7.D. Inspection, Maintenance, and Repair on Station.

1. Inspection. Sound signal inspection and preventive maintenance shall be accomplished on a semiannual basis or as indicated in Table 7-9.
2. Maintenance Policy. All sound signal maintenance and repair on station shall be accomplished by module replacement only. Module replacement refers to replacement of printed circuit boards, transformers, and other major components. On-station repair of printed circuit boards is prohibited. To protect hearing, see Table 7-8 when working near operating sound signals.
3. Additional Information. For information on maintenance and repair that is not covered in this manual, consult the manufacturer's instruction booklet and National Aids to Navigation School Publications.

Table 7-8
Sound Signal Minimum Safe Distances for Personnel
Not Wearing Hearing Protection

<u>Sound Signal Apparatus (dbA @ 1 meter)</u>	<u>Minimum Safe Distance in ft.</u>
1. FA-232 (118 dbA)	50
2. FA-232/02 (124 dbA)	90
3. SA-850 (119 dbA)	50
4. SA-850/02 (125 dbA)	100
5. ELG-300/02 (136 dbA)	370
6. ELG-300/04 (140 dbA)	580
7. ELG-500/02 (134 dbA)	290
8. ELG-500/04 (140 dbA)	580
9. SA-3C (133 dbA)	280
10. AB-360 (131 dbA)	210

NOTES:

1. If personnel must work closer to an operating sound signal than the "minimum safe distance", then authorized ear protection (see page 7-27) must be worn.
2. If personnel must work closer than 25 ft. from items 5, 6, 7, or 8, the power valve or switch (air or electrical) or panel door providing access shall be locked with power to the signal secured. The worker shall keep the key to the padlock in his possession. The lock shall be tagged "Secured-Man working on Sound Signal". Electrical lock switches are standard navy stock. Electrical lockouts may be obtained locally.
3. The minimum safe distances have been calculated for a 10% duty cycle. For 15% and 20% duty cycles the minimum safe distances will be increased by 24% and 42%, respectively.

7.D.4. Hearing Protection Devices. Ear plugs and ear muffs reduce ambient noise by approximately 30 decibels (dB) and the minimum safe distances by 90 percent. Plain cotton will not provide any hearing protection whatsoever. The following are applicable stock numbers (NSN) for the authorized hearing protection devices:

David Clark Muff	4240-00-759-3290
Replacement Seal	4240-00-979-4040
E-A-R Ear Plugs universal, disposable, boxed 200 pairs	6515-00-137-6345

5. Hearing Conservation Program. When personnel are routinely exposed to hazardous noise levels (with or without) hearing protection, a hearing conservation program must be implemented in accordance with COMDTINST M5100.29, *Safety and Occupational Health Manual*. Audiometric testing shall be performed in accordance with COMDTINST M6260.15, *Occupational Medical Monitoring Manual*.
6. Sound Signal Warning Signs. To prevent hearing loss to casual visitors near sound signalling apparatuses, warning signs visible from any approach shall be posted on or near the signal and shall read:

DANGER
KEEP 100 FEET AWAY
INTENSE SOUND SIGNAL MAY
SOUND WITHOUT WARNING

They are available from UNICOR FTS 783-7035. Identify yourself as a Coast Guard unit.

7.D.6.

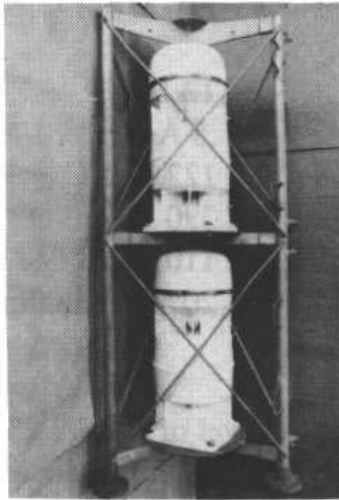
EQUIPMENT TASK	FA-232	FA-232/02	SA-850	SA-850/02	SA-3C	AB-860	CG-1000	ELG-300/02	ELG-300/04	ELG-500/02	ELG-500/04	KEY: * EACH VISIT (SEMIANNUALLY OR UNSCHEDULED) S SEMIANNUALLY, SPRING AND FALL A ANNUALLY
	NOTES											
CHECK CHARACTERISTIC	*	*	*	*	*	*	*					3% TOLERANCE IS ALLOWED
CHECK INPUT VOLTAGE	* 11-15 Vdc	* 11-15 Vdc	* 11-15 Vdc	* 11-15 Vdc	* 11-15 Vdc	* 10-14 Vdc	* 120 Vac					
CHECK EMITTER VOLTAGE	* 20-30 Vac	* 20-30 Vac	* 20-30 Vac	* 20-30 Vac	* 20-30 Vac	* 15 Vac		S 360-400 Vac	S 360-400 Vac	S 360-400 Vac	S 360-400 Vac	WITH MULTIPLE ARRAYS, EACH EMITTER MUST BE CHECKED
CHECK POWER FACTOR CAPACITOR VOLTAGE							S 325-375 Vac					WITH MULTIPLE ARRAYS, EACH EMITTER MUST BE CHECKED
CHECK VOLTAGE DIFFERENCE							S 35-55 Vac					WITH MULTIPLE ARRAYS, EACH EMITTER MUST BE CHECKED
CHECK EMITTER CURRENT							*					AS SPECIFIED ON ATONIS FORMS
CHECK EMITTER LEVEL SWITCH	*	*	*	*								SINGLE SIGNALS, AS SPECIFIED HIGH POSITION ONLY
ADJUST EMITTER CURRENT MONITOR							*					
VERIFY THAT EACH EMITTER IS WORKING		*		*		*			S		S	
REMOVE DEBRIS FROM EMITTER	*	*	*	*	*	*		*	*	*	*	
CLEAN DRAIN HOLES								A	A	A	A	
CHECK BATTERY	*	*	*	*	*	*						REFER TO CHAPTER 9 FOR BATTERY MAINTENANCE

Sound Signal Inspection Chart

7.E. General Description Data Sheets.



FA-232



FA-232/02

Function. The FA-232 and the FA-232/02 are sound signals with 1/2- and 1-nmi usual ranges, respectively. They can be used as the primary sound signal or the emergency backup signal at fixed locations or on structures.

These two signals are primarily used on stations where batteries are the only source of power. However, with the addition of a 120-Vac to 12-Vdc converter, both sound signals can be used on commercial power.

Physical Characteristics.

- Omnidirectional
- Directional (with plugs)
- Lightweight
- Compact and self-contained
- Corrosion resistant
- Waterproof
- 12-Vdc operation
- Low current drain
- Operates with any standard Coast Guard characteristics.

Data Sheet 7-E(1).

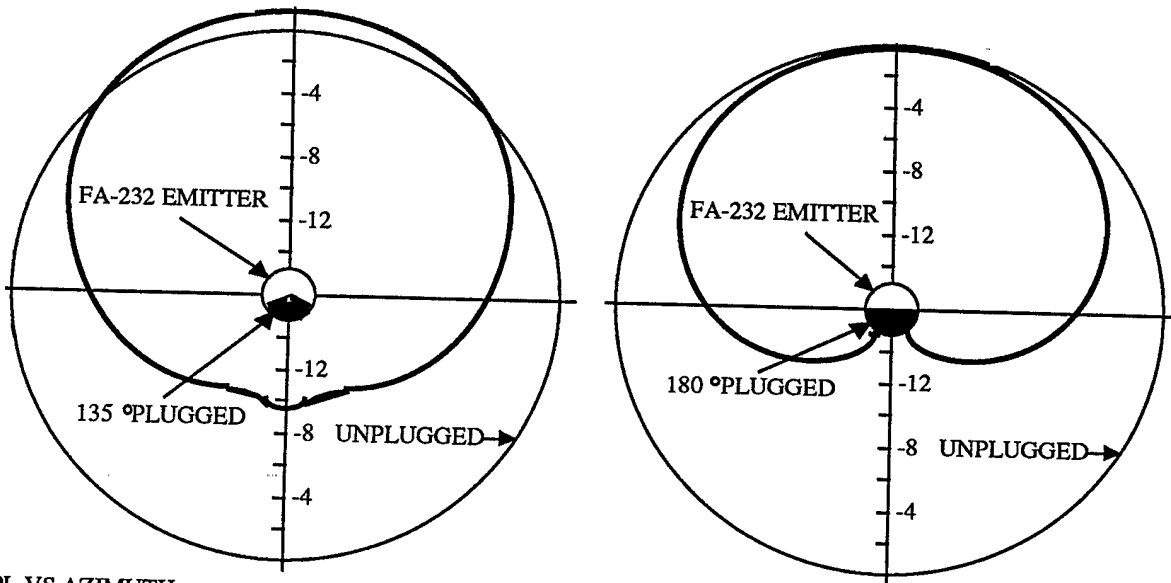
7.E.

Electrical, Acoustical, and Mechanical Characteristics.

	<u>FA-232</u>	<u>FA-232/02</u>
Voltage source	12 Vdc	12 Vdc
Current Drain 1	.8 A	3.6 A
Acoustical level	122.7 dBC	128.7 dBC
Acoustical frequency	390 Hz	390 Hz
Weight	110 lb	700 lb
Duty cycle	20% maximum	20% maximum

Output Level. The output level of the FA-232 can be reduced to 116.7 dBC by using the switch on the electronic power supply. This reduces the usual range of the signal to 1/4 nmi. The output level of the FA-232/02 cannot be reduced. The output level (dBC) varies proportionately with the square of the input voltage.

Directional Adaptation. The FA-232 and FA-232/02 signals can be made directional by using plugs (manufacturer's part no. 3030-0100). Figure 7-21 shows how the horizontal polar pattern is modified with the use of either three or four pairs of plugs (Figure 7-22).



**SPL VS AZIMUTH
EMITTER UNBAFFLED
6 PLUGS (3 ON TOP, 3 ON BOTTOM)**

**SPL VS AZIMUTH
EMITTER UNBAFFLED
8 PLUGS (4 ON TOP, 4 ON BOTTOM)**

Polar plots for a plugged FA-232 or FA-232/02.

Data Sheet 7-E(1). (cont'd).

7.E.

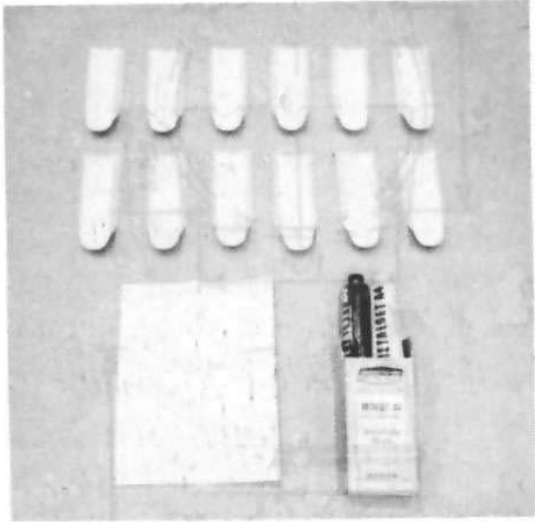


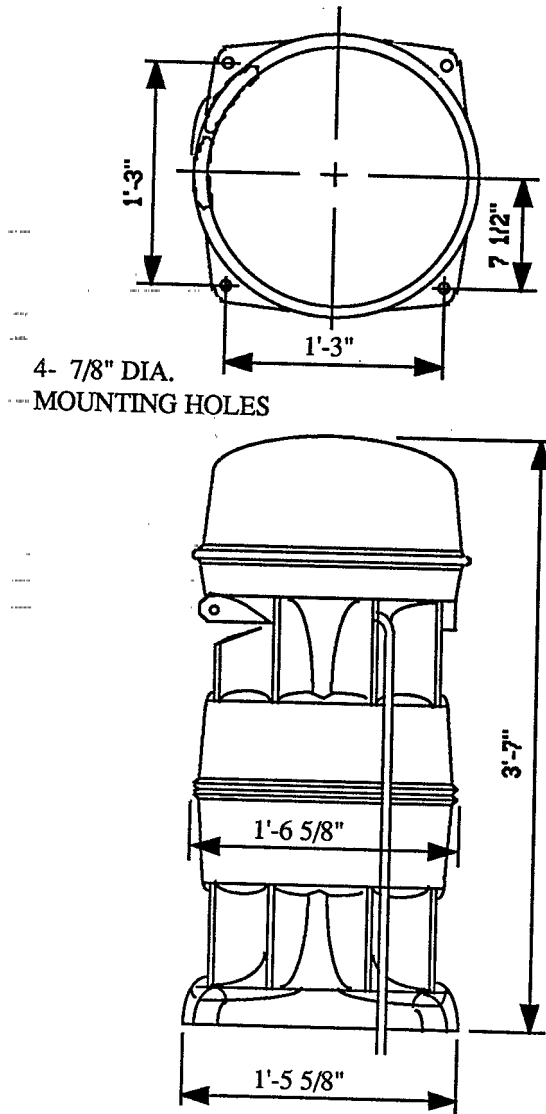
Figure 7-22. Plug kit, part no. 3030-0100.

FA-232/02 Components. The FA-232/02 is made up of two FA-232 fiberglass housings, two FA-232 drivers, one FA-232 electronic power supply, one power amplifier, and one galvanized steel tower. The special items (power amplifier and tower) are available from the manufacturer.

Dimensions. The dimensions of the FA-232 and the FA-232/02 are given in Figures 7-23 and 7-24.

Data Sheet 7-E(1). (cont'd).

7.E.



Dimensions of the FA-232.

Related Equipment. These signals are designed to be used as delivered; only a power source is required. They can be controlled by a fog detector, a telephone-controlled relay, or a radio link. When used as emergency backup signals, they are battery powered and controlled by the NA-VAID sensor module through the audio-visual controller.

When the FA-232 is used with the standard baffle, the sound pressure level (SPL) is reduced on the back side by approximately 30 dB. If the baffle is used with the FA-232/02, the metal tower arrangement shown in Figure 7-24 is not used.

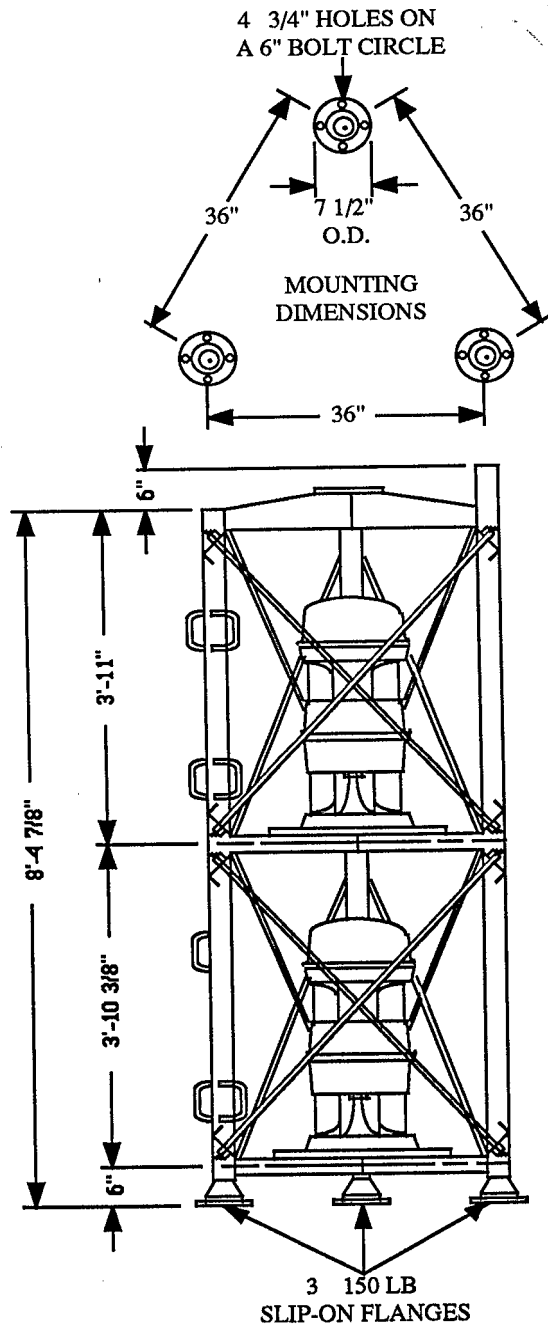
Data Sheet 7-E(1). (cont'd).

7.E.

Additional Data. The FA-232 pure-tone sound signal can be converted to a bell-tone type signal. This is done by replacing the existing power supply and the driver with the FA-232 bell-tone conversion assembly kit. For a single stroke per period, use manufacturer's part no. 1000-9106; for two strokes per period, use part no. 1000-9107; for three strokes per period, use part no. 1000-9108.

Manufacturer.

Automatic Power, Inc.
P.O. Box 230738
Houston, Texas 77223-0738

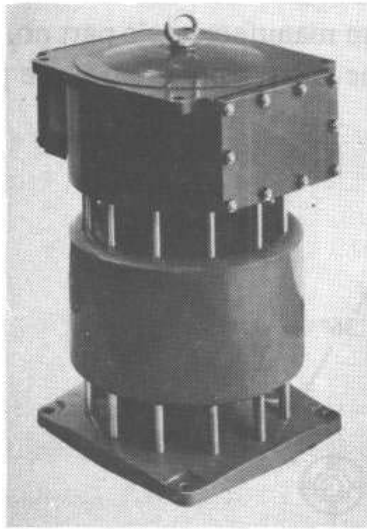


Dimensions of the FA-232/02.

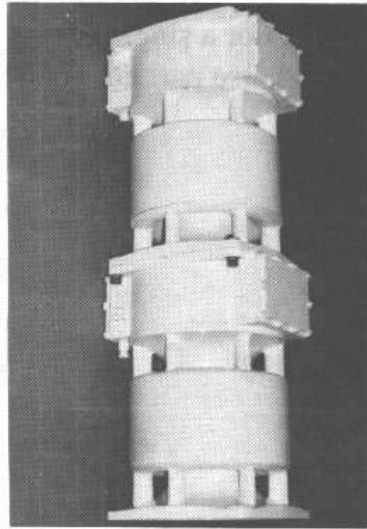
Data Sheet 7-E(1). (cont'd).

7.E.

SA-850 AND SA-850/02



SA-850



SA-850/02

SA-850

SA-850/02

Function. The SA-850 and the SA-850/02 are sound signals with 1/2- and 1-mi usual ranges, respectively, that are used on buoys or in remote places. The SA 850/02 is also used on LNB's. The SA-850 and SA-850/02 shall not be located nearer than 2 and 2-1/2 mi, respectively, from the closest residence. These distances shall be observed for either fixed or buoy installations.

Physical Characteristics.

- Omnidirectional
- Lightweight
- Compact and self-contained
- Corrosion resistant
- Waterproof
- 12-Vdc operation
- Low current drain
- Operates with any standard Coast Guard characteristics.

Data Sheet 7-E(2). SA-850 and SA-850/02 sound signal systems.

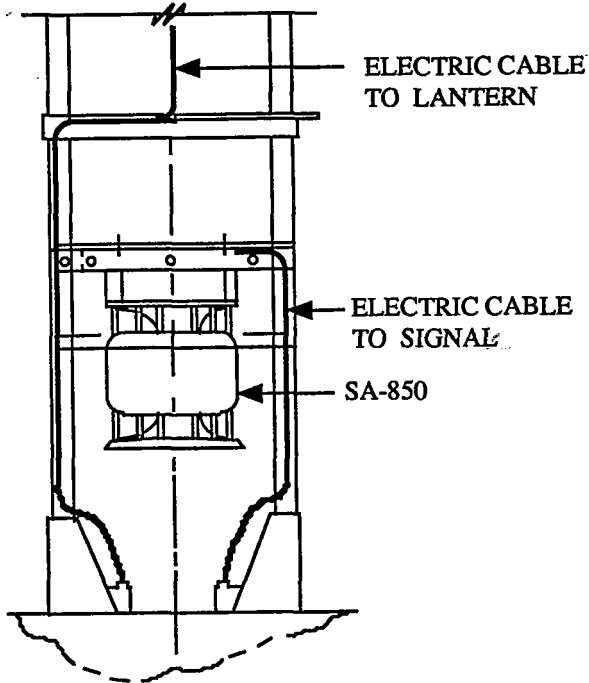
7.E.

Electrical, Acoustical, and Mechanical Characteristics

	SA-850	SA-850/02
Voltage source	12 Vdc	12 Vdc
Current Drain	1.25 A	3.25 A
Acoustical level	119.6 dBC	125.6 dBC
Acoustical frequency	850 Hz	850 Hz
Weight	128 lb	256 lb
Duty cycle	20% maximum	20% maximum

Output Level. The output level of the SA-850 can be reduced to 113.6 dBC by using the switch on the electronic power supply which is behind the cover on the side of the emitter housing. This reduces the usual range of the signal to 1/4 nmi. The output level of the SA-850/02 cannot be reduced. Both signals are primarily used on stations where batteries are the only source of power. The output level (dBC) varies proportionately with the square of the input voltage.

Buoy Installations. The SA-850 can be installed on 6X20 LR, 7X17 LR, and 8X26 LR buoys, as shown in Figures 7-25 (a), (b), and (c).

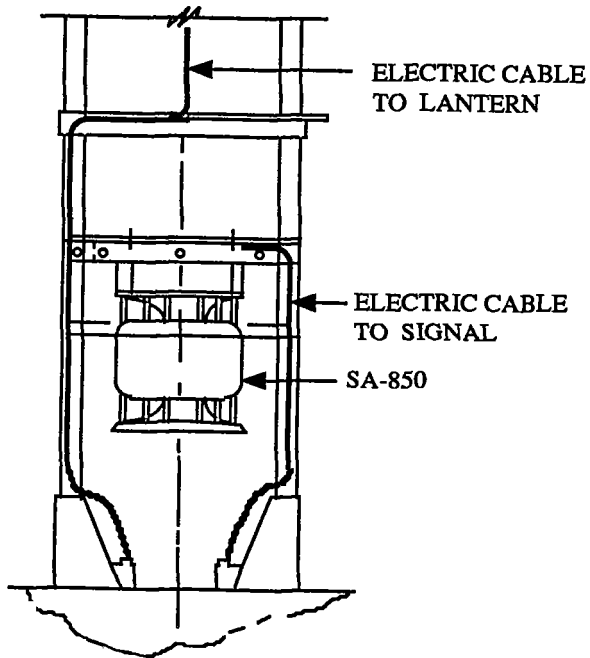


SA-850 installed on a 6X20 LR buoy.

Note: Modifications shall be made in accordance with Commandant (G-ECV) Drawing No. 120320.

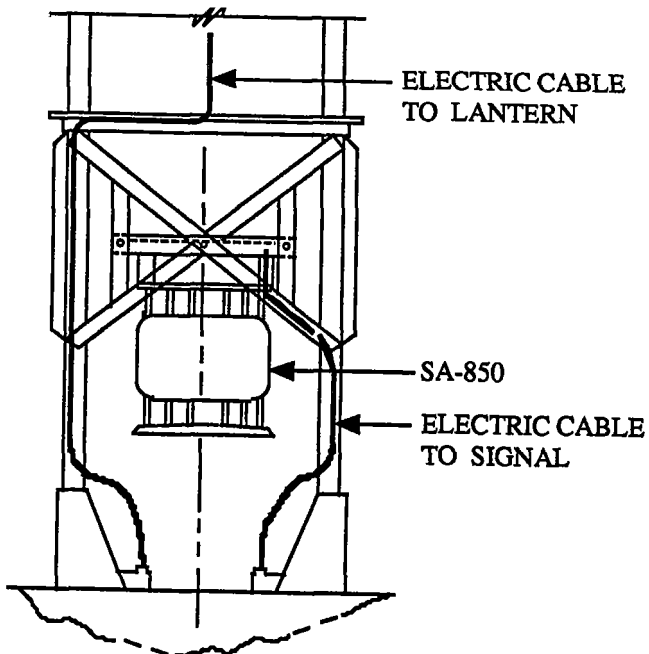
Data Sheet 7-E(2). (cont'd).

7.E.



SA-850 installed on a 7X17 LR buoy.

Note: Modifications shall be made in accordance with Commandant (G-ECV)
Drawing No. 120321.



SA-850 installed on an 8X26 LR buoy.

Note: Modifications shall be made in accordance with Commandant (G-ECV)
Drawing No. 120322.

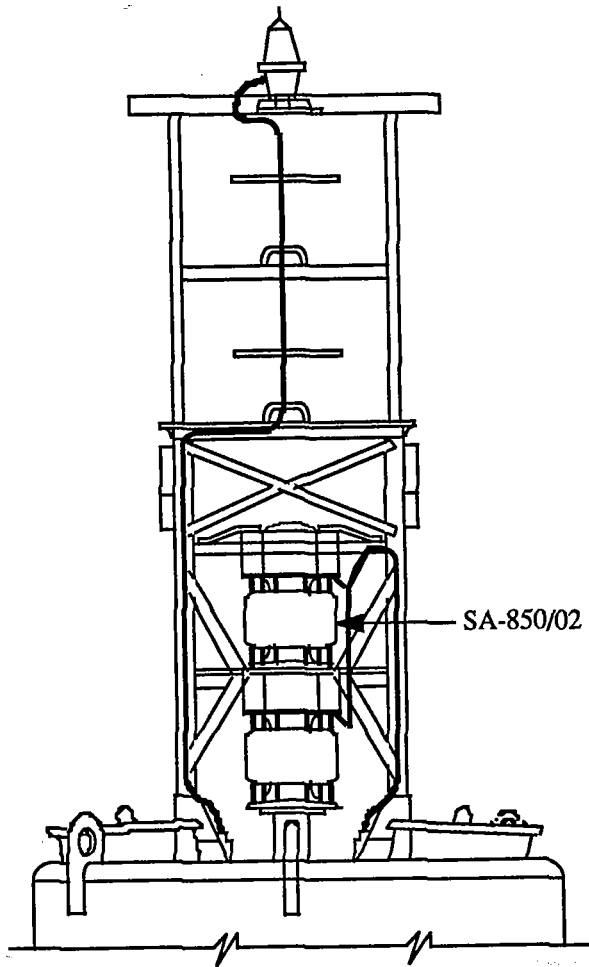
7.E.

SA-850/02 Components. The SA-850/02 is made up of two SA-850 emitter housings bolted together (no additional supporting structure is needed), two SA-850 drivers, one SA-850 power supply, and one power amplifier. The amplifier is available from the manufacturer. The SA-850/02 signal shall be installed on 1962-type, 8X26 LR buoys, as shown in Figure 7-26 and on LNB's as shown in Figure 7-27.

Dimensions. The dimensions of the SA-850 and the SA-850/02 are given in Figures 7-28.

Manufacturer.

Automatic Power, Inc.
P.O. Box 230738
Houston, Texas 77223-0738

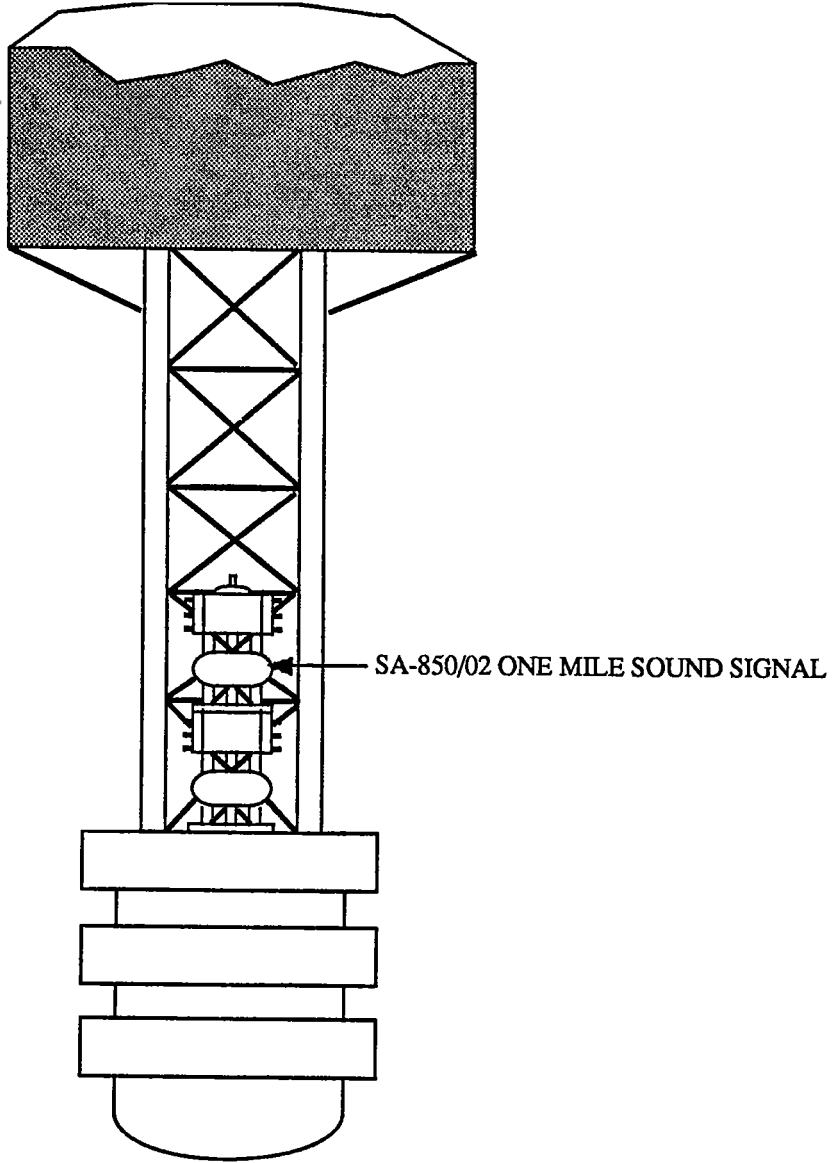


SA-850/02 installed on a 1962-type, 8X26 LR buoy.

Note: Modifications shall be made in accordance with Commandant (G-ECV)
Drawing No. 120077.

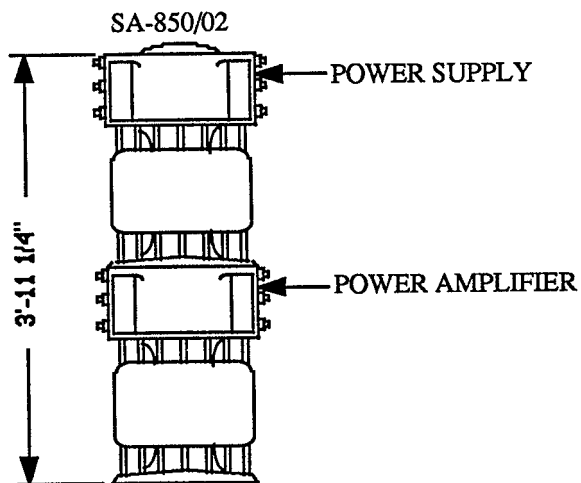
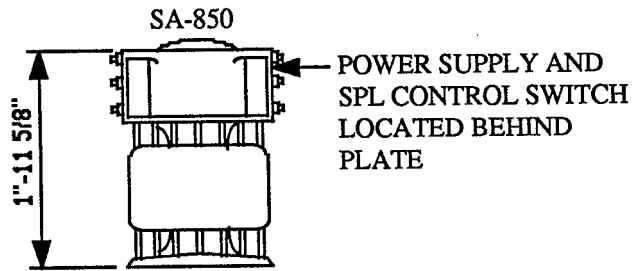
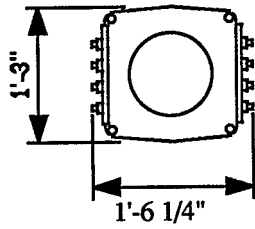
Data Sheet 7-E(2). (cont'd).

7.E.



Data Sheet 7-E(2). (cont'd).

TOP VIEW OF BOTH SIGNALS



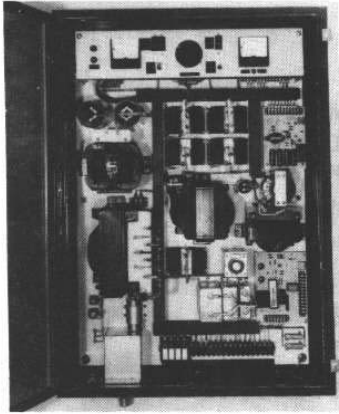
Dimensions of the SA-850 and SA-850/02.

Note: With the SA-850/02, there is no means of varying the output level or usual range.

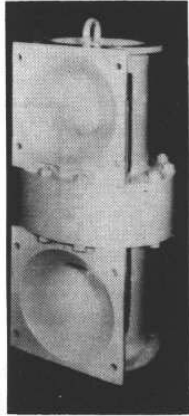
Data Sheet 7-E(2). (cont'd).

7.E.

CG-1000, ELG-300/02, ELG-300/04



CG-1000 Power Supply



ELG-300/02 Emitter

CG-1000, ELG-300/02 and ELG-300/04 sound signal systems.

Function. The CG-1000, ELG-300/02 sound signal system and the two CG-1000's, ELG-300/04 sound signal system are non-standard 3- and 4-nmi sound signals, respectively. They are used as primary sound signals on shore stations or on structures and are never used on buoys.

Physical Characteristics.

- Directional
- Variable range
- 120-Vac operation
- Corrosion resistant
- Waterproof
- Operates with any standard Coast Guard characteristics.

Data Sheet 7-E(3). CG-1000, ELG-300/02 and ELG-300/04 sound signal systems.

7.E.

Electrical, Acoustical, and Mechanical Characteristics

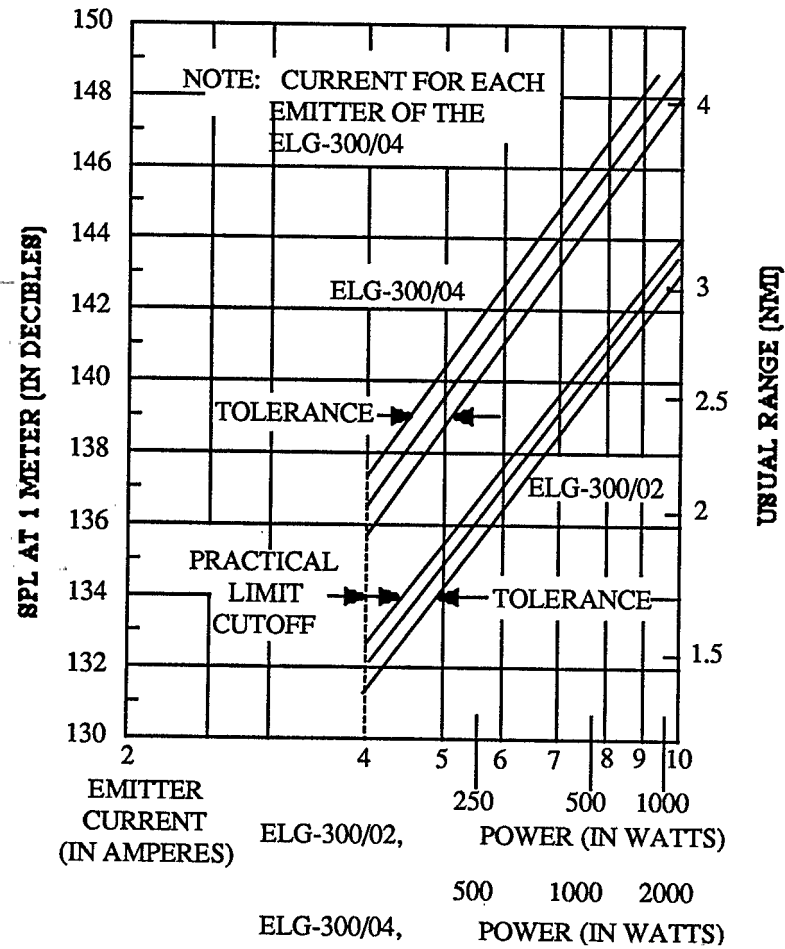
	<u>CG-1000, ELG-300/02</u>	<u>TWO-CG-1000'S, ELG 300/04</u>
Voltage source	120 Vac	120 Vac
Current Drain (silent)	2.5 A	5 A
(during blast)	21.5 A	43 A
Emitter voltage	350-400 Vac	350-400 Vac
Emitter current	9.3A	9.3 A (each supply)
Electrical frequency	150 Hz	150 Hz
Acoustical frequency	300 Hz	300 Hz
Acoustical level	143 dBC	147 dBC
Duty cycle	20% maximum	20% maximum
Emitter weight	496 lb	1,100 lb
Power supply weight	350 lb	700 lb

Output Level. The output level of either the single or dual arrangement can be reduced by means of the horn level control of the meter panel of the power supply. The lowest output level at which the ELG-300/02 emitter will function is 132 dBC, which corresponds to an emitter current of 4 A. When the level is reduced, the usual range of the signal is correspondingly reduced, as shown in Figure 7-29. When two CG-100 power supplies are used in parallel, both must be set to the same emitter current.

Directional Signals. The horizontal directivity patterns for the ELG-300/02 and the ELG-300/04 emitters are the same, as shown in Figure 7-30(a). The vertical patterns for the two emitters are significantly different, as shown in Figures 7-30(b) and (c).

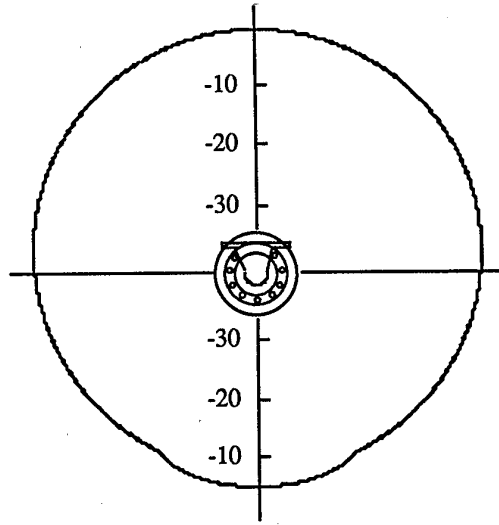
Dimensions. The dimensions for the ELG-300/02 and ELG-300/04 emitters are shown in Figure 7-31. The ELG-300/04 emitter is made up of two ELG-300/02 emitters and three spacers (Figure 7-31). CG-1000 power supply dimensions are given in Figure 7-32.

Data Sheet 7-E(3). (cont'd).

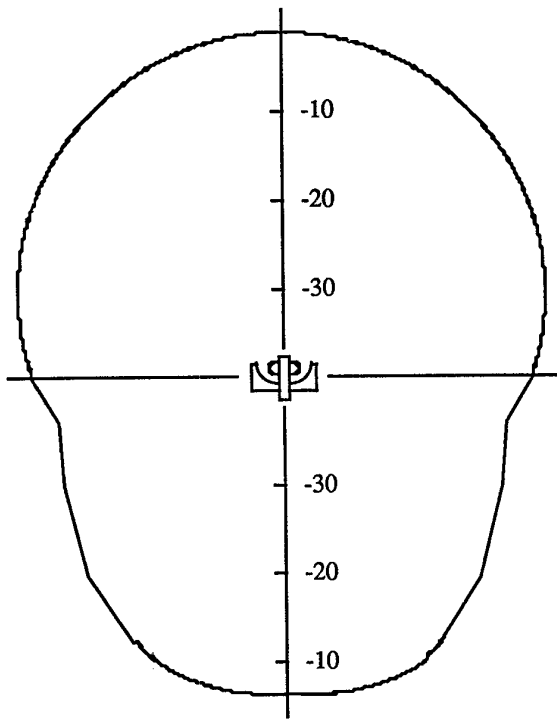


Input current and power to the emitter vs SPL for the ELG-300/02 and the ELG-300/04.

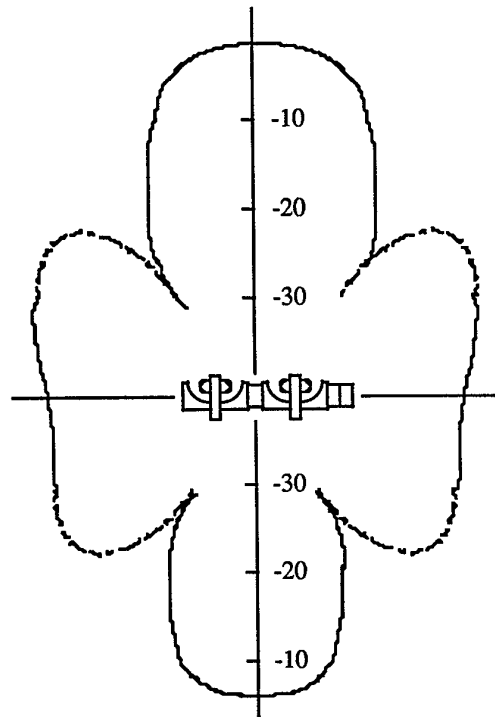
Data Sheet 7-E(3). (cont'd).



(a) Horizontal—ELG-300/02 and ELG-300/04.



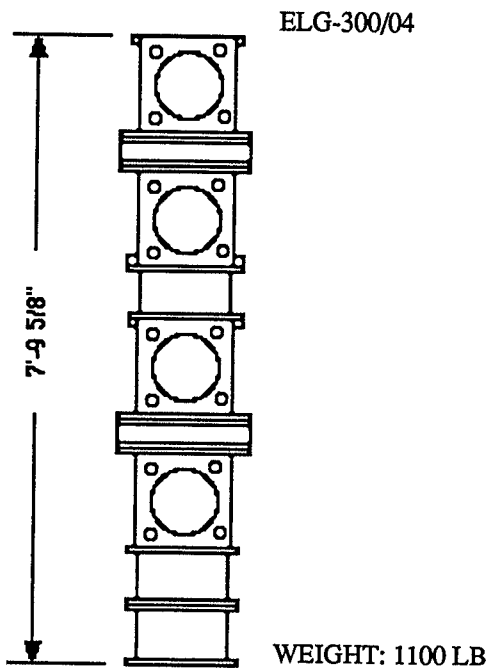
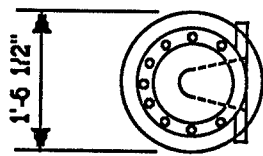
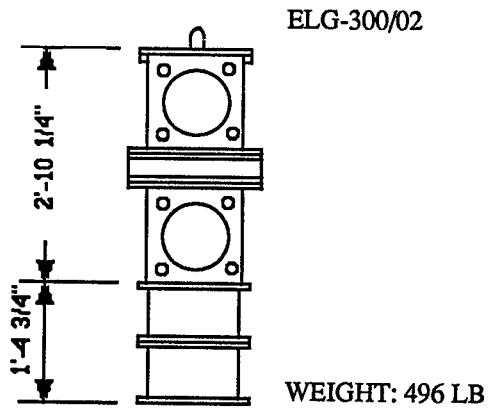
(b) Vertical—ELG-300/02.



(c) Vertical—ELG-300/04.

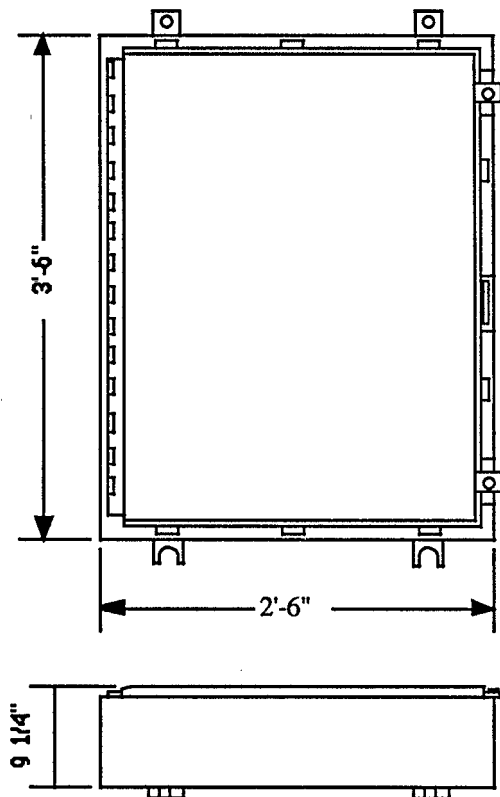
Horizontal and vertical directivity patterns for the ELG-300/02 and ELG-300/04 emitters.

Data Sheet 7-E(3). (cont'd).



Arrangement and dimensions for the 300-Hz directional emitters.

Data Sheet 7-E(3). (cont'd).



Dimensions of the CG-1000 power supply cabinet.

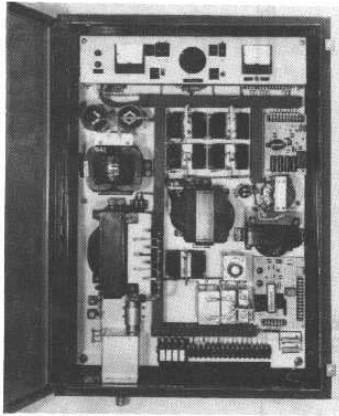
Related Equipment. These signals are designed to be used as delivered without supporting equipment other than the ac power source controls. They can be controlled by a fog detector or other remote means. Also, on aids where automatic transfer to a battery-powered emergency sound signal is required or where remote monitoring of sound signal status is necessary, these power supplies can be interfaced with the NAVAID sensor module through the audio-visual controller. A baffle can be used to reduce the SPL on the back side of the emitter by approximately 30 dB.

The CG-1000 power supply can be used with the temperature-controlled power factor corrector equipment, described on Data Sheet 7-E(6).

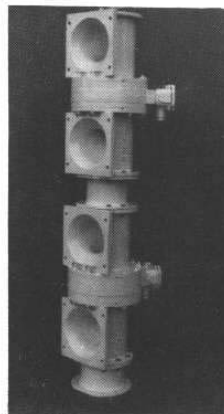
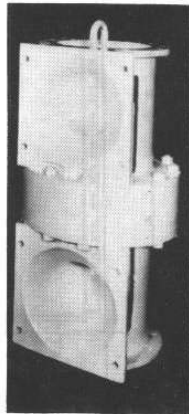
Additional Data. An older version of the CG-1000 was called the SCR-1000. For most installations, the two power supplies are interchangeable.

Manufacturer. Automatic Power, Inc., P.O. Box 230738, Houston, Texas, 77223-0738.

Data Sheet 7-E(3). (cont'd).



CG-1000 Power Supply



ELG-500/02, ELG-500/04 Emitters

CG-1000, ELG-500/02 AND ELG-500/04 SOUND SIGNAL SYSTEMS.

Function. The CG-1000, ELG-500/02 and ELG-500/04 sound signal systems are used as an alternative system for the ELG-300/02 (with a usual range of 2 or 3 nmi). The CG-1000, ELG-500/02 is reserved for use in situations where use of the FA-232/02, SA-850/02, or ELG-300/02 signals could be confusing to the mariner. Such confusion could result if other 390-, 850-, or 300-Hz signals are in use nearby, regardless of the fact that they have different timing characteristics.

When used as a 3-nmi signal, the system consists of one CG-1000 power supply and an ELG-500/04 emitter; when used as a 2-nmi signal, the system consists of one CG-1000 power supply and an ELG-500/02 emitter.

The use of either of these signals is to be minimized because of potential noise pollution caused by the 500-Hz pure tone. Whenever operational requirements permit, the signal should be used in conjunction with a baffle.

Physical Characteristics.

- Directional
- Variable range
- 120-Vac operation
- Corrosion resistant
- Waterproof
- Operates with any standard Coast Guard characteristics.

Data Sheet 7-E(4). CG-1000, ELG-500/02 and ELG-500/04 sound signals systems.

7.E.

Electrical, Acoustical, and Mechanical Characteristics.

	<u>CG-1000,</u> <u>ELG-500/02</u>	<u>CG-1000,</u> <u>ELG-500/04</u>
Voltage source	120 Vac	120 Vac
Current Drain		
(silent)	2.5 A	2.5 A
(during blast)	15 A	21.5 A
Emitter voltage	350-400 VAC	350-400 Vac
Emitter current	4.5 A	9 A
Electrical frequency	250 Hz	250 Hz
Acoustical frequency	500 Hz	500 Hz
Acoustical level	139 dBC	146 dBC
Duty cycle	0% maximum	20% maximum
Emitter weight	85 lb	176 lb
Power supply weight	350 lb	700 lb

Output Level. As indicated under Function, the usual range of this signal can be 2 or 3 nmi. If a 3-nmi signal is required, one CG-1000 and an ELG-500/04 are used and the emitter current is set to 9A.

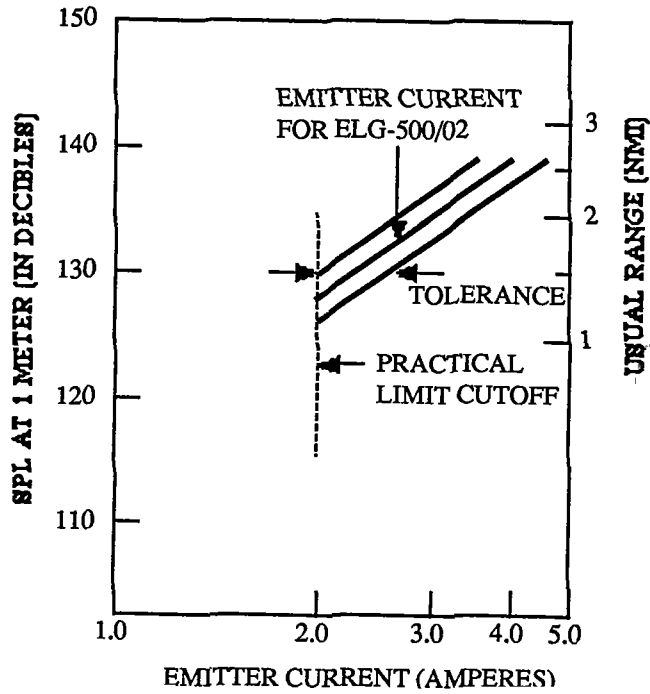
Directional Signals. The horizontal directivity patterns for the ELG-500/02 and the ELG-500/04 emitters are the same as shown in Figure 7-34(a). The vertical directivity patterns for the two emitters are significantly different, as shown in Figures 7-34 (b) and (c).

Dimensions. The dimensions for the ELG-500/02 and ELG-500/04 emitters are shown in Figure 7-35. The ELG-500/04 emitter is made up of two ELG-500/02 emitters and three spacers (Figure 7-35). CG-1000 power supply dimensions are given in Figure 7-36.

Related Equipment. These signals are designed to be used as delivered without supporting equipment other than the ac power source controls. They can be controlled by a fog detector or other remote means. Also, on aids where automatic transfer to a battery-powered emergency sound signal is required or where remote monitoring of sound signal status is necessary, these power supplies can be interfaced with the NAVAID sensor module through the audio-visual controller.

Data Sheet 7-E(4). (cont'd).

7.E.



Input current and power to the emitter vs SPL for the ELG-500/02.

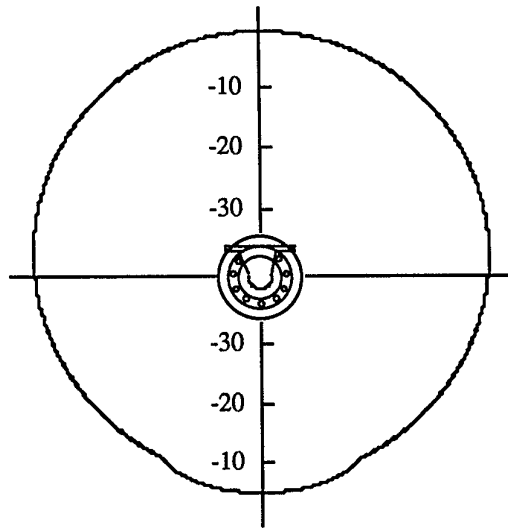
A baffle can be used to reduce the SPL on the back side of the emitter by approximately 30 dB.

The CG-1000 power supply can be used with the temperature-controlled power factor corrector equipment, described on Data Sheet 7-E(6).

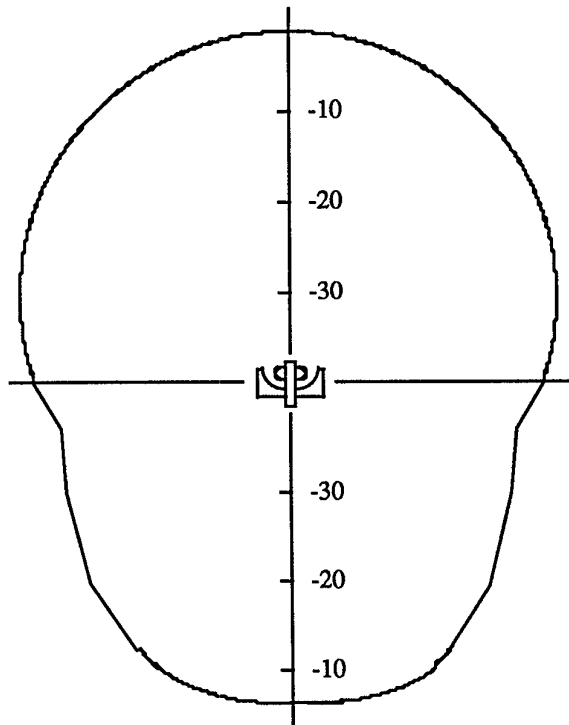
Manufacturer.

Automatic Power, Inc.
P.O. Box 230738
Houston, Texas 77223-0738

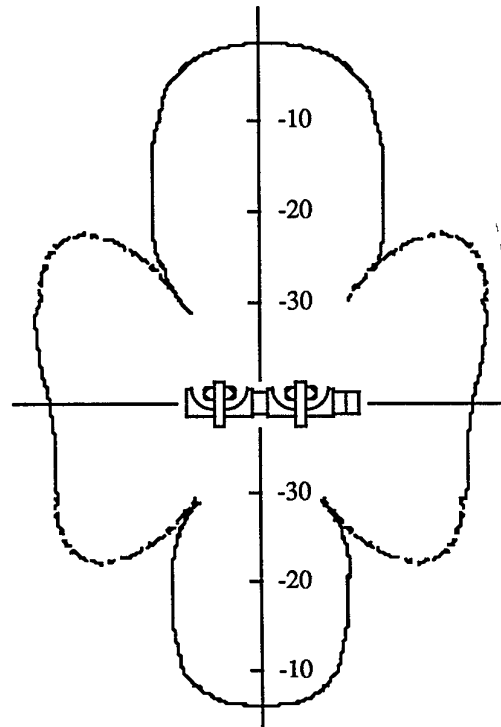
Data Sheet 7-E(4). (cont'd).



(a) Horizontal—ELG-500/02 and ELG-500/04.



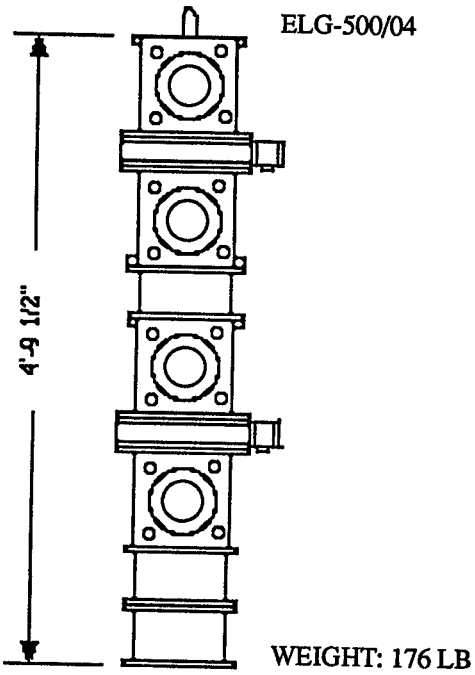
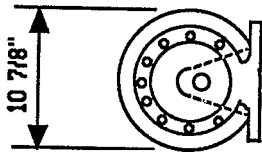
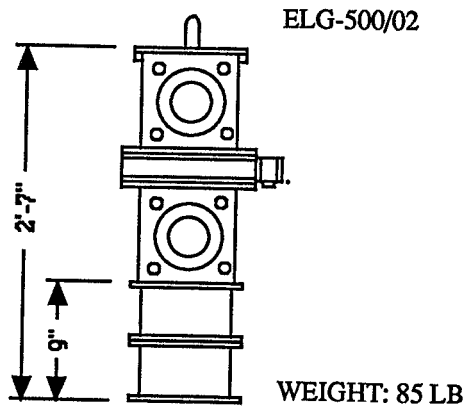
(b) Vertical—ELG-500/02.



(c) Vertical—ELG-500/04.

Horizontal and vertical directivity patterns for the ELG-500/02 and ELG-500/04 emitters.

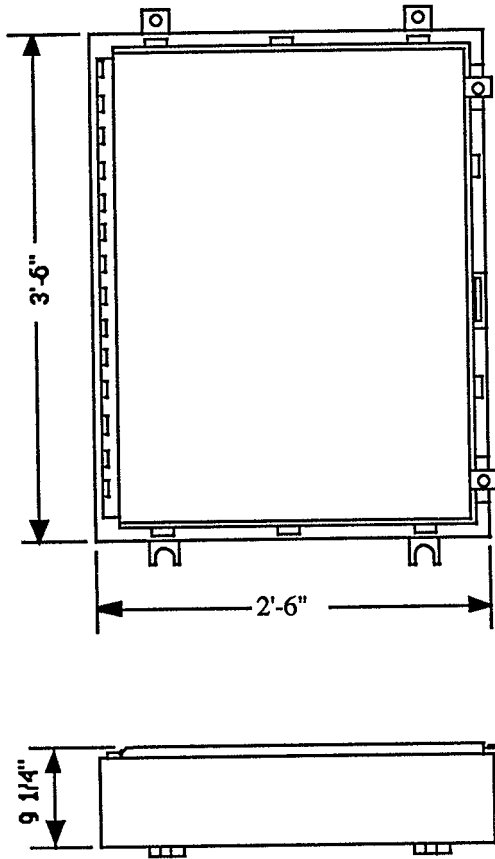
7. E.



Arrangement and dimensions for the 500-Hz directional emitters.

Data Sheet 7-E(4). (cont'd).

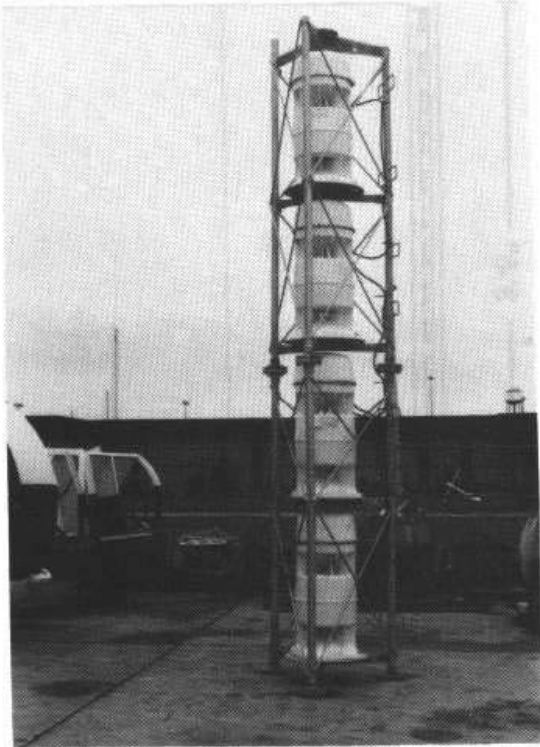
7. E.



Dimensions of the CG-1000 power supply cabinet.

Data Sheet 7-E(4). (cont'd).

7.E.



SA-3C

Function. The SA-3C is a sound signal with 2-nmi usual range. It can be used as the primary sound signal at fixed locations in populated areas.

The signal is primarily used on stations where batteries are the only source of power. However, with the addition of a 120-Vac to 12-Vdc converter, it can be used on commercial power.

Physical Characteristics.

Omnidirectional
Self-contained
Corrosion resistant
Waterproof
120-Vdc operation
Operates with any standard Coast Guard characteristics.

Data Sheet 7-E(5). SA-3C sound signal system.

7.E.

Electrical, Acoustical, and Mechanical Characteristics.

Voltage source	12 Vdc
Current Drain	9 A
Acoustical level	131.7 dBC
Acoustical frequency	390 Hz
Weight	1200 lb
Duty cycle	20% maximum

Output Level. The output level of the SA-3C cannot be reduced. The output level (dBC) varies proportionately with the square of the input voltage.

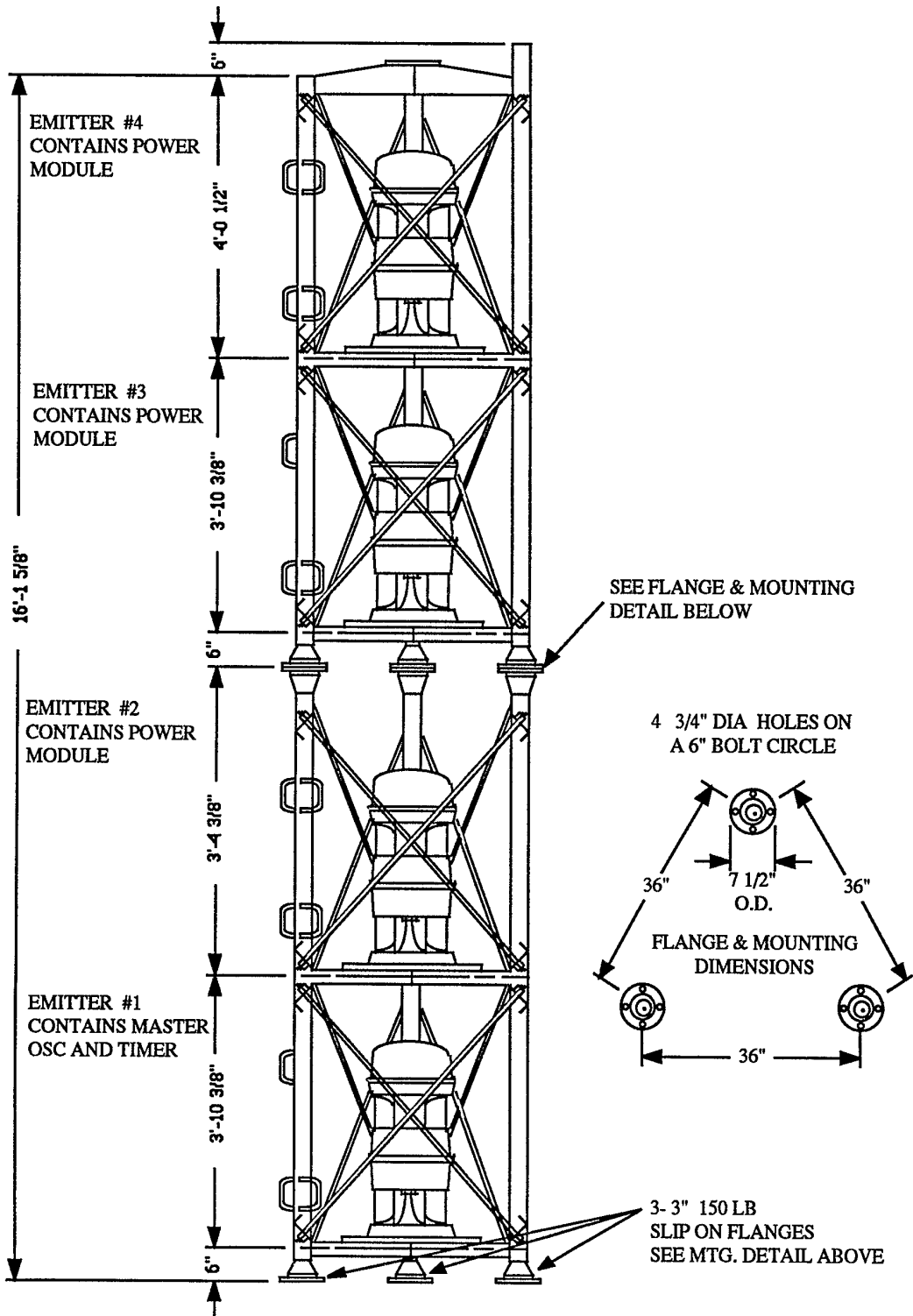
Dimensions. The dimensions of the SA-3C are given in Figure 37.

Manufacturer.

Automatic Power, Inc.
P.O. Box 230738
Houston, Texas 77223-0738

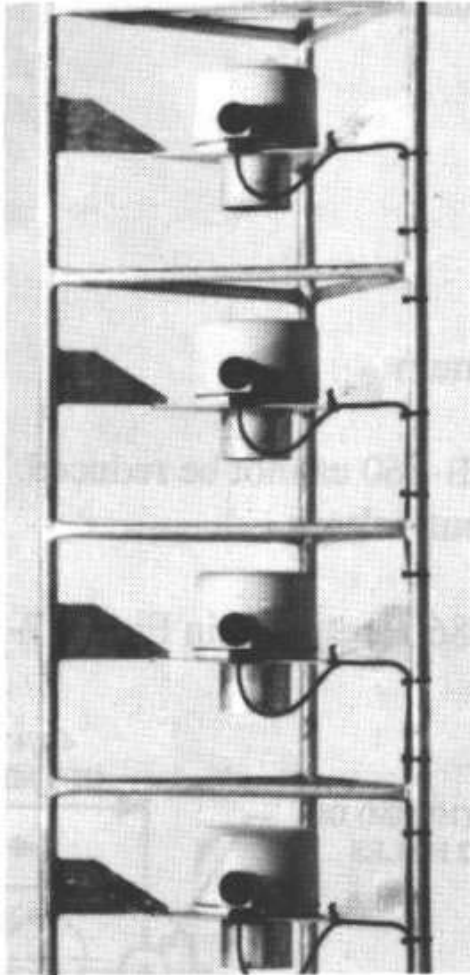
Ordering Information. Specify 12 Vdc SA-3C Sound Signal consisting of four FA-232 emitters, one oscillator/timer, three power modules, and one tower (housing all emitters). Also, specify rhythm.

Data Sheet 7-E(5). (cont'd)



Dimensions of the SA-3C.

7.E.



AB-860

Function. The AB-860 is a sound signal with 2-nmi usual range. It can be used as the primary sound signal at fixed locations in unpopulated areas.

The signal is primarily used on stations where batteries are the only source of power. However, with the addition of a 120-Vac to 12-Vdc converter, it can be used on commercial power.

Physical Characteristics.

- Omnidirectional
- Self-contained
- Corrosion resistant
- Waterproof
- 120-Vdc operation
- Operates with any standard Coast Guard characteristics.

Data Sheet 7-E(6). AB-860 sound signal system.

7.E.

Electrical, Acoustical, and Mechanical Characteristics.

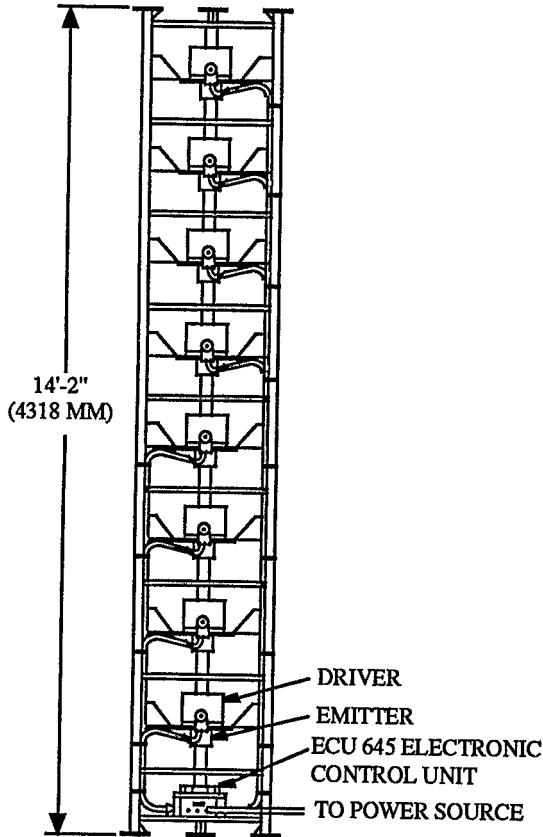
Voltage source	12Vdc
Current Drain	4.2 A
Acoustical level	133.2 dBC
Acoustical frequency	645 Hz
Weight	585 lb
Duty cycle	20% maximum

Output Level. The output level of the AB-860 cannot be reduced. The output level varies proportionately with the square of the input voltage.

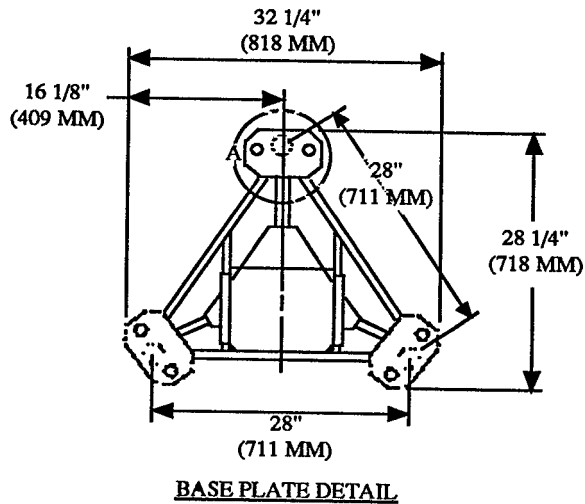
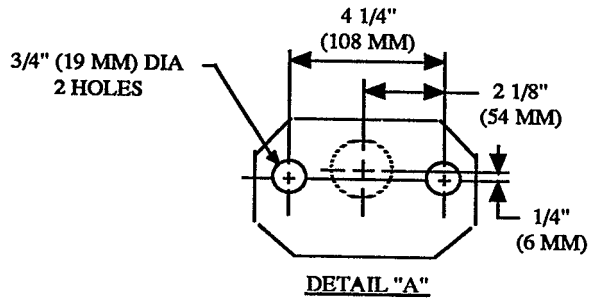
Dimensions. The dimensions of the AB-860 are given in Figure 7-38.

Manufacturer.

Tideland Signal Corporation
P.O. Box 52430
Houston, Texas 77052



Dimensions of the AB-860.



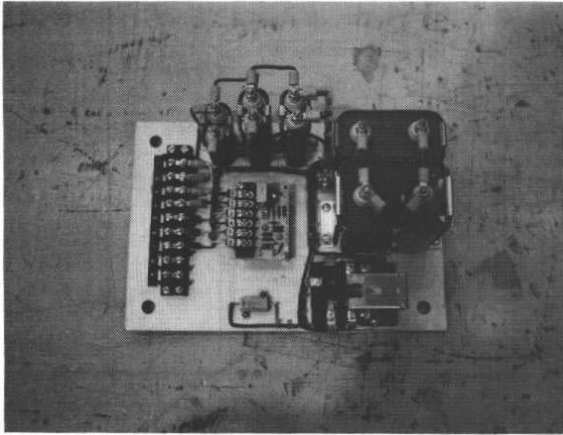
Dimensions of the AB-860.

Data Sheet 7-E (6). (cont'd).

Data Sheet 7-E(6). (cont'd).

7.E.

TEMPERATURE-CONTROLLED POWER FACTOR CORRECTOR



Function. The temperature-controlled power factor corrector is a device that will automatically switch in or out capacitance, as specified by the temperature. It shall be used if the ambient temperature falls below 20 degrees Fahrenheit for an extended period of time.

Physical Characteristics.

Temperature sensing
Automatic switching
Operates from either 12 Vac or 24 Vac.

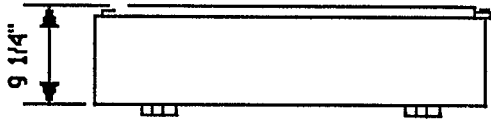
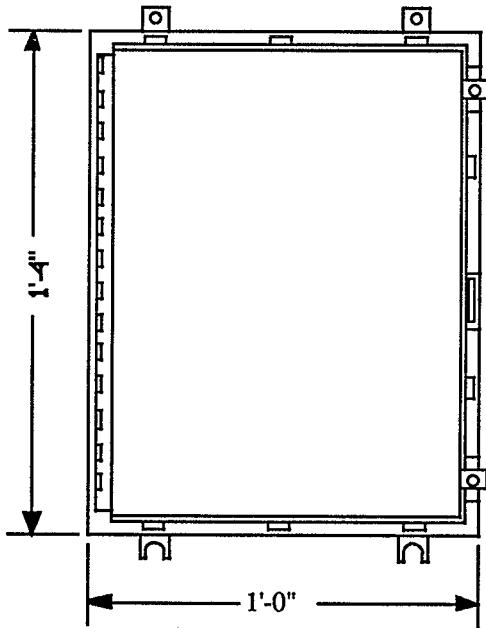
Dimensions. The dimensions for the temperature-controlled power factor corrector cabinet are shown in the Figure 7-39.

Related Equipment. The temperature-controlled power factor corrector can be used with the CG-1000 power supply.

Manufacturer.
Automatic Power, Inc.
P.O. Box 230738
Houston, Texas 77223-0738

Data Sheet 7-E(7). Temperature-controlled power factor corrector equipment.

7.E.



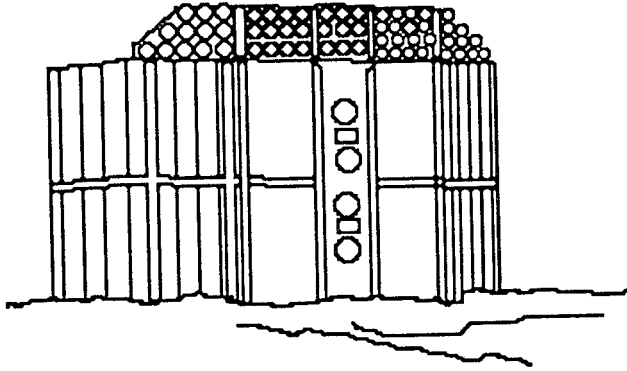
WEIGHT: 27 LB

Weight and dimensionWeight and dimensions of the temperature-controlled power factor corrector cabinet.

Data Sheet 7-E(7). (cont'd).

7.E.

STANDARD BAFFLE



Function. the baffle can be used to reduce the SPL on the back side of the signal. It can be used with any of the following pure-tone emitters--ELG-300/02, ELG-300/04, ELG-500/02, ELG-500/04, FA-232, or FA-232/02.

Where operational requirements permit, the baffle should be used as a noise control tool on existing structures or on new stations to be established or automated. In these situations, there would be either a history of noise complaints or an indication--through environmental assessment--of potential noise pollution.

Physical Characteristics.

Directional
Minimal maintenance.

Mechanical and Acoustical Characteristics. The approximate SPL reduction is 30 dB. This is shown by the directivity patterns for the baffles, as presented in Figures 7-40 through 7-45.

The physical construction of the baffle for the ELG-series emitters is reinforced concrete and steel. The physical construction of the baffle for the FA-232 is steel. All baffles are built on a reinforced concrete slab. This particular design for each of the baffles permits a wind loading velocity of 120 mi/hr.

Dimensions. Baffle dimensions for the six pure-tone emitters are shown in Figures 7-40 through 7-45.

Availability. CG supply of baffles is exhausted. COMDT (G-ECV) will supply construction drawings for CG District fabrication or procurement.

Data Sheet 7-E(8). Standard baffle for sounds signals.

7. E.

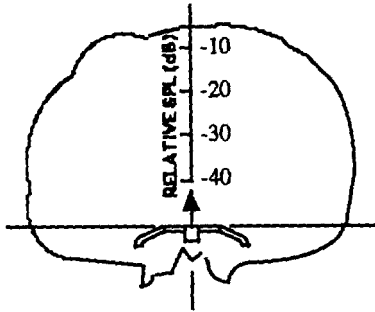
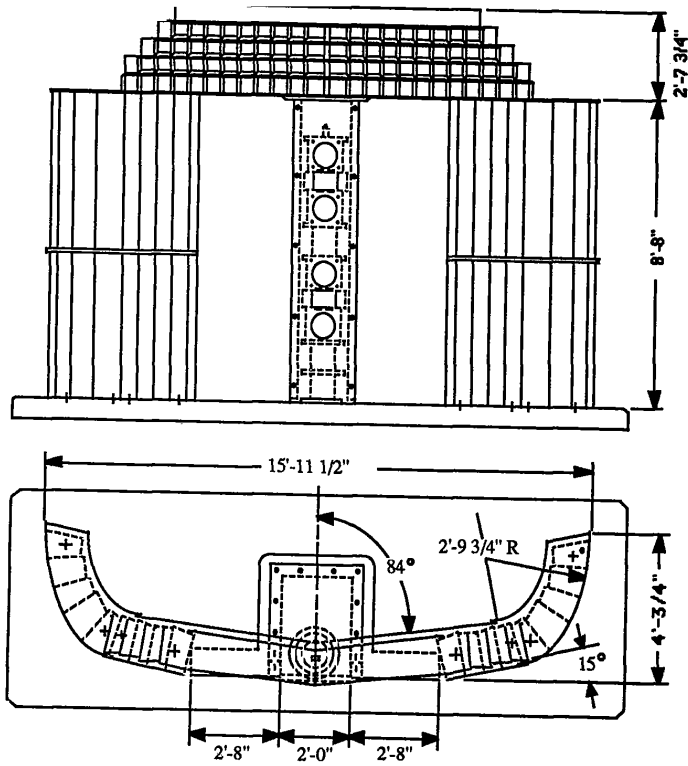


Figure 7-40(a). Directivity pattern for the standard baffle--broad pattern.*



*C.I. Malme, Development of Improved Baffle Systems for Directional Fog Signals, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-40(b). Assembly drawing of the standard baffle (broad pattern) for the ELG-300/04 emitter (Commandant (G-ECV) Drawing No. 130105-1, sheet #1).

Data Sheet 7-E (8). (cont'd).

7.E,

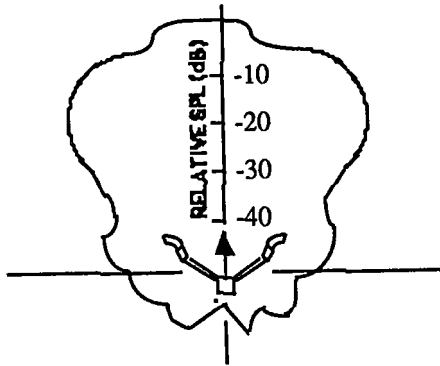
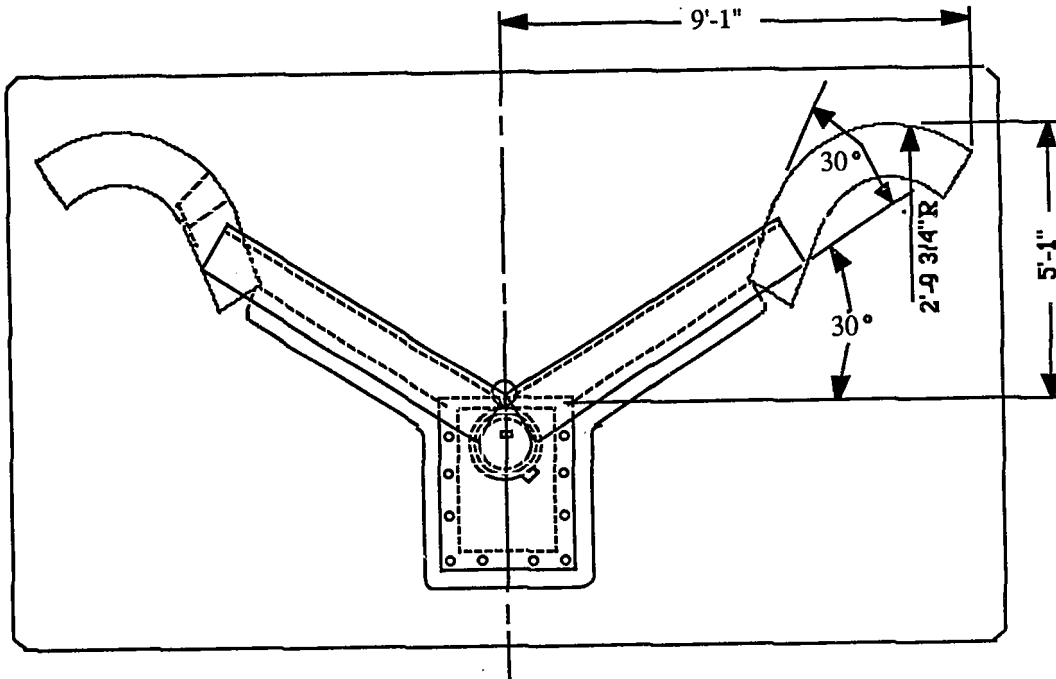


Figure 7-41(a). Directivity pattern for the standard baffle--narrow pattern.*



*C.I. Malme, Development of Improved Baffle Systems for Directional Fog Signals, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-41(b). Plan view drawing of the standard baffle (narrow pattern) for the ELG-300/04 emitter (Commandant (G-ECV) Drawing No. 130105-1, sheet #5).

Data Sheet 7-E-(8). (cont'd).

7.E.

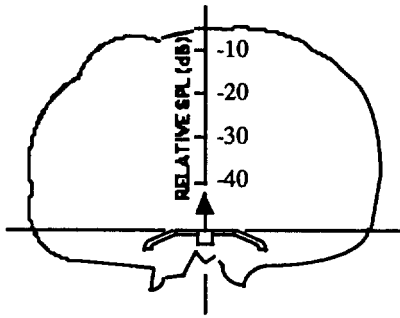
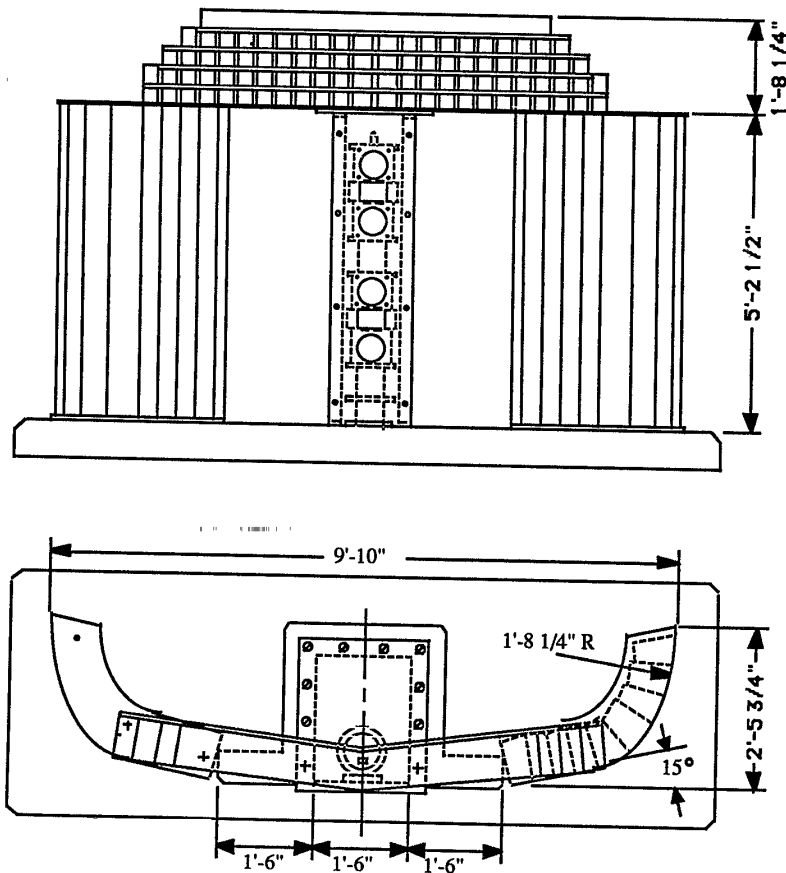


Figure 7-42(a). Directivity pattern for the standard baffle--broad pattern.*



*C.I. Malme, Development of Improved Baffle Systems for Directional Fog Signals, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-42(b). Assembly drawing of the standard baffle (broad pattern) for the ELG-500/04 emitter (Commandant (G-ECV) Drawing No. 130105-2, sheet #1).

Data Sheet 7-E (8). (cont'd).

7.E.

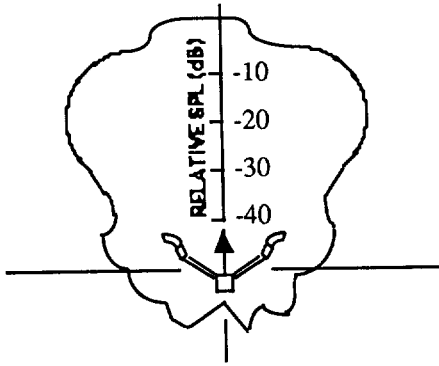
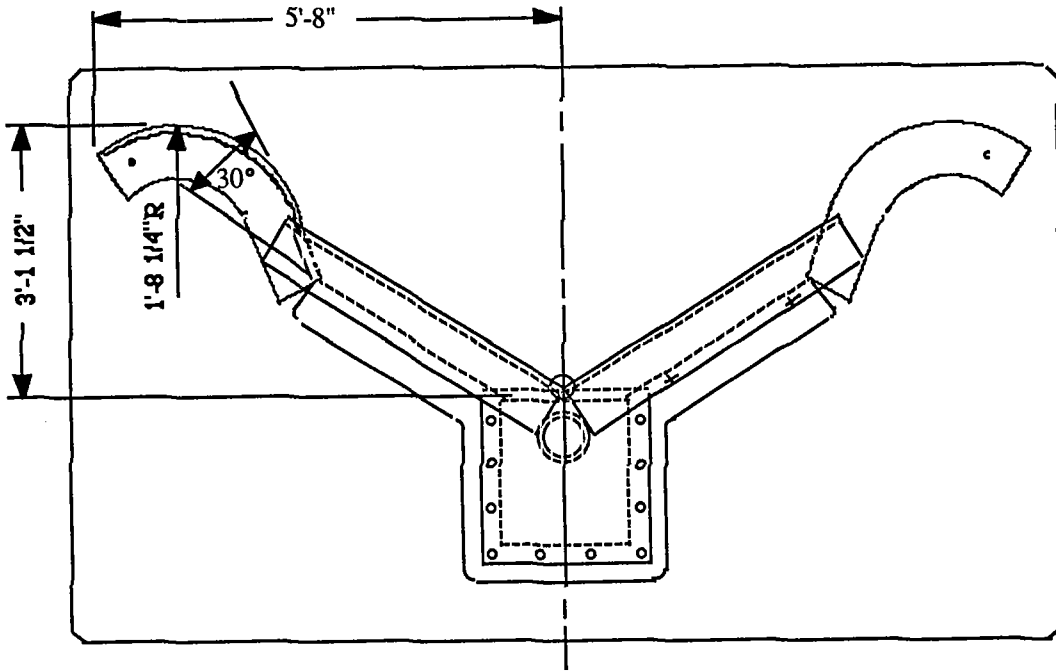


Figure 7-43(a). Directivity pattern for the standard baffle--narrow pattern.*



*C.I. Malme, Development of Improved Baffle Systems for Directional Fog Signals, Contract No. DOT-CG-30200-a (U.S. Coast Guard, February 1975).

Figure 7-43(b). Plan view drawing of the standard baffle (narrow pattern) for the ELG-500/04 emitter (Commandant (G-ECV) Drawing No. 130105-2, sheet #5).

Data Sheet 7-E-(8). (cont'd).

7. E.

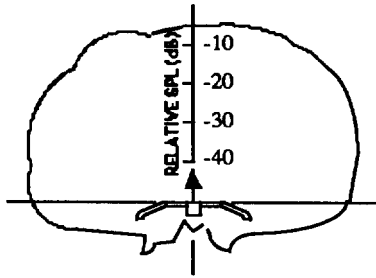
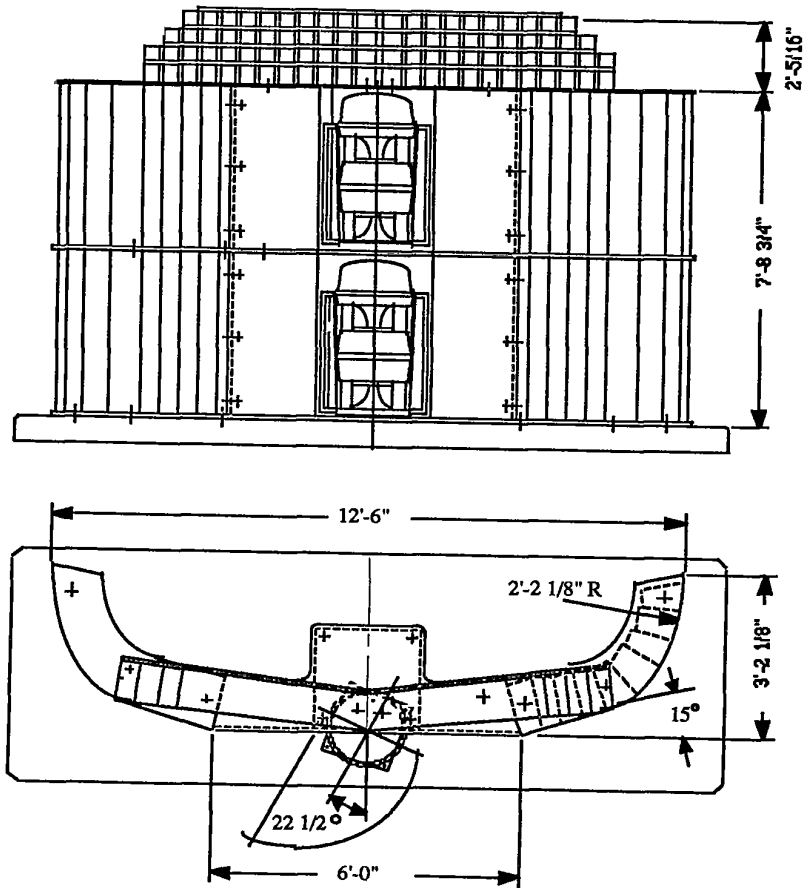


Figure 7-44(a). Directivity pattern for the standard baffle--broad pattern.*



*C.I. MALME, Development of Improved Baffle Systems for Directional Fog Signals, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-44(b). Plan drawing of the standard baffle (broad pattern) for the FA-232 emitter (Commandant (G-ECV) Drawing No. 130105-3, sheet #1).

Data Sheet 7-E (8). (cont'd).

7.E.

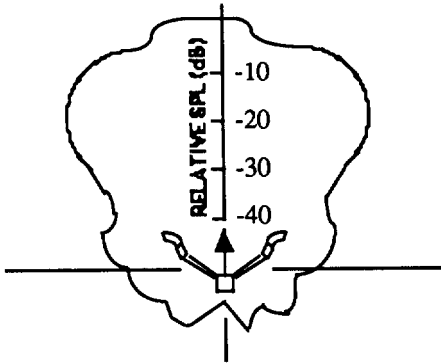
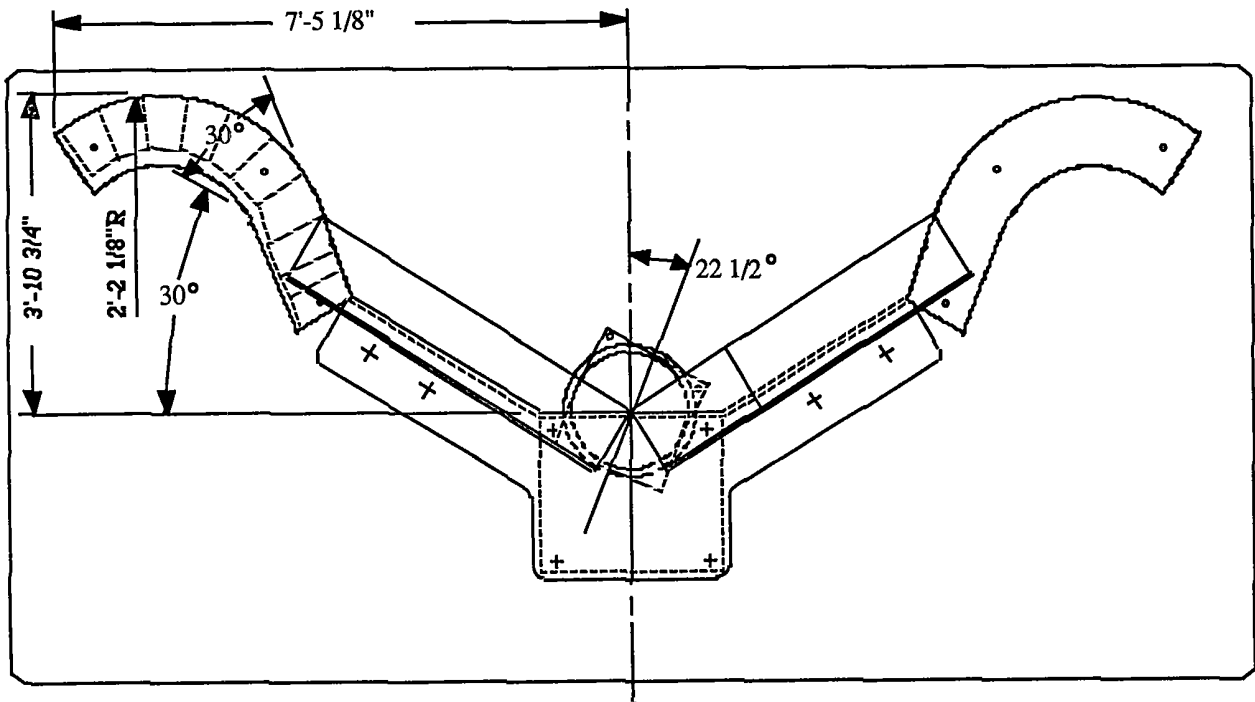


Figure 7-45(a). Directivity pattern for the standard baffle--narrow pattern.*



C.I. Malme, Development of Improved Baffle Systems for Directional Fog Signals, Contract No. DOT-CG-30200-A (U.S. Coast Guard, February 1975).

Figure 7-45(b). Plan view drawing of the standard baffle (narrow pattern) for the FA-232 emitter (Commandant (G-ECV) Drawing No. 130105-3, sheet #5).

Data Sheet 7-E(8). (cont'd).

CHAPTER 8. MONITOR AND CONTROL EQUIPMENT

A. Introduction.

This chapter provides guidance for selection, inspection, maintenance, and repair of the monitor and control equipment used at automated aids to navigation.

Equipment that interfaces the monitor and control equipment with the aids is also discussed. Applicable policies, reference literature, and sources of supply are identified.

B. Selection Guide.

1. Introduction. Selection of monitor and control equipment requires that the aid first be classified by the category selection process of Automation Technical Guidelines (M16500.8A). Using the appropriate category, enter Table 8-1 to determine the required and optional monitor and control equipment for the aid.
2. Communication Equipment Options. Point-to-point communications for auto-mated aids to navigation can be provided by radio, landline, cable, cellular phone and microwave, or a combination of these. Selecting the most effective and efficient communication system requires that both administrative and engineering issues be resolved. The *Telecommunication Manual* (M2000.3) establishes communication planning guidelines and *Automation Technical Guidelines* (M16500.8A) provides engineering guidelines.

8.B.2.

Table 8-1
 Selection Guide for Required and Optional
 Monitor and Control Equipment

<u>EQUIPMENT*</u>	<u>EQUIPMENT CATEGORY</u>								
	I	II	III	IV	V	SOLAR			
	I	II	III	IV	V	I	II	III	
AID CONTROL & MONITOR SYSTEM USQ-91(V)									
MASTER UNIT (MU)	R	R							
TRANSFER UNIT (TU)									
REMOTE UNIT (RU)									
RADIO LINK SET, MASTER STATION (MLC PROVIDED)	O	O					R		
RADIO LINK, REMOTE STATION (MLC PROVIDED)	O	O					R		
AUDIO-VISUAL CONTROLLER									
GCF-RWL-2098	R	R	R						
NAVAID SENSOR MODULE									
GCF-RWL-2076	R	R	R						
NAVAID SENSOR MODULE PANEL									
GCF-RWL-2241	R	R	R						
VM-100 FOG DETECTOR	O	O	O	O	O	O	O	O	
AC FLASH CONTROLLER									
GCF-RWL-2106				O					
HW POWER SUPPLY									
CDPZ-227-8556						R			
LOW ENERGY ACMS, REMOTE UNIT							R		

*R=REQUIRED,
 O=OPTIONAL

8.C. Preparation and Installation.

The preparation and installation of Aid Control and Monitor System (ACMS) monitor equipment is described in *Automation Technical Guidelines* (M16500.8). ACMS is also covered in ACMS technical manuals.

D. Inspection, Maintenance, and Repair.

1. Inspection and Maintenance.

- a. Inspection Intervals and Maintenance Checks. Maintenance checks shall be conducted at the intervals indicated in Table 8-2 and in Coast Guard Preventive Maintenance System (CGPMS) materials as they become available.
- b. Standards. Procedures for conducting these maintenance checks are covered in the particular equipment technical manuals, and on Commandant (G-SEC) Standard Drawings for Aids to Navigation. Also, additional information explaining proper system operation is contained in M16500.8A publication. Coast Guard Preventive Maintenance System (CGPMS) (M16500.25 will cover all lighthouse electronics. No standards, such as acceptable voltage limits, are listed in this section. Standards are listed in the technical manuals.

8.D.1.1.b.

8.D.1.b.

Table 8-2
Monitor and Control Equipment Maintenance
Checks and Inspection Intervals EQUIPMENT

KEY: A = ANNUALLY SA = SEMIANNUALLY Q = QUARTERLY * = AT EVERY VISIT <u>MAINTENANCE CHECK</u>	AUDIO-VISUAL CONTROLLER GCF-RWL-2098	NAVAID SENSOR MODULE GCF-RWL-2076	NAVAID SENSOR MODULE PANEL GCF-RWL-2241	VM-100 FOG DETECTOR	AC FLASH CONTROLLER GCF-RWL-2106
FRAYED, LOOSE, OR DEFECTIVE WIRING COMPONENTS	SA		SA	SA	SA
RELAYS SECURE, TERMINATIONS TIGHT	SA			A	A
BARRIER STRIP TERMINATIONS TIGHT, HARDWARE SECURE	SA		A		A
CG-181, 1R1, 1RY9 TERMINATIONS TIGHT	SA				A
BULKHEAD/FLOOR MOUNTING SECURE; CONDUITS 10/FROM ENCLOSURE SECURE, WIRES NOT CHAFING	SA			SA	SA
ENCLOSURE DAMAGE, GASKET INTACT (UNDAMAGED)	A		SA		SA
EMERGENCY SOUND SIGNAL TRANSFER AND MONITOR CHECK	SA	SA			
EMERGENCY LIGHT TRANSFER AND MONITOR CHECK	SA	SA			
LAMPCHANGER(S)	SA				
CURRENT SENSITIVE RELAY, 1RY9, OPERATION CHECK	SA				
CURRENT SENSITIVE RELAY, 1RY9, CALIBRATION	SA				
AUTOMATIC RESET	SA				
30-MIN OFF DELAY TIMER	SA				
CG-181 STUTOFF CHECK	SA				
FOG DETECTOR RESET	SA				
FOG DETECTOR FAILURE INDICATOR	SA				
CG-181 CHARACTERISTIC CHECK	*				
PRINTED CIRCUIT CARDS SECURE	SA	SA	SA		

8.D.1.b.

Table 8-2 (cont'd).

KEY: A = ANNUALLY SA = SEMIANNUALLY Q = QUARTERLY * = AT EVERY VISIT <u>MAINTENANCE CHECK</u>	AUDIO-VISUAL CONTROLLER GCF-RWL-2098	NAV AID SENSOR MODULE GCF-RWL-2076	NAV AID SENSOR MODULE PANEL GCF-RWL-2241	VM-100 FOG DETECTOR	AC FLASH CONTROLLER GCF-RWL-2106
DAYLIGHT CONTROL INSPECTION					CHAP.6
DAYLIGHT CONTROL OPERATIONAL CHECK					SA
MAIN CIRCUIT BREAKER ON/OFF CHECK					SA
PROJECTOR LAMP FLASHING				*	
EXTERIOR OF RECEIVER AND PROJECTOR WINDOWS FREE OF DIRT, FROST, AND MOISTURE				*	
STATE OF FAILURE INDICATOR ON TEST PANEL OR AVC	*				
SUPPLY VOLTAGE				SA	
CALIBRATION CHECK				SA	
VISIBILITY ALARM FUNCTION				SA	
PERFORM FAIL-SAFE TEST				SA	
REPLACE FLASH LAMP				2YR	

- 8.D.1. c. Test Equipment. Test equipment required for servicing monitor and control equipment is listed in Table 8-3. Consult *Electronics Manual* (M10550) for policy concerning acquisition of electronic test equipment not provided by Commandant (G-SCE) with the initial equipment issue.
2. Repair. Repair of the following monitor and control equipment shall conform with the policies specified in the Aids to Navigation Automation and Monitor Equipment chapter of the *Electronics Manual-Maintenance* (M10550.25):
- Aid Control and Monitor System.
 - Radio link sets.
 - NAVAID sensor module and panel.
 - VM-100 Fog Detector.
 - Audio-Visual Controller.
 - AC Flash Controller.
 - 12V power supplies.

Repair, operational failure, removal, and similar events associated with monitor and control equipment are to be reported as required by current directives.

8.D.2.

Table 8-3
Test Equipment for Monitor and Control Equipment

TEST EQUIPMENT		HQ PROVIDED WITH INITIAL EQUIPMENT ISSUE	ACMS	RADIO LINK SET	AUDIO-VISUAL CONTROLLER	NAVAID SENSOR MODULE	NAVAID SENSOR MODULE PANEL	VM-100 FOG DETECTOR	AC FLASH CONTROLLER
NAME	DESCRIPTION								
OSCILLOSCOPE	1 MV/DIV, 50-MHZ BANDWIDTH		*			*		*	
FREQUENCY COUNTER	HP-5245L OR EQUAL		*	*					
VOLT-OHMMETER	TRIPLET 630A OR EQUAL		*	*	*	*	*	*	*
THRULINE WATT-METER, 0-50W, UHF	BIRD MODEL 43 OR EQUAL			*					
FM FREQUENCY GENERATOR	MEASUREMENTS MODEL 560 OR EQUAL			*					
FM DEVIATION METER	MOTOROLA S-1323A OR EQUAL			*					
TEST SET, GE	TM-11	*		*					
MERCURY THERMOMETER				*					
LOGIC PROBE	COMPATIBLE WITH MODULE LOGIC					*			
STOPWATCH OR CLOCK						*			
CALIBRATION BOX							*		
DATA CHECKER			*						
PHONE LINE CHECKER, RJ11			*						

8.E. General Description Data Sheets.

Aid Control and Monitor System (ACMS)

Overall System Function. The Aid Control and Monitor System (ACMS) is used to remotely monitor and control lights, sound signals, intrusion alarms, engine generators, fire systems, flooding systems, etc., on automated aids to navigation. The system consists of the Control-Display Group [Master Unit (MU)], the Interconnecting Group [Transfer Unit (TU)], and the Monitor Group [Remote Unit (RU)]. The nomenclature for the complete Aid Control and Monitor System is AN/USQ-91V.

When an ACMS Remote Unit receives an interrogation from an ACMS Master Unit, it sends back a data message which contains the status of all the monitored systems on the aid. The data in the message is displayed on the ACMS Master Unit. The ACMS Remote Unit also generates data messages without interrogation when an alarm condition exists. The interrogation and data messages may be sent by telephone or radio, or a combination of the two.

Master and Remote Units are normally linked by telephone. A radio link is established where telephone service to the aid is not practical. When a radio cannot be installed at the Master Unit location to reach the Remote Unit site, an ACMS Transfer Unit and radio are installed at another location and connected to the Master Unit by telephone. The Remote Unit is connected to control and sensor circuits in the aid to navigation which control the operation of the aid and provide status information to the Master Unit.

Overall System Features. ACMS has the following features:

- Up to 32 monitored functions at each remote site.
- Up to 8 control functions at each site (5 standard, 3 user selected).
- Alarms (status changes at the remote aid) are presented visually, along with an audible alarm.
- Access to a directory of connected remote sites.
- Daily automatic interrogation of all remote sites (time of day is programmable on the new ACMS Master Unit).
- Immediate auto reports from Remote Units upon aid signal status change.
- Provisions for various combinations of communications links.
- Auto reset after commercial power failures.
- Auto recording of status information of the remote aids.
- Weekly automatic engine generator exercise (user selectable day/time).
- Battery - Status of charge level - 24Hrs
- Battery voltage status at LEACMS sites
- Data Sheet 8-E(1). Aid Control and Monitor System (ACMS).

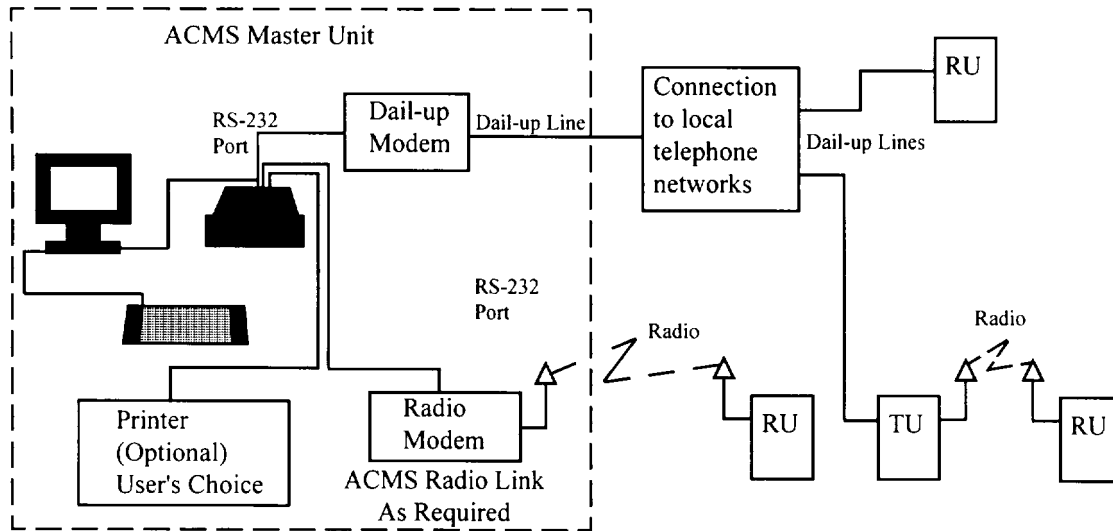


Figure 8-1. Aid Control and Monitor System.

Additional information.

Technical Manuals. Technical Manuals are available from the Coast Guard Supply Center under the following stock numbers:

<u>Equipment Name</u>	<u>Technical Manual</u>
ACMS Master Unit Operating Instruction Manual:	7610-01-GF4-1115
ACMS Master Unit Radio Communications Module Manual:	7610-01-GF2-4301
ACMS Transfer Unit Technical Manual:	7610-01-GF4-1101
ACMS Remote Unit Technical Manual:	7619-01-GF4-1110
LEACMS Remote Unit Technical Manual:	7610-01-GF5-8801

Central support. Control Repair/Exchange ELC Baltimore (02L) provides central support of ACMS equipment (see E/GICP Inst. 4408 series). Consult Commandant (G-SEC-2) for Standard Drawings for interfacing ACMS to standard aids to navigation signal power equipment.

Other instructions. Consult the following references for further details:

- Electronics Manual: COMDTINST M10550.25
- Automation Technical Guidelines: COMDTINST M16500.8

Data Sheet 8-E(1). (cont'd).

8.E.

ACMS Master Unit (Control-Display Group)

Function. The ACMS Master Unit (Control-Display Group), based upon the Coast Guard Standard Workstation, allows an operator to maintain constant surveillance and control of several automated aids to navigation. There are two nomenclatures for the Master Unit. If no radio/modem is installed, the nomenclature is GCF-W-1204/USQ-91(V). If there is a radio/modem installed, the nomenclature is GCF-W-1204A/USQ-91(V).

The following units comprise the basic ACMS Master Unit.

Stand-alone Coast Guard Standard Workstation, consisting of:
Intel Pentium 133Mhz Processor with 64 MB RAM,
1.3 GB IDE Hard Drive,
CD-ROM,
1.44 MB Floppy Drive,
15" Color Monitor,
Keyboard,
Mouse,
RJ45-RJ45 patch cord, and
Line cord

28,800 BPS Microcom V.34 Internal Data/ Fax Modem
Bundled Software
ACMS Software

Master Units linked to Remote Units via radio will also be equipped with:
FM-UHF data telemetry radio/modem
UHF RF power amplifier
Power supply

Electrical Characteristics.

120 VAC 10%.
60 Hz 10%.
12 Amps maximum.

Physical Characteristics. A 24"W x 8"H x 22"D computer stand is used for mounting the ACMS Master Unit and associated communications hardware.

Data Sheet 8-E(2). ACMS Master Unit (Control-Display Group).

8.E.

ACMS Transfer Unit (Interconnecting Group)

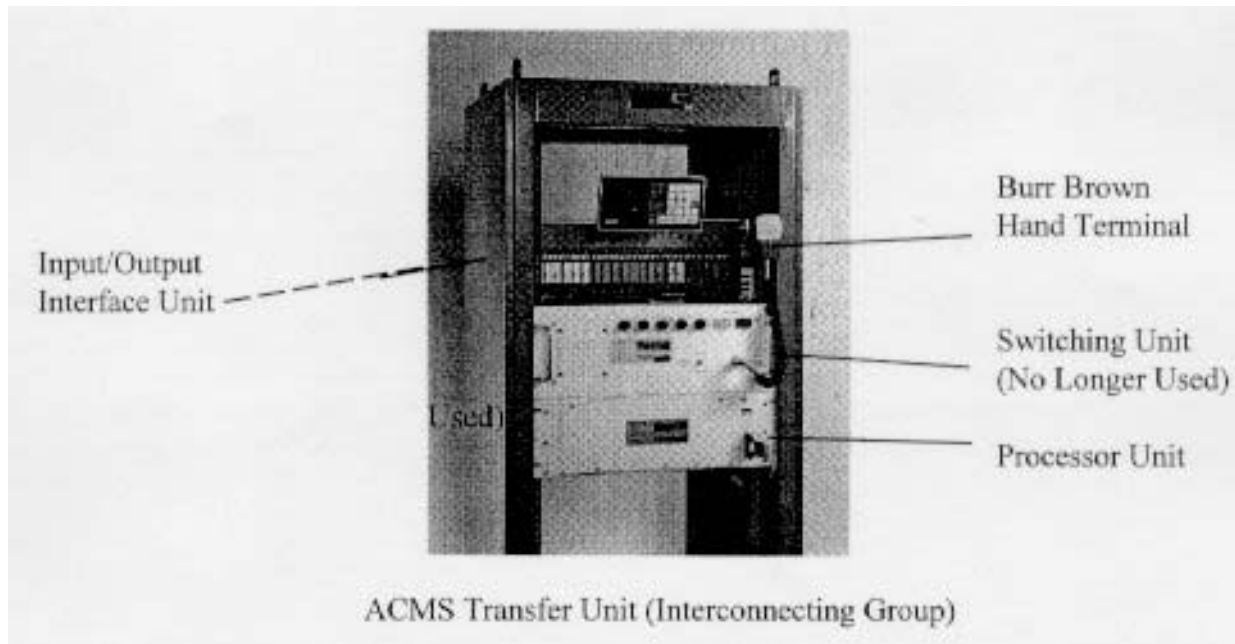
Function. The ACMS Transfer Unit relays data and control signals between the Master Unit and the Remote Unit. It also has eight user defined inputs and eight user defined outputs for monitoring and controlling equipment. The nomenclature for the Transfer Unit is ON-267 (V)1.

The following units comprise the ACMS Transfer Unit:

- Interface Unit, Input/Out 3A1
- Processor Unit 3A3
- Hand-Held Terminal 3A4

The 3A4 provides an interface between the technician and the Z80 microprocessor. It allows the technician to observe a limited number of processor functions during normal operation, i.e.:

- Test communications links via radio to the Remote Unit and lease line or dial-up to the Master Unit.
- Test Input/Output modules activity.
- Test date and time of operational Transfer Unit.



Data Sheet 8-E(3). ACMS Transfer Unit (Interconnecting Group).

8.E.

Electrical Characteristics.

115 Volts 10%.

60 Hz 10%.

5 Amps nominal.

Physical Characteristics. The ACMS Transfer Unit contains two sub units which weigh 30 lbs. each (3A1, 3A2) and a hand-held terminal (3A4). These units can be installed in any standard 19"W x 60"H x 24"D electronic equipment cabinet.

ACMS Installation Data.

Installation materials required, but not supplied, can be found in the ACMS technical manuals.

Radio equipment is selected and supplied by ELC (02L).

Data Sheet 8-E(3). (cont'd).

8.E.

ACMS Remote Unit (Monitor Group)

Function. The ACMS Remote Unit monitors the status of and remotely controls aids to navigation in lighthouses:

- Lights
- Sound System
- Intrusion Alarms
- Fire, Flooding
- Racons
- Power System

There are two models of the Remote Unit. The OA-9211(V)1 model is DC powered and is suitable for installation at sites at which AC power is unreliable or unavailable. Standard Lamp Ni-Cad batteries are required at these sites. The OA-9211(V)3 version is suitable for sites at which AC power is available and reliable.

The following units comprise an ACMS Remote Unit:

Interface Unit, Input 2A1- This unit contains twenty-four digital input modules which connect to the aid to navigation (AtoN) equipment to be monitored.

Interface Unit, Input/Output 2A2 - This unit contains ten digital input modules and eight digital output relay modules. Eight of the input modules and three of the output control modules are user definable. The remainder are dedicated to monitor and control specific AtoN equipment.

Processor Unit 2A4 - This unit controls the Remote Unit operation. It is built around a Z80 microprocessor which is housed in a STD BUS enclosure along with other circuit cards necessary for the operation of the Remote Unit.

Hand Held Terminal 2A5 - This unit provides an interface between the technician and the Z80 microprocessor. It allows the technician to observe a limited number of processor functions during normal operations.

Data Sheet 8-E(4). ACMS Remote Unit (Monitor Group).

8.E.

Electrical Characteristics.

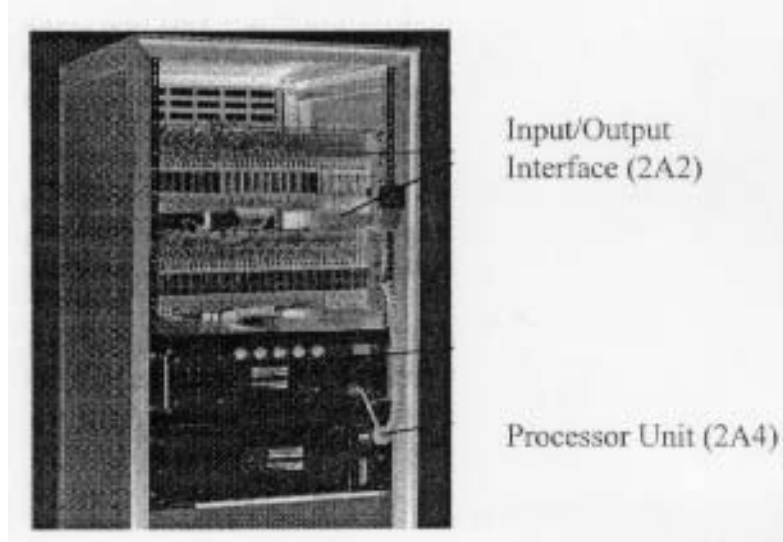
OA-9211(V)1 (DC powered)	OA-9211 (V)3 (AC powered)
9-18 VDC	115 Volts 10%
5 Amps nominal	60 Hz. 10%
	5 Amps nominal

Physical Characteristics.

The OA-9211(V)1 or OA-9211(V)3 Remote Units contain three or four sub units which weigh 40 lbs. each. These units can be installed in any standard 19"W x 60"H x 24"D electronics cabinet.

ACMS Installation Data.

Installation materials required but not supplied can be found in the ACMS technical manuals. Radio equipment is selected and supplied by ELC (02L).



Data Sheet 8-E(4). (cont'd).

8.E.

Low Energy Aid Control and Monitor System
GCF-W-1221-LEACMS

Function. The LEACMS remote unit, GCF-W-1221, is a self-contained Aid to Navigation system that will monitor and control equipment associated with a Solar Category I lighthouse:

Lights	Racon
Sound Signals	Intrusion
Power System	Solar Battery Voltage

The single equipment cabinet contains a radio/modem unit, a STD bus based micro-controller, optically isolated input monitors and output controls, and a DC/DC converter to provide regulated, filtered operating voltages.

The following units comprise an LEACMS remote unit:

STD Bus Card Cage, 1A1-The STD bus card cage provides a standard set of electrical connections through a motherboard to allow all of the Circuit Card Assemblies (CCA) to communicate with each other. Optoisolator Motherboard, 1A2-This unit provides standard electrical connections for up to sixteen (16) DC voltage input or output optoisolator modules.

Interface Panel Assembly, 1A3-This assembly provides for circuit protection, microprocessor reset and reverse polarity protection for the entire LEACMS RU.

DC/DC Converter, 1A4-The 15-watt DC/DC converter provides regulated outputs of +5, +12 and -12 VDC required to operate the CCAs.

Radio/Modem Unit, 1A5-The UHF radio is used to establish data communications with the ACMS MU. The radio/modem unit consists of a transceiver, a modem and an interface module. The transceiver broadcast and receives modulated radio signals. The modem converts digital information to analog (Transmit) and vice versa (Receive). The interface module allows the user to visually and audibly (Receive Only) monitor the data messages through LEDs and a microphone/speaker respectively.

Electrical Characteristics

10-18VDC Input Voltage Range
5.1-Watts @ 13.5VDC (Continuous Power)

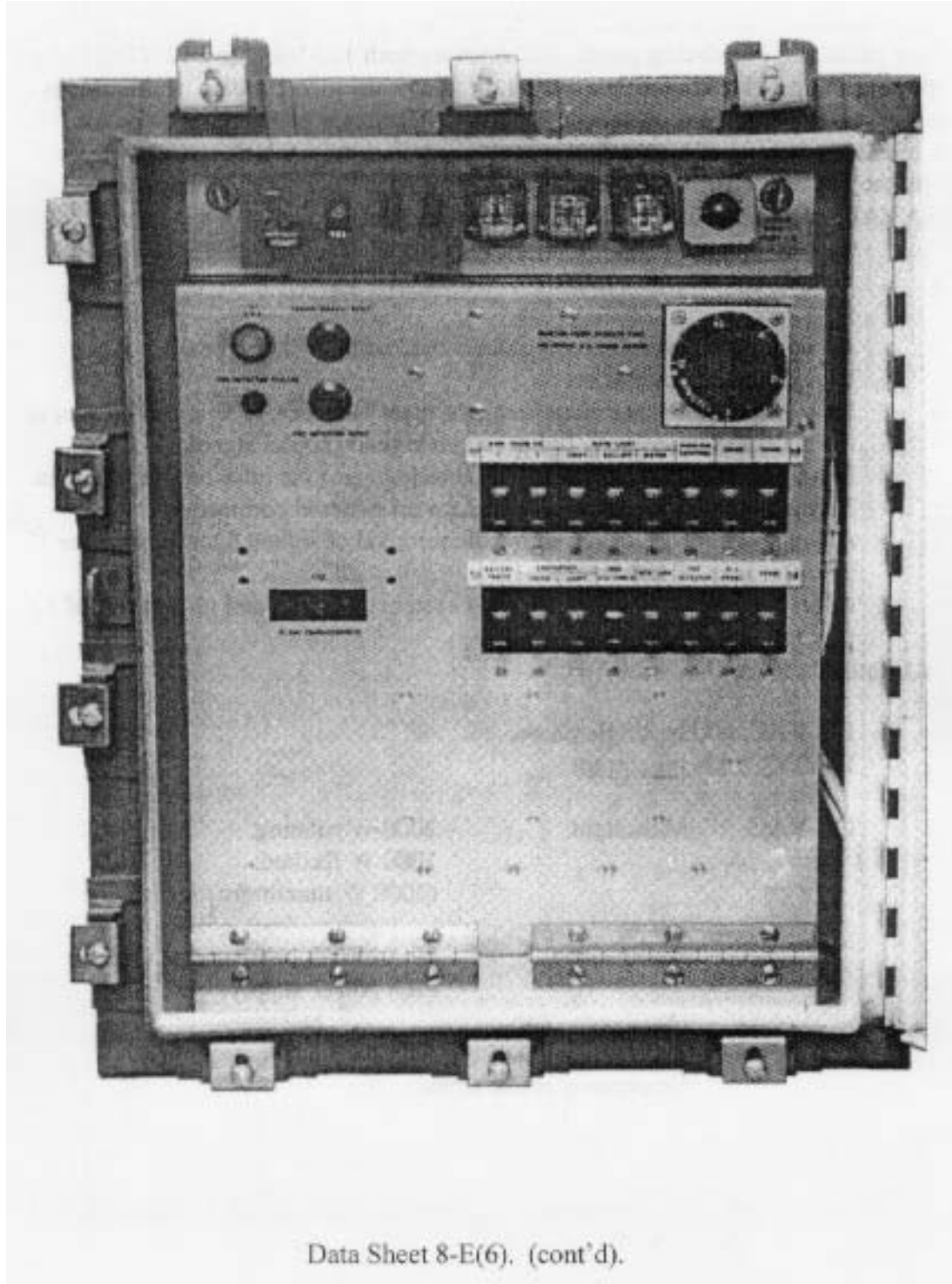
Data Sheet 8-E (5) LEACMS Remote Unit

8.E.

Low Energy Aid-Control Monitor System

Data Sheet 8-E(5). (cont'd).

8.E.



8.E.

Physical Characteristics.

Dimensions: 20" high.
 16" wide.
 10" deep*.
Weight: 55 lbs.

Related Equipment. The AVC is supplied with all relays, switches, circuit breakers, and current detector printed circuit boards. Some additional assembly may be required to accommodate specific equipment arrangements. Items required with the audio-visual controller but not supplied, excluding the aids and any necessary monitor and control system, are listed below:

NAVAID sensor modules for light and sound signal as applicable.
120 VAC and 12 VDC continuous sources.

Current-sensitive relay, 1RY9, and a 25 A, 120 VAC circuit breaker if the main light is a 2000 W rotating beacon.
Solid-state flasher, CG-181, with proper characteristic if the main light is flashed.

Additional Data. Fidelity Technologies Corporation, 2501 Kutztown Road, Reading, Pennsylvania 19605-2961, manufacture the audio-visual controller (codes AT, SS, and WR, respectively). The *Instruction Booklet for Audio-Visual Controller, GCF-RWL-2098* and the *Technical Manual for NAVAID Sensor Module, GCF-RWL-2076* are available from SUPCEN Baltimore stock. The AVC is managed by Commandant (G-SCE). AVC's are available from Commandant (G-SEC) for approved projects.

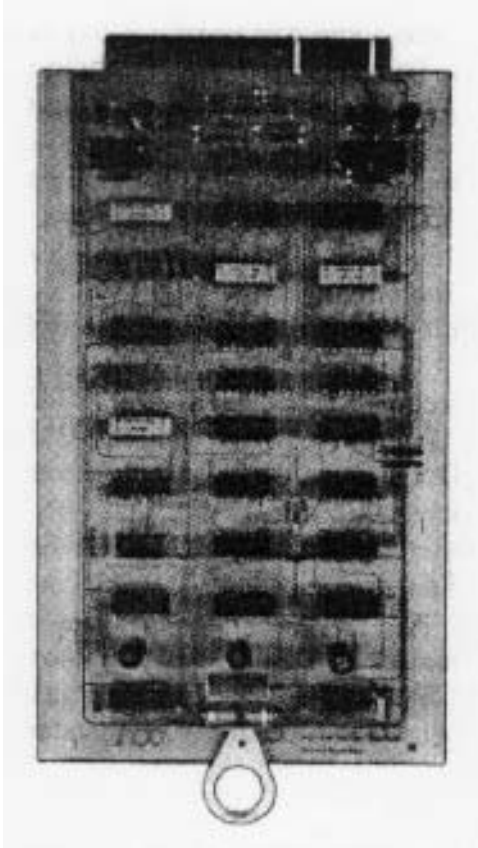
* An additional 1 ft-3 in. is required to allow full opening of the enclosure door.

Data Sheet 8-E(6). (cont'd).

8.E.

NAVAID Sensor Module
GCF-RWL-2076

Function. The NAVAID sensor module is the central processor for light and sound signal status information. It senses main signal characteristics, controls the transfer from main to emergency signals, and presents signal status information to the aid control monitor system (ACMS). One card is required for light signal functions and another card is required for sound signal functions. The two cards used in the navaid sensor module are GCF-RWL-2076.



Features.

Glass-epoxy, keyed printed circuit boards.

Each sensing channel adjustable for signal characteristics.

Local manual, remote automatic, and remote commanded reset capabilities.

Command line function for use with fog detector.

Command line function for use with daylight control.

Data Sheet 8-E(6). NAVAID Sensor Module, GCF-RWL-2076.

8.E.

Electrical Characteristics. The cards are constructed on G-10 glass-epoxy printed circuit boards.

Voltage requirements: +5 VDC and +12 VDC.
Operating power: less than 2.1 W.

Physical Characteristics.

Dimensions: 4 3/4" X 9 1/2".
Weight: 6.5 oz.

Related Equipment. The NAVAID sensor module is supplied complete and ready for installation after sensing channel timing settings are made. The following items are required for use with the NAVAID sensor module, but not supplied:

NAVAID sensor module panel, GCF-RWL-2241.
GCF-RWL-2098 audio-visual controller.

Additional Data. The *Technical Manual for NAVAID Sensor Module, GCF-RWL-2076* is available from ELC Baltimore stock. NAVAID sensor modules are available from Commandant (G-SEC) for approved projects.

Data Sheet 8-E(7). (cont'd).

8.E.

NAVAID Sensor Module Panel
GCF-RWL-2241

Function. The NAVAID sensor module panel, GCF-RWL-2241, is a cabinet that houses only the NAVAID sensor modules, GCF-RWL-2076. This cabinet is required at automated aids that have an emergency light or emergency sound signal. It is also required for use with ACMS, USQ-91(V).

Features.

Assembled and wired in a NEMA-4 cabinet.

Edge connectors for two model GCF-RWL-2076 NAVAID sensor modules (one for the light and one for the sound signal).

Barrier strips for making connections to the audio-visual controller, aid control system, or aid monitor system.

Regulator assures stable input voltage to the NAVAID sensor modules.

Nylon stuffing tube for wire entry.

Electrical Characteristics.

Input: +12 VDC.

Physical Characteristics.

Dimensions: 14" high.
12" wide.
6" deep.

Weight: 15 lbs.

Related Equipment. The NAVAID sensor module panel is supplied completely assembled. Items required but not supplied are listed below:

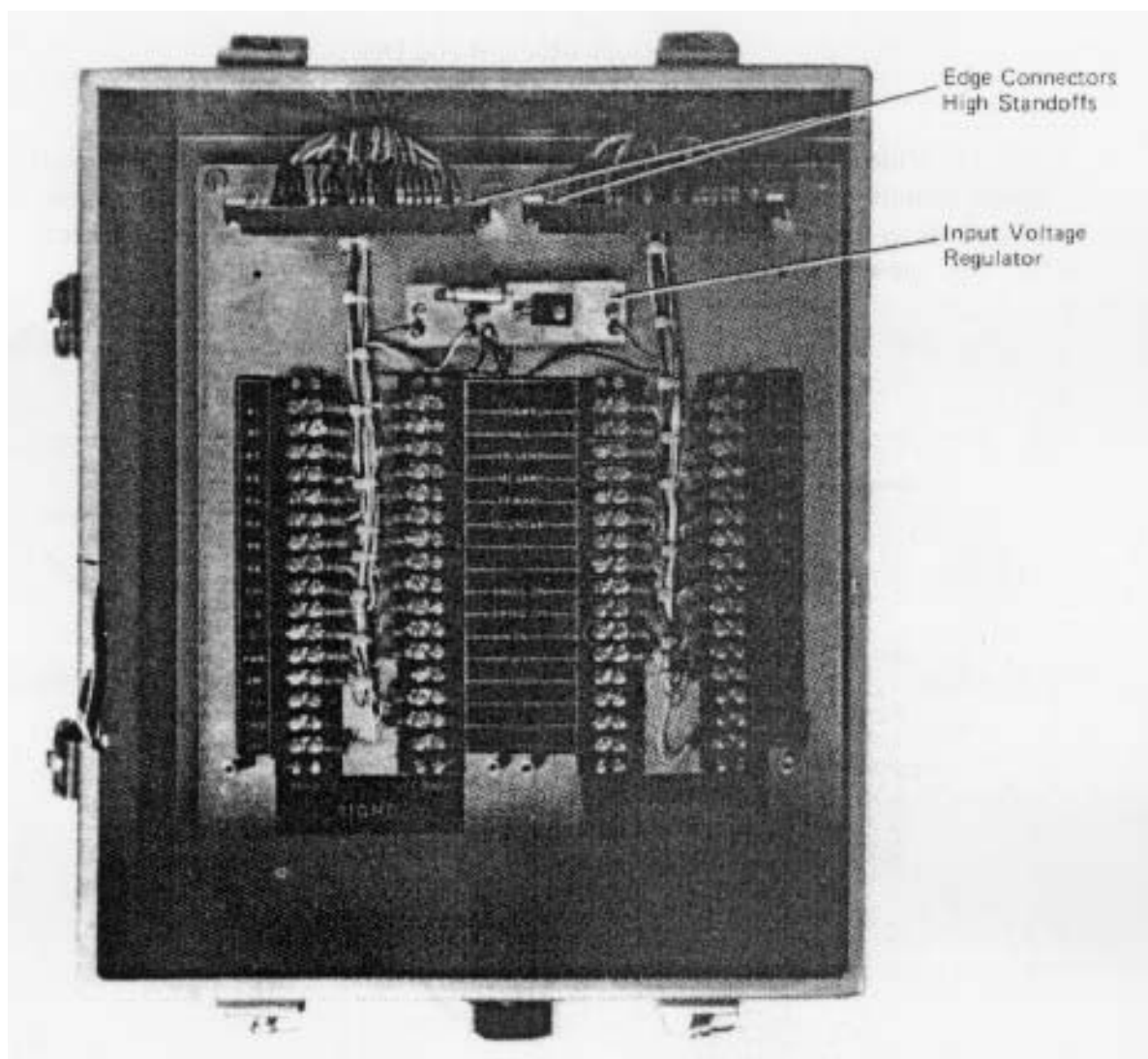
Two Model GCF-RWL-2076 NAVAID sensor modules, (one module for the light and one for the sound signal).

12 VDC continuous source.

External interconnecting wiring.

Data Sheet 8-E(8). NAVAID Sensor Module Panel, GCF-RWL-2241.

8.E.



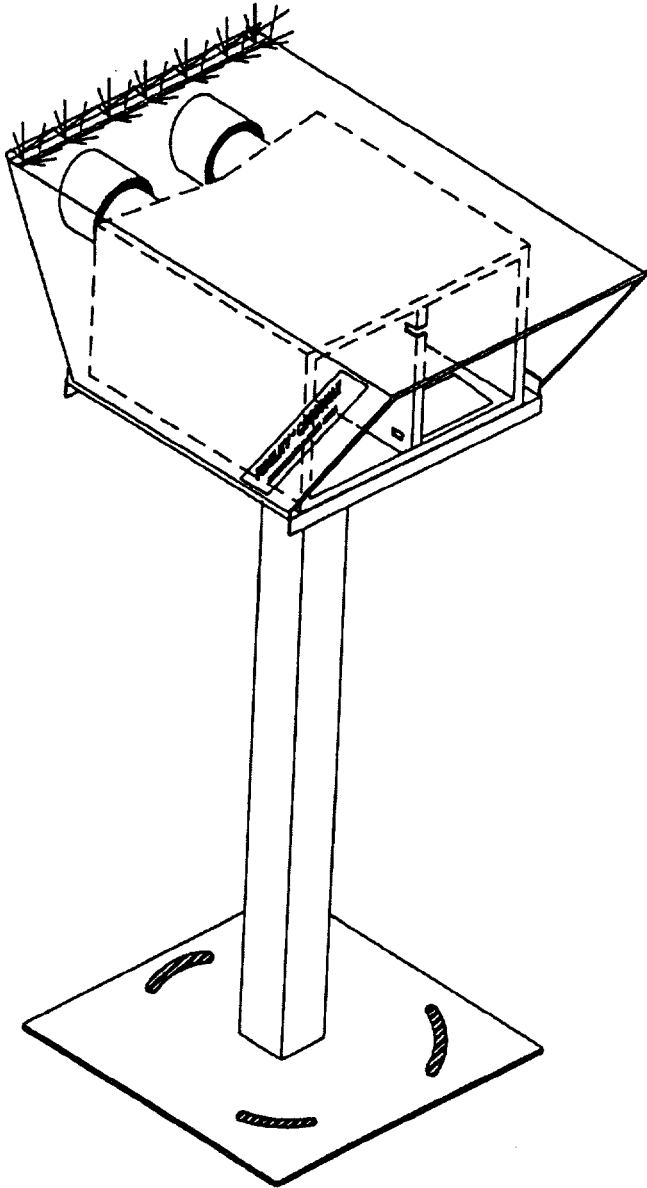
Additional Data. The *Technical Manual for NAVAID Sensor Module, GCF-RWL-2076* is available from ELC Baltimore stock. The NAVAID sensor module panel is managed by Commandant (G-SCE). NAVAID sensor module panels are available from Commandant (G-SEC) for approved projects.

Data Sheet 8-E(8). (cont'd).

8.E.

VM100 Fog Detector

Function. The VM100 Fog Detector is a microprocessor controlled meteorological instrument capable of measuring visibility through the atmosphere using the backscattered light principle. It is used at automated aids to control the operation of sound signals by the receiver which detects light (from the transmitter) that is backscattered from fog, rain, snow or air pollution.



Data Sheet 8-E(9). VM100 Fog Detector

8.E.

Features.

Assembled and wired on a weatherproof aluminum housing.

Long-life Xenon projector flash lamp.

Protective circuitry with automatic reset.

Automatic interrogation (self-checking) with fail-safe.

Mounts on a pedestal.

Thermostatically controlled heaters prevent mist and frost formation on windows and lens.

Shading tubes protect transmitter optics output and receiver optics input from stray light and weather.

Solar radiation shield.

Physical Characteristics.

Dimensions: 8" high.
 17" wide.
 11" long*.

Weight: 76 lbs. with pedestal and hood

Related Equipment. The fog detector is supplied completely assembled. Excluding the sound signal, the fog detector requires the following (which are not supplied):

9 to 18 VDC continuous.

Interfaces with the Audio-Vsual Controller, GCF-RWL-2098, when installed at a remote commercially power site.

Interfaces with Solar Distribution Box, when installed at a Solar Category I or II site.

Additional Data. Fidelity Technologies, Corp., 2501 Kutztown Road, Reading, Pennsylvania 19605-2961, is the manufacturer of the VM100 fog detector.

* Length at receiving shield. The length of the fog detector shield is 29".

Data Sheet 8-E(9). (cont'd).

8.E.

Electrical Characteristics.

General:

Input:	9 to 18 VDC.
Operating temperature:	-30F to +120 F.
Window heater:	normal thermostat setting +50F.

Transmitter:

Power consumption:	projector, 3.5 W. window heater, 5 W.
Lamp life expectancy:	2 yr (minimum).

Receiver:

Power consumption:	amplifier, 2 W. fail-safe, 2.5 W. window heater, 5 W.
Measuring range:	0.1 to 10 nm visibility.

Additional Data.

A manual, *Fog Detector VM100 Technical Manual (CG7610-01-GL5-3401)*, is issued with the equipment. Additional copies are available from ELC Baltimore stock.

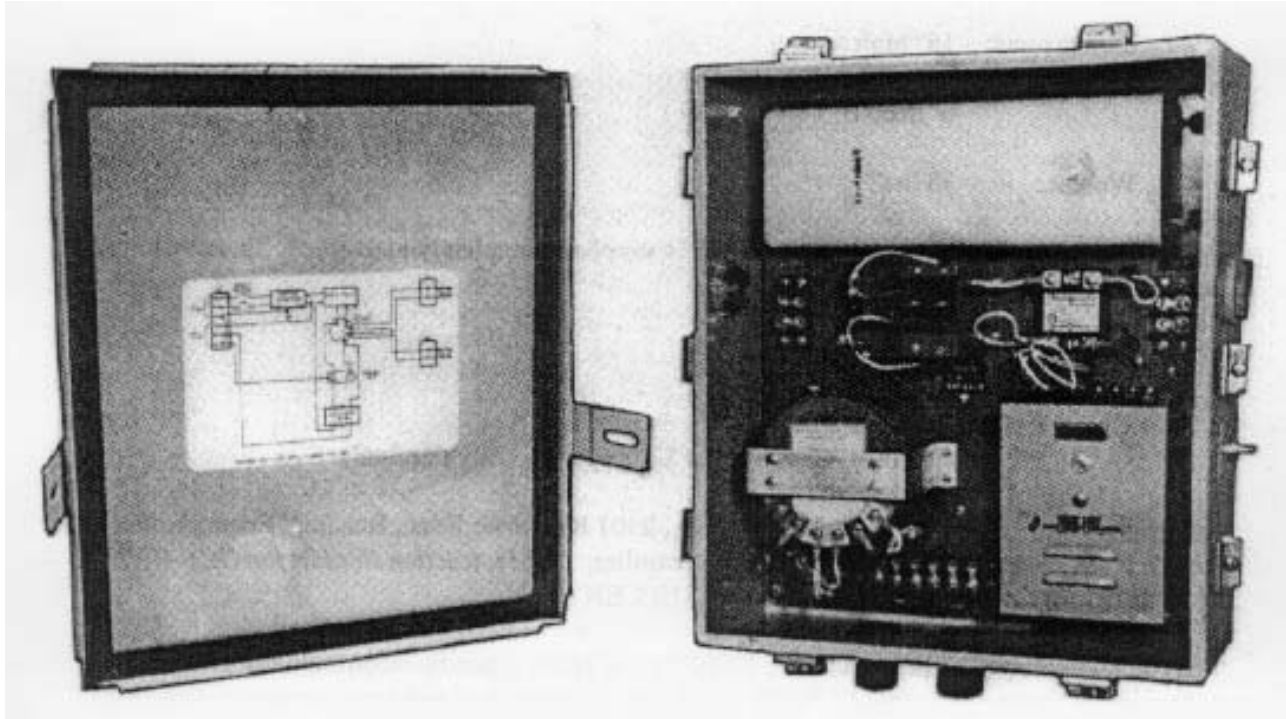
The VM100 fog detector is managed by Commandant (G-SCE). Specific information is supplied as an endorsement to the applicable ELECTRONALT. VM100 fog detectors are available from Commandant (G-SEC) for approved projects.

Data Sheet 8-E(9). (cont'd).

8.E.

AC Flash Controller
GCF-RWL-2106

Function. The AC flash controller, GCF-RWL-2106, is an integrated controller used to flash and daylight control 120 VAC incandescent lamps of up to 2000 W where there is no requirement for an emergency light. It also provides power-line transient protection and circuit breaker protection for the lamp and internal control circuits.



Features.

Assembled and wired in a NEMA-4 enclosure.

Enclosure cover can be double padlocked.

Uses CG-181 solid-state flasher.

Terminals and receptacles for CG-234 type L daylight control.

Nylon stuffing tubes for wire entry.

Data Sheet 8-E(10). AC Flash Controller, GCF-RWL-2106.

8.E.

Electrical Characteristics.

Input: 120 VAC, 60 Hz, single phase, 25 A.
Output: 120 VAC, 60 Hz, single phase, 25 A (maximum).
Internal: 12 VDC, 2 A (maximum) is available within the enclosure to power the CG-181 flasher.

Physical Characteristics.

Dimensions: 16" high.
14" wide.
6" deep.
Weight: 35 lbs.

Related Equipment. The AC flash controller is supplied completely assembled. Items required but not supplied are listed below:

CG-181 solid-state flasher.

120 VAC continuous input.

External wiring.

Daylight control, CG-234 type L (if operationally required).

Additional Data. Fidelity Technologies, Corp., 2501 Kutztown Road, Reading, Pennsylvania 19605-2961, is the manufacturer of the AC flash controller. The *Instruction Booklet for GCF-RWL-2106 AC Flash Controller* is available from ELC Baltimore stock.

The AC flash controller is provided by Commandant (G-SCE). AC flash controllers are available from Commandant (G-SEC) for approved projects.

Data Sheet 8-E(10). (cont'd).

CHAPTER 9. POWER SYSTEMS

A. Introduction. The three major factors that determine the overall power system used on an aid to navigation are electrical load, operational importance and accessibility for maintenance. Electrical load establishes the type and capacity of the power system. It includes all signal, support and special system power requirements. Operational importance determines the reliability and backup power requirements of the power supply system. It includes the relative importance of each signal in the aids to navigation system elements. The standard power system variations are displayed in Figure 9-1. The variation used on an aid to navigation generally depends on the type and amount of power required for the electrical load and reliability of commercial power.

The type and amount of power can be categorized as follows:

Direct Current (DC). Primary (nonrechargeable) batteries and solar arrays with secondary (rechargeable) batteries serve all floating and most fixed aids. Commercial (AC) power with 120 VAC to 12 VDC conversion serves the remaining DC fixed aids-both with or without battery backup.

Alternating Current (AC). Commercial (AC) power is used on many fixed aids, both with and without engine-generator backup power. Prime (engine-generator) (AC) power is still used at one aid.

The following factors must be weighed when considering the reliability of commercial power:

If the aid is critical to the area aids to navigation system, backup power for the commercial supply is required.

If the commercial power is unreliable, backup power is required.

If a direct current aid is critical, or if commercial power is unreliable, a 120 VAC/12 VDC battery charger and secondary battery, or a solar panel and secondary battery is required. Equipment must be housed in an adequate shelter to ensure protection from the environment

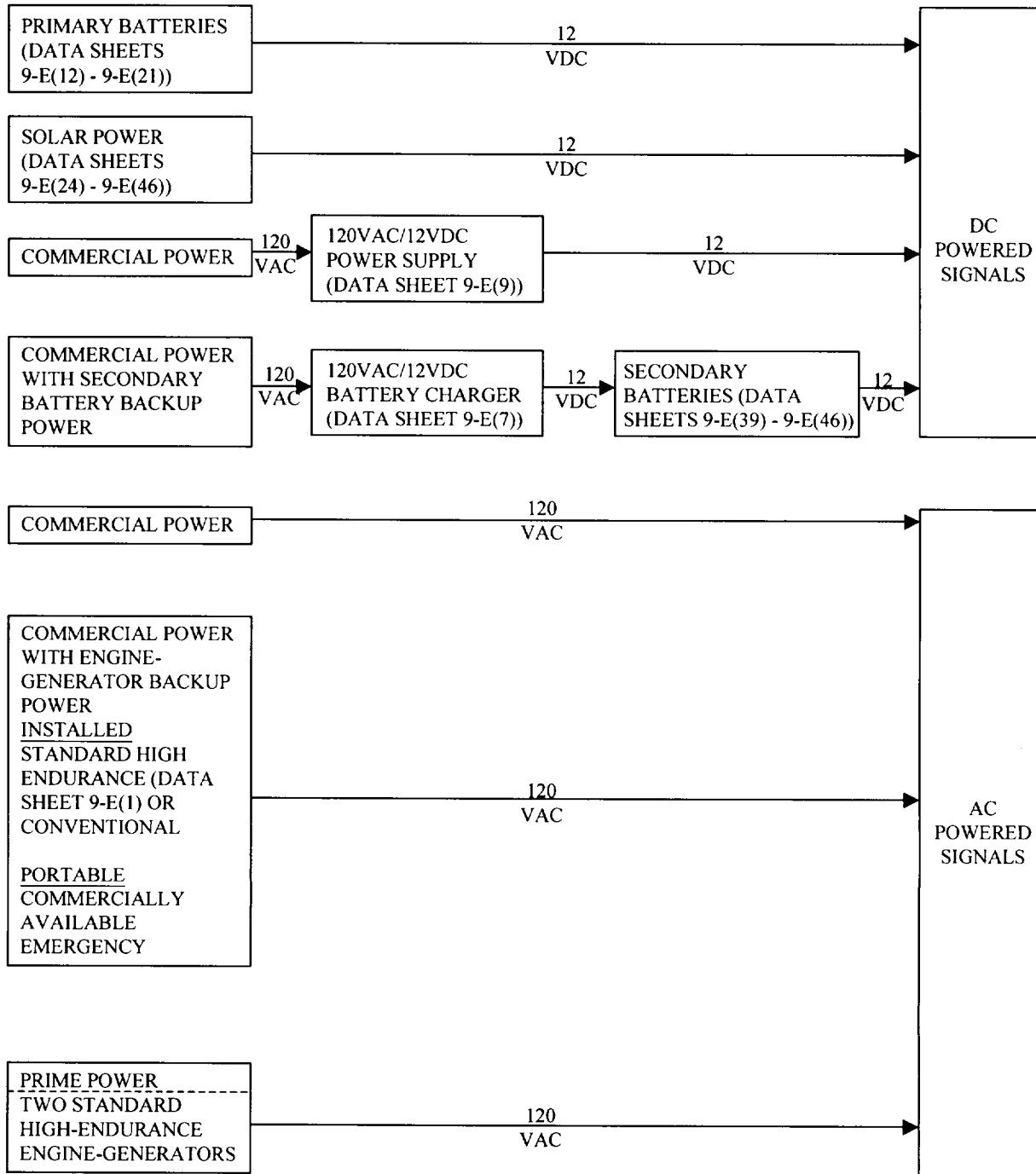


Figure 9-1. Standard power system variations.

9.B. Selection Guide.

1. Type of Power Required. The type of primary and backup power systems required for an aid are determined by the type of equipment installed and operational, economic, reliability and accessibility considerations. (See COMDTINST M16500.8A, Automation Technical Guidelines and COMDTINST M16500.24, Solar Design Manual for additional guidance on choosing power systems for aids to navigation).
2. Component Selection.
 - a. Commercial Power Systems. Standard drawings for commercially powered aids are available from your Civil Engineering Unit or Commandant (G-SEC-2A).
 - (1) Cable. Information on selection of cable is contained in Table 9-1, which specifies characteristics for various cables by classification and use. The two cable classifications are high voltage (greater than 600 volts) and low voltage (600 volts or less). Each classification is further broken down by use: underwater (submarine), overhead or buried. Double armored cable may be used at terminations transiting through rocky terrain or in areas susceptible to ice damage. Notes in Table 9-1 give further selection standards.
 - (2) Power Supplies. The standard aids to navigation power supply, described on Data Sheet 9-E(9), converts commercial AC power to 12 VDC and is capable of operating loads up to 25 amperes, total.
 - (3) Battery Chargers. Information on commercially available 12 VDC full float chargers is given on Data Sheet 9-E(7). They are used to float charge standby nicad batteries at commercially power lights with emergency lights. Battery chargers may be used in conjunction with nicad batteries to provide uninterrupted power to 12 VDC aids when no emergency equipment is installed and power is deemed unreliable (see Figure 9-2)

Table 9-1
Commercial Power Cable Selection Information

CLASS	USE	IDENTIFICATION	CHARACTERISTICS
High voltage	Submarine	USCG Spec. G-ECV-390	Power cable, three no. 6 AWG
		Marine Cable, Power & Control, Type I	conductors, 5kV insulation, no. 8 BWG armor.
		NSN 6145-01-298-1043	(1000 ft reels)
		NSN 6145-01-296-9295	(5000 ft reels)
		NSN 6145-01-436-0691	(1000 ft reels, double armor, Type IA)
		NSN 6145-01-436-0704	(3000 ft reels, double armor, Type IA)
	Submarine	USCG Spec. G-ECV-390	Power/Control cable, four no 8 AWG
		Marine Cable, Power & Control, Type III	conductors, 5 kV insulation, no. 8 BWG armor.
		NSN 6145-01-298-2044	(1000 ft reels)
		NSN 6145-01-298-2043	(5000 ft reels)
		NSN 6145-01-436-0713	(1000 ft reels, double armor, Type IIIA)
		NSN 6145-01-436-0826	(3000 ft reels, double armor, Type IIIA)
	Overhead or buried	This type of cable is specified by power utility companies for each installation in accordance with applicable NEMA, ICEA, ASTM and NEC standards*	
Low voltage	Submarine	USCG Spec. G-ECV-390	Control cable, four no 10 AWG
		Marine Cable, Power & Control, Type II.	conductors, 600 volt insulation, no. 12 BWG armor. Light duty for ease of handling.
		NSN 6145-01-298-1042	(1000 ft reels)
		NSN 6145-01-298-1041	(5000 ft reels).
	Overhead or buried	Many cables used for direct burial can be used if the protective jacket can withstand the seawater environment.	
		As with high voltage cable, the power utility company will specify this cable to meet particular needs of an installation. Since a variety of cables can be used in low-voltage applications, no specific cable is described herein.	

* National Electrical Manufacturers Association (NEMA), Insulated Cable Engineers Association (ICEA), American Society for Testing and Materials (ASTM), National Electric Code (NEC)

9.B.2.a.

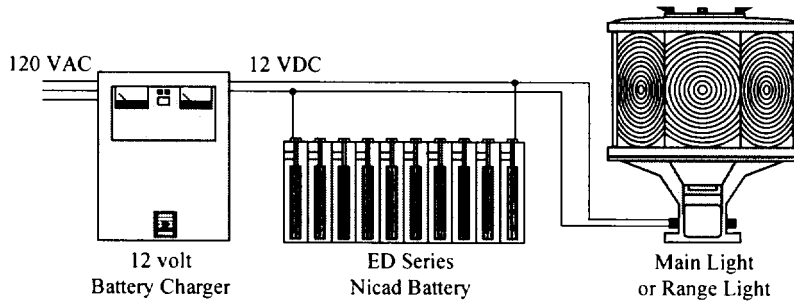


Figure 9-2. Commercial Power/12-volt Aid with Battery Backup

- (4) Range Switch Box-AC. The Range Switch Box-AC (RSB-AC) is used on commercially powered day/night ranges and switches the appropriate light on depending on the status of the photoelectric sensor. Data Sheet 9-E(11) details features of the RSB-AC and Figure 9-3 shows a typical installation.

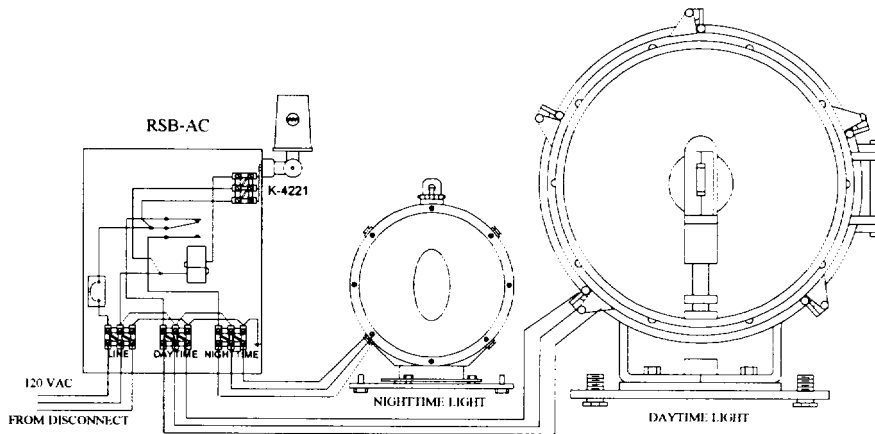


Figure 9-3. Commercially Powered Day/Night Range

- (5) Emergency Switch Box-AC. The Emergency Switch Box- AC (ESB-AC) is used at commercially powered 120 VAC day/night or night only ranges that have a separate and independent 12 VDC power source and 12 VDC emergency range light. Upon commercial power failure, the emergency range light will be powered by the 12 VDC battery (charged by a 10-Watt solar panel) until commercial power is restored or the battery is exhausted. Data Sheet 9-E(10) details features of the ESB-AC and Figure 9-4 shows a typical installation.

9.B.2.a.

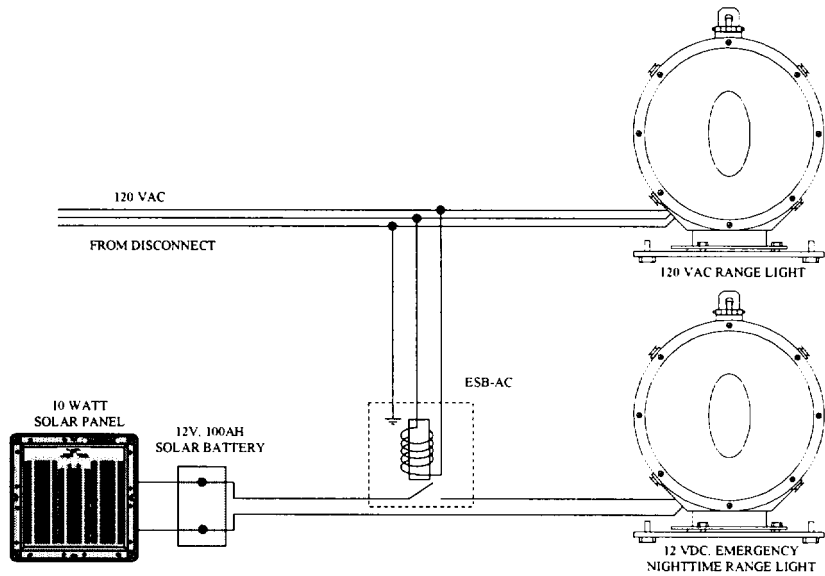


Figure 9-4. Commercially Powered Range with 12 VDC Backup

- (6) Other Requirements. Other commercial power system equipment shall be selected according to individual design features, National Electric Code requirements and individual utility company requirements. Individual design features are influenced by power availability and cost, accessibility for repair, availability of qualified maintenance personnel and vulnerability to damage.
- b. Engine-Generator Systems. Standard drawings for commercially powered aids with emergency engine-generator systems are available from your Civil Engineering Unit or Commandant (G-SEC-2A).
 - (1) Ratings. Standard high endurance engine-generators were available in five ratings. Various ratings are obtained by coupling the same Lima generator to Lister diesel engines of varying horsepower ratings. The five standard ratings are 4, 6.5 8, 10 and 11 kW. Complete ratings of the engines and engine-generator combinations are listed in Data Sheet 9-E(1). The inventory of generators is limited to those installed. The engines used are obsolete and, while one site is still prime powered, the remainder are used as backup power to commercial installations. The low operating interval along with available spare parts should allow these engine-generators to operate for many years. Some 8 and 11 kW engine-generator sets are still in stock and may be used when the operational unit is no longer rebuildable. Care must be exercised to ensure that the generator selected will not only supply peak power requirements, but also be adequately loaded at all times. Generators should operate at 75 percent to 100 percent of rated capacity, even when sized in a standby capacity.

9.B.2.b.(1)(cont'd)

- (2) Fuel Consumption. Fuel consumption is a function of load. For Lister diesel engines, the specific fuel consumption rates are listed in Data Sheet 9-E(1). For standby installations, fuel storage should be adequate to power the engine for the longest anticipated outage, but not so excessive that long-term storage (shelf life) will be a concern.
- (3) Accessories. The following accessories are used on all standard high endurance engine-generator installations:
 - (a) Controls-Lighthouse Power Controller (LPC) (Data Sheet 9-E(4))
 - (b) Starting Battery-24 volt battery bank consisting of 20 cells Saft America, Inc., SBH102 (HED-100 in older installations) or Alcad XHP100 nickel-cadmium batteries (Data Sheet 9-E(6)).
 - (c) Battery Charger-24 volt battery charger (Data Sheet 9-E(5))
 - (d) Fuel Daytank and Transfer Pumps-Standard fuel daytank assembly (Data Sheet 9-E(3)). Note: this may be omitted in gravity feed fuel systems.
 - (e) Environmental Controls-Standard Environmental Control Unit (ECU) (Data Sheet 9-E(2)).
- (4) The functions of these accessories must be individually engineered for all non-standard engine-generator installations. Figure (9-5) shows equipment used in a standard power volume.

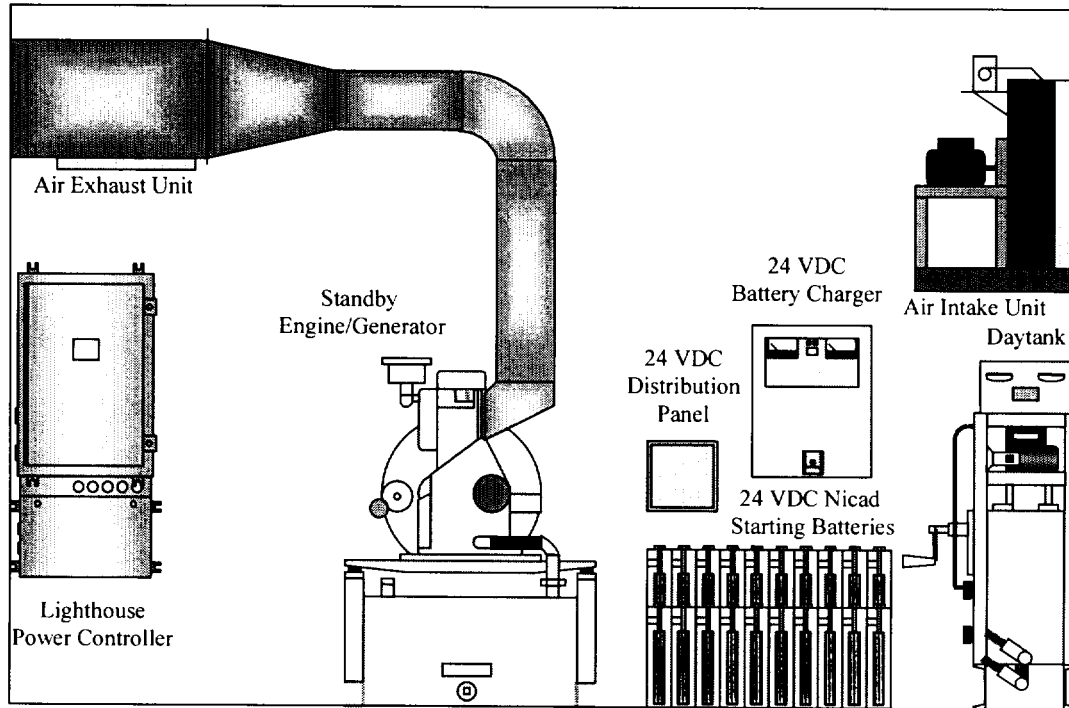


Figure 9-5. Standard Power Volume Layout

c. Primary Batteries.

- (1) General Information. Primary batteries are those which cannot be recharged. Only batteries that meet G-SEC purchase specifications shall be used in aids to navigation. There are many types of primary batteries. Air-depolarized batteries require oxygen from the air to operate. Air enters the battery through the carbon electrode. Dry cell batteries that do not require oxygen are used in ice buoys.

- (2) Nomenclature. The following nomenclature is used to describe air-depolarized primary batteries:

(a) Primary Classification

Use-Shore (fixed) aids (S); Buoy (B)

Capacity-Ampere-hours divided by 100

Electrolyte-Non Liquid (Dry) (D); Liquid (A)

9.B.2.c.(2)

- (b) Shore Aid Cell Designation. The number of cells in each individual battery (one, two or three) further designates shore aid batteries as a prefix to the primary classification symbols.
- (c) Buoy Power Units. Buoy Power Units (BPUs) are supplied with gelatinous electrolyte (D) activated by the manufacturer.

Examples:

B10D-Buoy Power Unit, 12-volt, 1000
ampere-hour, activated by the manufacturer
(Celair)

3S30A-Shore Aid, 12-volt, 3000 ampere-
hour, liquid electrolyte (Saft America).

(3) Non-Seasonal Applications.

- (a) Current Capacity. Primary batteries have a low current discharge rate limiting the lamp size to a specific battery capacity. Before selecting a battery, the lamp size and flash rhythm must be properly matched, in accordance with Table 9-2.

**Table 9-2
Maximum Allowable Lamp Size**

Rhythm	Maximum Allowable Lamp Size (A) for a Given Battery Capacity (Ah)			
	<u>1000Ah</u>	<u>2000Ah</u>	<u>3000Ah</u>	<u>6000Ah</u>
Fixed	.25	.55	.77	2.03
Oc 4	.25	.77	1.15	2.03
Iso 6	.55	1.15	1.15	3.05
FL(2)6	.77	1.15	2.03	3.05
Q	.77	1.15	2.03	2.03*
Mo(A)	.77	1.15	2.03	3.05
FL(2)5	1.15	2.03	3.05	3.05
FL(2+1)6	1.15	2.03	2.03	2.03*
FL2.5(.3)	1.15	2.03	2.03	2.03*
FL4(.4)	1.15	2.03	3.05	3.05
FL6(.6)	1.15	2.03	3.05	3.05

*Lamp size is limited by contact closure time, not current capacity

- (b) Battery Capacity. Battery capacity shall be selected for a given installation so that the recharge period is at least one year, but not more than three years.
- (c) Rated Battery Discharge Time (RBDT). RBDT is the expected useful life of a battery in days based on the applied loads and environmental conditions. It is found by dividing the battery capacity by average daily current consumption and applying installation correction factors and environmental correction factors, as necessary. The RBDT is used to find when batteries in continuous service should be replaced by counting forward from the installation date the number of RBDT days. RBDTs must be calculated for each specific aid site. The tables published in earlier versions have been removed because of the limited usage of these batteries.

The RBDT can be calculated as follows:

$$\text{Basic equation: RBDT} = \frac{Bc}{Dcc} - \text{Installcf}^* - \text{Envcf}$$

Where: Bc = battery capacity in amp-hours
 Dcc** = average daily current consumption in amp-hours/day (see below)
 Installcf = installation correction factor in days (see Table 9-3)
 Envcf = environmental correction factor in days (see Table 9-4).

* Used only when light is daylight controlled. You must calculate Bc/Dcc first to find Installcf

** $Dcc = I_{avg} \times D \times H + Fd$

Where: Iavg = average lamp current in amperes (see Table 9-5)
 D = duty cycle of flasher (Table 9-5)
 H = hours of operation (13 is daylight controlled, 24 if not daylight controlled)
 Fd = daily flasher dissipation in amp-hours/day (use 0.48 ah/day)

Table 9-3
Installation Correction Factor (Install_{cf})

Battery Service Life at 13 hrs/day (Bcc/Dcc)				Install _{cf} (days)
365-390	721-735	736-750	1081-1095	0
391-420	691-720	751-780	1051-1080	10
421-450	661-690	781-810	1021-1050	20
451-480	631-660	811-840	991-1020	30
481-510	601-630	841-870	961-990	40
511-540	571-600	871-900	931-960	50
541-553	556-570	901-915	916-930	60

Table 9-4
Environmental Correction Factors (Env_{cf})

Correction Factor	Env _{cf} (days)
Heavier than average daily cloud cover in: CGD1, upper CGD5 and upper CGD9 CGD13 and CGD17	15 30
Average daytime temperature over 80°F for entire RBDT	30
Daylight control shaded at sunrise	30
Daylight control shaded at sunset	30
Average nighttime temperature less than 30°F during 3 or more months of RBDT	15

Table 9-5
**Average Lamp Current in Amperes
for Rated Lamp Sizes**

Rhythm	Duty Cycle(%)	0.25a	0.55a	0.77a	1.15a	2.03a	3.05a
Fixed	100	.250	.550	.770	1.15	2.03	3.05
Oc 4	75	.252	.559	.785	1.18	2.10	3.17
Iso 6	50	.252	.559	.785	1.18	2.10	3.17
Fl(2)6	33	.258	.578	.816	1.24	2.23	3.42
Q	30	.278	.639	.916	1.42	2.76	
Mo(A)	30	.262	.592	.844	1.29	2.38	3.70
Fl2(5)	16	.271	.621	.894	1.38	2.62	4.15
Fl(2+1)6	15	.278	.639	.916	1.42	2.76	
Fl 2.5(.3)	12	.278	.639	.916	1.42	2.76	
Fl 4(.4)	10	.271	.621	.894	1.38	2.62	4.15
Fl 6(.6)	10	.266	.596	.859	1.31	2.45	3.81

Example: What is the RBDT of a buoy using a 1000 Ah BPU with 0.55 amp lamps and a FL4(.4) flasher with daylight control? The buoy will be installed in the First Coast Guard district.

$$D_{cc} = 0.621 \text{ amps} \times 0.10 \times 13 \text{ hr/day} + 0.48 \text{ Ah/day}$$

$$D_{cc} = 1.287 \text{ Ah/day}$$

$$B_c/D_{cc} = 1000\text{Ah} / 1.287 \text{ Ah/day} = 777 \text{ days}$$

$$\text{Install}_{cf} = 10 \text{ days}$$

$$\text{Env}_{cf} = 15 \text{ days}$$

$$\text{RBDT} = 777 \text{ days} - 10 \text{ days} - 15 \text{ days}$$

$$\text{RBDT} = 752 \text{ days or } 2 + 22 \text{ yr/days.}$$

CG-6P lamp life = 4 + 65 (Table 9-6; not a factor in determining this RBDT) and use of 0.55 amp lamps is acceptable with a 1000 Ah BPU (Table 9-2)

A 2000 Ah BPU would provide a RBDT in excess of 3 years, exceeding the maximum allowable interval.

- (d) Lamp Life. For some flasher/lamp combinations, the rated life of six lamps in the CG-6P lampchanger will be less than the RBDT. In some cases, a special notation shall be made on the ATONIS form to indicate that lamp replacement time is less than the RBDT. See chapter 6 for the lamp life calculations to determine the replacement interval for the lamp/flash rhythm combination.

9.B.2.c.(3)(e)

(e) Activation. All primary batteries, with the exception of dry cell batteries (ice batteries) require air to function. Remove sealing tape covering vents prior to use (including buoy power units).

(4) Special Applications.

(a) Ice Buoys. Especially designed lithium type primary batteries (Data Sheet 9-E(21) are authorized for use in ice buoys. These batteries have a two year shelf life; spares may be used the following season in operational hulls. Ice buoys do not have vented pockets because they frequently submerge and this, together with the shock loads encountered, precludes the use of other types of batteries. Table 9-6 provides calculated RBDTs for standard MPV-LED/flasher combinations used on ice buoys.

(b) Emergency Use. Lithium ice buoy batteries may not be used as emergency temporary power sources.

Red, White, Green MPV-LED Lantern RBDT

Yellow MPV-LED Lantern RBDT

Rhythm	Days	# of Battery Packs	Days	# of Battery Packs
FL6 (0.6)	225	1	183	1
FL4 (0.4)	225	1	183	1
FL2.5 (0.3)	188	1	152	1
FL 6 (2+1)	150	1		
Q	150	2	121	2
Mo (A)	150	2		

Table 9-6
Ice Buoy Battery RBDT

9.B.2.d.

- d. Secondary Batteries. Secondary batteries are batteries that can be recharged by either a battery charger or photovoltaic (solar) array. Nickel-cadmium batteries are used to provide DC power for diesel starting, and power for emergency light and sound signals. Lead-acid batteries are used primarily on solar power aids.
- (1) Diesel Starting Batteries. 24-volt nickel-cadmium batteries are used at prime-powered (1 remaining) and commercially powered sites requiring a backup engine-generator. Twenty 1.2-volt pocket plate type cells are wired in series to achieve 24 volts. The battery is specifically designed for long float service and capable of starting a diesel engine. See Data Sheet 9-E(6).
 - (2) Emergency Batteries. 12-volt nickel-cadmium batteries are used at some commercially powered and solar powered sites to provide backup power for emergency signals. Ten 1.2-volt pocket-plate type cells are wired in series to achieve 12-volts. This battery was chosen because it retains its capacity over a long period of time (in excess of 20 years) and is capable of being float charged by a battery charger or non-standard solar panel. Battery capacity should be selected to provide a minimum of 8 days autonomy based on an 11.0-volt cutoff voltage. See The Lighthouse Manual, COMDTINST M16500.8 (series), for additional information. See Data Sheet 9-E(8).

- (3) Photovoltaic (Solar) Batteries. Secondary batteries used in solar power applications are design to provide small amounts of current over along period of time. The batteries look similar to automotive batteries, which are designed to deliver large amounts of current in short periods of time. Use of automotive type batteries in AtoN will likely lead to premature failure.
- (a) Maintenance-Free 12-volt Batteries. Batteries with a nominal rating of 12 volts, 100 ampere-hours are used on all solar powered buoys and most structures. Data sheets 9-E(40) and 9-E(41) detail two commonly used solar batteries. COMDTINST M16500.24 lists additional suggested sources of supply.
- (b) Large Battery Systems. These batteries are used at stationary aids to navigation requiring more than 400 amp-hours. Six 2-volt cells are wired in series for a nominal 12-volt system. Data sheets 9-E(47) and 9-E(48) detail two large battery systems.
- (4) Emergency Use. Solar batteries may be used as Hot Pack batteries as long as the following conditions are met:
- (a) The battery is sealed;
- (b) Permanently marked “For Discrepancy Use Only”;
- (c) Derated to one half of advertised capacity;
- (d) Protected from rain, sun and salt spray, if possible;
- (e) Recharged as soon as it is removed from the aid.

Table 9-7 details the RBDT when using one solar battery to temporarily power these common daylight controlled light signals.

Hot Pack* RBDT in Days

Flash Rhythm	Lamp Size			
	0.25	0.55	0.77	1.15
Fl 6(.6)	57	36	28	20
Fl 4(.4)	56	35	27	20
Fl 2.5(.3)	51	31	23	16
Fl (2+1)6	45	26	20	14
Fl (2)5	44	25	19	13
Fl 4(1.0)	34	19	14	10
MO A	30	16	12	8
Fl (2)6	28	15	11	8
Q	29	15	11	7
Iso 6	21	11	8	5
Occ 4	15	7	5	4

*Using one 12 volt, 100 AH secondary battery

Table 9-7. Hot Pack RBDT in Days

- e. Solar Power System. A minor aids solar power system consists of solar panel(s), rechargeable (secondary) batteries and mounting hardware. Systems are designed using the Solar Design Program (COMDTINST M16500.24) so that the minimum seasonal state of charge does not drop below 65% (80% for large battery systems) during an unusually harsh year. Minor aid systems do not use a charge controller as the solar panels are closely matched to the charging characteristics of lead-acid secondary batteries as long as the charge rate is within specified limits, as detailed by the Solar Design Program.

In general, solar power systems can be designed to work wherever there is sunlight. Sites shadowed by cliffs, or bluffs can, in some cases, be overpowered to compensate for the lack of direct sunlight, otherwise they must use primary batteries. Contact COMDT (G-SEC-2A) for assistance.

Solar power systems for large installations contain multiple solar panels, Local Terminal Boxes (LTBs), a PV Combiner box, large battery systems, charge controllers and a Solar Distribution Box (SDB). COMDTINST M16500.24 and COMDTINST M16500.8A provide more detail on the design and installation of these systems. The Solar Lighthouse Spare Parts Kit, available from Commandant (G-SEC), contains components commonly replaced or hard to find at solar powered lighthouses.

Solar power systems can be divided into three basic types: minor aid, lighthouse and range. The minor aid power system is the

simplest and is depicted in Figure 9-6. These systems have one or two solar panels and up to four solar batteries. Some range power systems are considered minor power systems.

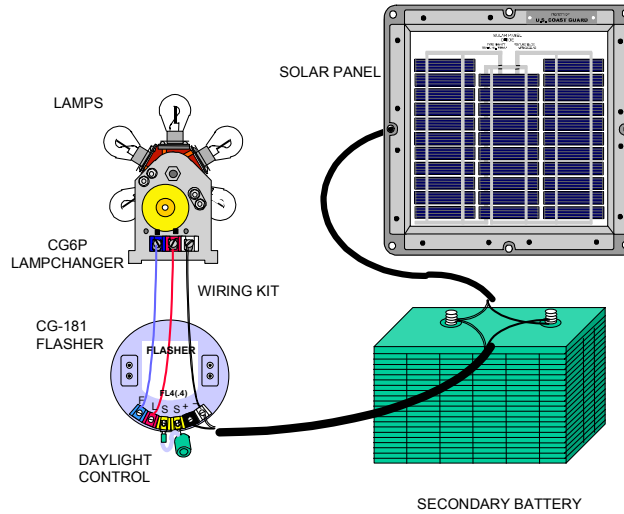


Figure 9-6. Typical Minor Aid System

Lighthouse power systems are more complex. Most have multiple solar panels, a charge controller to prevent overcharging the battery, a large 12 VDC battery system comprised of six two volt cells wired in series, and multiple loads controlled by a central distribution box. Figure 9-7 depicts a typical lighthouse power system. Some high intensity day/night ranges may use some of these components.

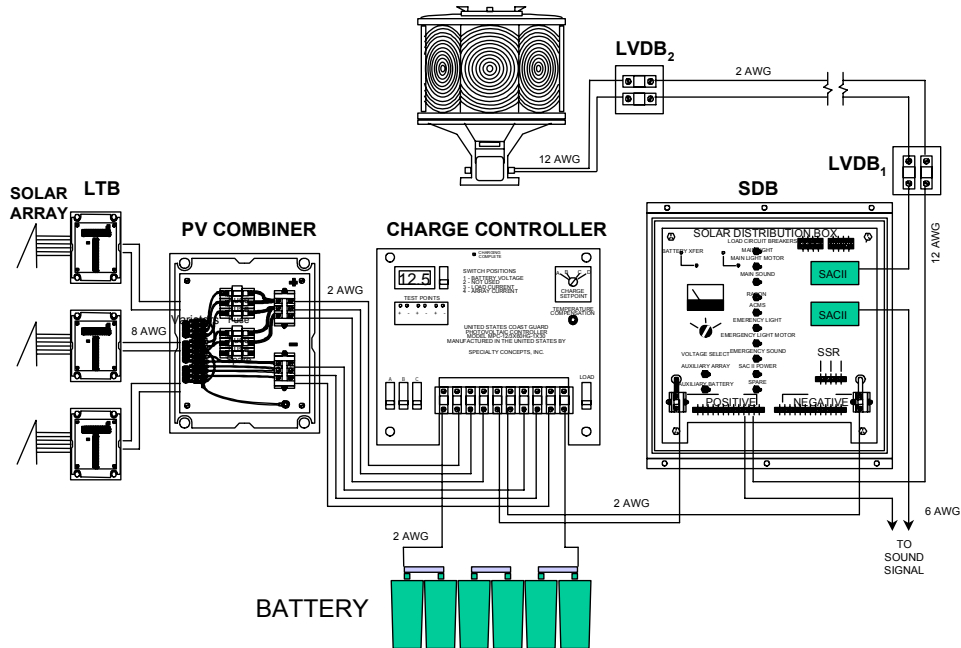


Figure 9-7. Typical Lighthouse Power System

The range power system is typically used on high intensity nighttime ranges and day/night ranges. It may also be used at lights containing up to eight solar panels. The system is comprised of up to eight solar panels, and a Range Power Box (RPB) to prevent overcharging the battery and provide low voltage protection, and a Range Switch Box-DC (RSB-DC) for day/night ranges. Figure 9-8 depicts a typical range power system. The Range Spare Parts Kit, available from Commandant (G-SEC), contains hardware commonly replaced on both AC and DC powered day/night ranges.

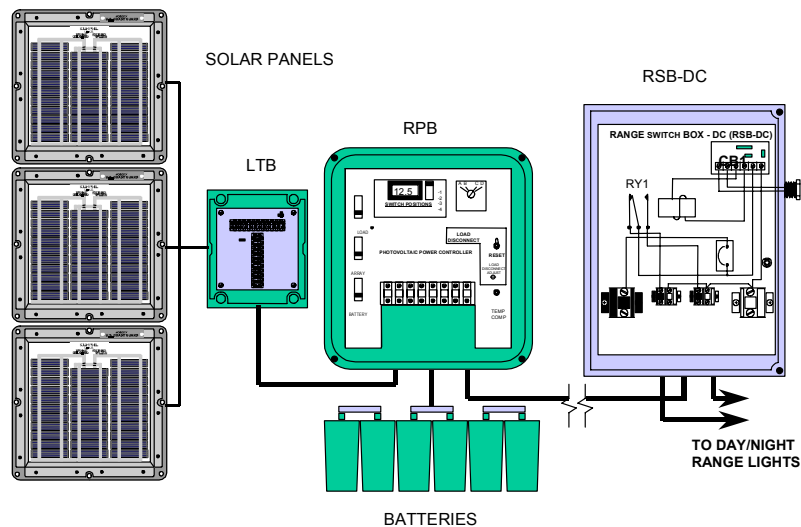


Figure 9-8. Typical Range Power System

- (5) Solar Panels. Solar panels are photovoltaic devices that convert sunlight into direct current (DC) electricity. The energy produced by the solar panel during the day charges the secondary battery that powers the day or night (or both) load. Three types of solar panels are available: standard, SM46 and SM50-H. Standard panels are available in 10 watts, 20 watts and 35 watts. These panels are designed to withstand the vigors of operation on lighted aids to navigation. The SM46 (old M65) panel is a commercially available module that is used on protected structures requiring high-density packaging. These panels are rated at 46 watts, but are not robust enough for installation at exposed lighthouses. A single SM50-H (old M75) is used at solar powered installations requiring emergency batteries. The higher voltage of this panel is ideally suited to float charge nickel-cadmium batteries. See Data Sheet

9.B.2.e.(1)(cont'd)

- (2) System Sizing. The Solar Design Program detailed in COMDTINST M16500.24 provides the tools necessary to determine the system sizing (solar panel and battery size) for a given load(s). The manual also contains precalculated tables for most common lamp sizes and flash rhythms.
- (3) Mounting. Solar panels installed on structures in the Northern hemisphere are oriented toward true South (+/-5) and tilted at angles (measured from horizontal) governed by the following locations: Alaska - 75 , Continental U.S. - 60, Hawaii and GANTSEC - 30 . Custom designs, daytime ranges, etc., may specify alternate tilt angles to maximize system performance. Orientation on a buoy is not possible, therefore either a single horizontal (0), dual 15 , dual 90, triple 60 , or quad 90o panel mounting configurations are possible. COMDTINST M16500.24 can help in choosing the optimum-mounting scheme. Solar panels shall not be placed in radar reflectors as shadowing by the lantern ring and adjacent reflectors will cause unpredictable power production.
- (4) Hardware. Brackets, housings and stands are available to mount minor aid solar hardware to buoys and structures. Chapters 2 and 4 detail these components. Large power systems are custom designed by the local Civil Engineering Unit (CEU). The Solar Installation Kit, available from ELC Baltimore, contains the appropriate hardware for installation of solar panels at all sites. See Data Sheet 9-E(27).
- (5) Buoy Mounted Junction Box. The Buoy Mounted Junction Box is used on buoys containing two, three or four solar panels. The box provides a convenient place to terminate solar panels, the battery lead and up to three loads. The box is designed to be rainproof and will withstand occasional submergence. See Data Sheet 9-E(28).
- (6) Local Terminal Box. The Local Terminal Box (LTB) is used on ranges and lighthouses requiring multiple solar panel installations. The LTB acts as a gathering point for up to eight solar panels so that large capacity conductors can be used between the array and point of destination with minimal voltage drop. LTBS are terminated at a PV Combiner Box, if more than one LTB is used, or at Range Power Box (RPB), if only one LTB is used. See Data Sheet 9-E(29).

9.B.2.e.(6)(cont'd)

- (7) PV Combiner Box. The PV Combiner Box provides a convenient termination for multiple LTBs and the ability to step up to very large (1/0 AWG) wire for input into the charge controller. The PV Combiner is fused to provide overcurrent protection and allow testing of solar panel blocking diodes in an entire string. See Data Sheet 9-E(30).
- (8) Charge Controller. The charge controller is used to prevent overcharge of battery systems used at large photovoltaic installations employing multiple LTBs. The controller switches off multiple array strings when the battery is fully charged. A third string is continuously connected to the battery (through the controller) to float charge the battery. See Data Sheet 9-E(31).
- (9) Solar Distribution Box. The Solar Distribution Box (SDB) replaces the Multi-Array Controller (MAC) and is used at 12 VDC solar powered lighthouses with multiple loads and/or emergency batteries. The SDB may also be used at commercially powered 12 VDC lights that require battery backup. These sites require the addition on a Power Supply Monitor Box (PSMB, Data Sheet 9-E(37)) for proper operation of the SDB. See Data Sheet 9-E(35).
- (10) Solar Aid Controller II (SACII). The SACII is used in conjunction with the SDB and transfers operation from the main to emergency signals upon main power failure, component failure, operates the lampchanger at lights with lamps 50 watts and greater or is monitored. Two SACIIs are required if the aid has both emergency light and sound signals. See Data Sheet 9-E(36).
- (11) Sound Signal Current Detector (SSCD). The SSCD is used on FA-232 and SA-850 series sound signals when monitored and controlled by a SACII. One SSCD is needed for each emitter, i.e., two SSCDs are used on a FA-232/02. The SSCD provides a better method of determining proper sound signal operation by monitoring each emitter's driver current. See Data Sheet 9-E(38).

9.B.2.e.(12)(cont'd)

- (12) Range Power Box. The Range Power Box (RPB) is used at solar powered ranges that contain one LTB and require overcharge protection. The RPB can also be used at other aids to navigation installations meeting the above criteria. The RPB is a commercially available small charge controller that contains array, battery and load circuit breakers to provide overcurrent protection and a disconnect to allow safe servicing on high-current battery systems. See Data Sheet 9-E(32).
- (13) Low Voltage Drop Kit. The Low Voltage Drop Kit is used to prevent excessive voltage drop between the power source and load. It is typically used between the SDB and main light or between the RPB and Range Switch Box or range light. Two short lengths of 12/2 SO are provided to facilitate hookup at the source and load with large conductor wire between the boxes. Only one box is required when using a Range Switch Box as it can terminate large conductor wire directly. See Data Sheet 9-E(39).
- (14) Range Switch Box-DC. The Range Switch Box-DC (RSB-DC) is used on 12 VDC powered day/night ranges and switches the appropriate light on depending on the status of the daylight control. See Data Sheet 9-E(33).
- (15) Emergency Switch Box-DC. The Emergency Switch Box- DC (ESB-DC) is used at 12 VDC powered 120 VAC day/night or night only ranges that have a separate and independent 12 VDC emergency power source and 12 VDC emergency range light. Upon failure of the 12 VDC power system, the 12 VDC emergency battery (charged by a 10-Watt solar panel) will power the emergency range light until main 12 VDC power is restored or the emergency battery is exhausted. See Data Sheet 9-E(34).
- (16) Portable Diesel E/G. The portable diesel engine-generator set is used at solar powered lighthouses to provide the initial freshening charge on large 12 VDC battery systems or recharge a system that is discrepant. The set is capable of charging batteries at a rate of up to 100 amperes, continuous and has convenience receptacles (120VAC) for operating lights and tools. See Data Sheet 9-E(50).

9.B.2.f. (cont'd)

- f. Wave Turbine Generators (WTGs). WTGs are used on Exposed Location Buoys (ELBs) that can not be powered by solar, alone. The WTG is an air driven turbine powered by the rising and falling water column in the tailtube of a buoy. It is mounted on the whistle stand of 8x26 and 9x35 buoys. The WTG must be used in conjunction with the Power Distribution Box which contains the electronics necessary to rectify the 3-phase output and prevent overspeeding the turbine. WTGs are maintenance intensive and use is discouraged unless the aid can not be solarized. See Data Sheets 9-E(51) and 9-E(52), and COMDTINST M16500.24, Solar Design Manual, for power system sizing instructions.

C. Preparation and Installation.

1. Commercial Power Systems. All commercial power systems shall be installed according to the National Electric Code (NEC) and individual utility requirements. Additional information is contained in the Civil Engineering Manual (COMDTINST M11000.11A). Due to the rapid degradation of SO type cable in sunlight, and the chance of personnel injury, all wiring should be installed in rigid conduit or liquid-flex type conduit. Specific guidelines for installation of commercial power systems and a complete list of drawings are contained in the Automation Technical Guidelines, COMDTINST M16500.8A and the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17.
2. Primary Batteries.
 - a. Air-Depolarized Batteries.
 - (1) Inspection. All batteries shall be inspected by the receiving unit for manufacturing defects and/or shipping damage. In the event of either problem, a claim shall be made against the manufacturer or carrier, as appropriate.
 - (2) Tracking. Battery tracking labels (Data Sheet 9-E(43)) shall be applied to each buoy power unit and group of cells. This appropriate information shall be recorded in the battery tracking log.
 - (3) Personnel Protection Equipment. Personnel handling air-depolarized batteries should always exercise caution to prevent contact between electrolyte and skin. Batteries being removed from service after several years of operation may leak electrolyte. Personnel handling batteries shall wear and splash proof goggles or full-face shield and rubber (preferred) or leather gloves (leather gloves should be inspected periodically for deterioration and discarded or cleaned immediately if wetted by electrolyte

9.C.2.a.

- (4) Treatment for Electrolyte Burns. Potassium hydroxide electrolyte is an extremely strong alkaline solution and not an acid. If the alkali comes in contact with the skin, the exposed area should be washed immediately with freely running cold water for at least 5 minutes. Compresses of vinegar, lemon juice, boric acid or 5 percent acetic acid solution may be used. Eyes should be washed with plenty of water until medical attention can be obtained. Neutralizing solutions should not be placed in the eyes.
- (5) Storage.
 - (a) Requirements. Batteries shall be stored in sealed shipping cartons in clean, dry location. Storage temperatures above 75o severely affect shelf life and may cause premature failure of batteries. Batteries may be stored outside in an environmentally protected location not subject to high temperatures. Cartons shall remain sealed until activation or use. All batteries shall be stored in an upright position. Because of the differences in electrolyte, lead-acid and nicad batteries shall not be stored next to primary batteries.
 - (b) Shelf Life. Air depolarized batteries shall be used as soon as practicable after receipt. Batteries that have been in storage shall always be placed in use before newly received batteries. Batteries that show signs of deterioration after storage shall not be placed in service. Batteries in storage for more than two years shall be derated one day for every excess day in storage.
- (6) Fixed Aid Installation.
 - (a) Figures 9-7 through 9-9 show standard installations of primary batteries in standard battery boxes. Each battery box has built-in vents. During installation, ensure that all vents are clear so that an adequate air supply is provided to the batteries.
 - (b) Batteries used in the same installation shall be matched by date of manufacture and maintained in an upright position within the leakage-containing plastic bag

9.C.2.a.(6)

- (c) Celair and Saft America manufacture primary batteries currently approved for use. There is a slight difference in hookup between Saft America and Celair batteries. Saft America uses 10, 20 or 30 cells, while Celair uses 9, 18 or 27 cells for 1000, 2000 and 3000 AH shore aids, respectively. Use of Saft America 3000 AH cells requires construction of a Battery Platform, as shown on Data Sheet 9-E(22). Saft America does not manufacture buoy power units.
 - (d) Batteries shall be procured from the manufacturer prewired to the proper amp-hour capacity, 1000 Ah, 2000 Ah or 3000 Ah. When making field interconnections, use the manufacturer supplied jumper wire. Wire between battery boxes shall be type SO 12/2 AWG stranded copper cable. Apply No-Ox grease or petroleum jelly to each connection after wiring and enter the aid location in the battery tracking log.
 - (e) Each assembled battery rack shall be load tested prior to wiring the aid as detailed in section D.3.a.(4), Routine Testing.
- (7) Buoy Installation.
- (a) Each Buoy Power Unit (BPU) shall be load tested as detailed in section D.3.a.(4) prior to installation.
 - (b) BPUs have two steel braces attached to the base which center the rack against the inside of the buoy battery pocket. These braces are reversible to allow a snug fit in either 22-inch or 24-inch battery pockets. The braces curl outward, away from the rack for 24-inch pockets and curl in towards the rack for 22-inch pockets. Do not discard these braces.

9.C.2.a.(7)

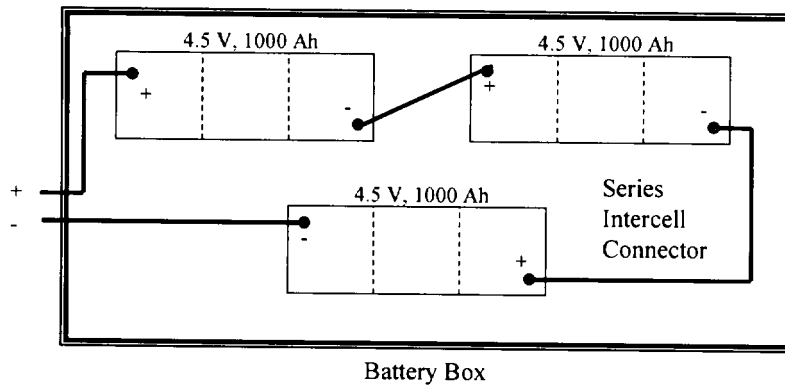


Figure 9-9. 12-volt, 1000 Ah Primary Battery Bank (Shore Aid-Celair)

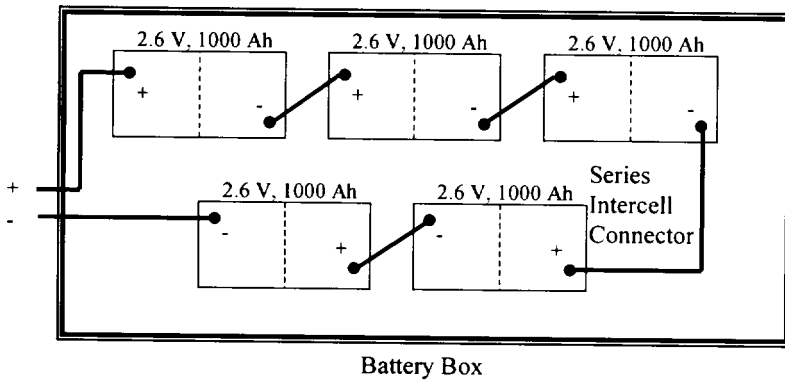


Figure 9-10. 12-volt, 1000 Ah Primary Battery Bank (Shore Aid-Saft America)

- (c) The Power Assembly Clamp (PAC, Data Sheet 9- E(23)) shall be securely attached to the top of each power unit. Only one orientation of the clamp will allow easy access to the terminal block for wiring connections and engage the anti-rotation bracket on top of each power unit. The clamp prevents the BPU from rotating after the bolts are tightened against the battery pocket walls.

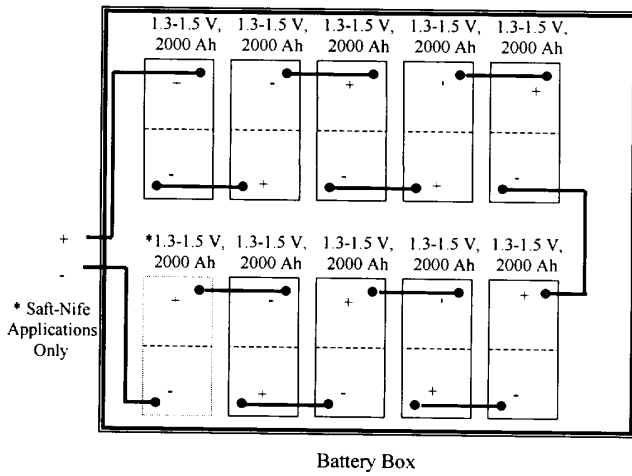


Figure 9-11. 12-volt, 2000 Ah Primary Battery Bank (Shore Aid)

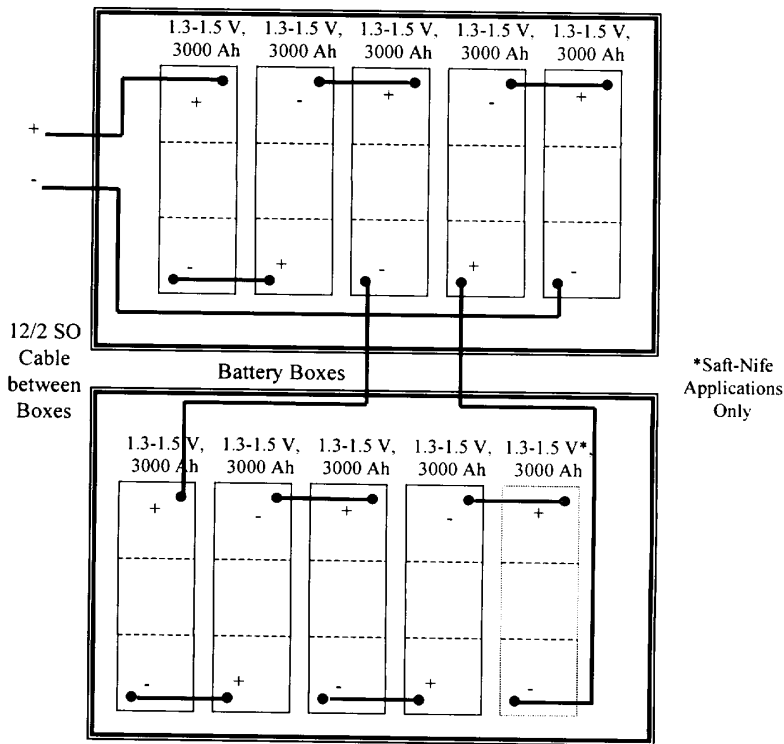


Figure 9-12. 12-volt, 3000 Ah Primary Battery Bank (Shore Aid)

- (d) Buoy pockets are vented to allow air-depolarized batteries to breathe. Vent pipes must remain clear and free of obstructions and buoy ballast shall not consist of rusting chain or spalling concrete.

9.C.4.

- a. Solar Panels. Solar panels shall be stored in a clean, dry location. Although solar panels have been designed by their manufacturer to be sufficiently rugged to withstand the normal vigor's of aids to navigation service, they are not designed to withstand mishandling or abuse. Panels must not be dropped or subjected to unnecessary shocks or impacts. Solar panels should be attached with vandal resistant nuts, where necessary, and installed in accordance with the instructions enclosed in the Solar Installation Kits (Data Sheet 9-E(27) and COMDTINST M16500.19A).
- b. Buoy Mounted Junction Box. The buoy mounted junction box is installed on the tripod stand or on the superstructure. Install solar panel leads through the small stuffing tubes on one side; some plugs must be replaced with the provided packings. Wire the panels to the (+) and (-) terminal strips. The battery and load(s) are terminated through the large stuffing tubes on the opposite side of the box and terminal strip. Be sure to follow the enclosed instructions for assembling the packing assembly and secure the cover fasteners evenly to prevent leakage.
- c. PV Combiner Box. The PV Combiner Box is also installed on the array structure to gather the inputs from multiple LTBs. Up to six LTBs may be terminated into one PV Combiner Box. Generally, in order to reduce voltage drop, inputs are divided equally among the three strings, A, B and C. Up to three pairs of 1/0 AWG wire may be used between the PV Combiner and the Charge Controller. Consult COMDTINST M16500.24, Solar Design Manual to determine the proper wire size.
- d. Solar Charge Controller. The solar charge controller is installed in a shelter near the main battery bank. Up to three pairs of 1/0 wire may be terminated into array inputs A, B and C. Generally, the inputs are divided equally between them. If all inputs are not used, array input C must be used. The input for array input C is sized to provide a float charge rate (in amps) of $c/100$ to $c/200$ where c is the battery capacity in ampere-hours. Outputs from the charge controller include connection to the main battery, temperature compensation probe and loads. The temperature compensation probe is attached to the side of the battery case about halfway up from the bottom, out of direct sunlight and away from drafts. The probe is sandwiched between the adhesive side of the foam pad and case. Additional tape may be required to secure it to the case. The load output is applied to the Main Power inputs of the Solar Distribution Box.

Consult COMDTINST M16500.24, Solar Design Manual to determine the proper wire size for all wire runs.

e. Photovoltaic (Solar) Batteries – Minor Aid Systems.

- (1) Storage. Batteries shall be stored upright in a clean, dry place. Lead-acid and nicad batteries shall never be stored together. Extreme care must be used when transporting lead-acid batteries in the vicinity of primary or nicad batteries. The electrolyte, a strong acid in lead-acid batteries and a strong base in nicads and primary batteries which, if mixed can cause a violent thermal reaction.

Storage temperatures above 75° F cause a high self-discharge rate and grid corrosion, which can affect shelf life and lead to premature failure of batteries. Batteries may be stored outside in an environmentally protected location not subjected to high temperatures. The storage temperature for batteries should be above –20°F to prevent freezing. Never rest tools or store metallic objects above a battery where they could fall and come into contact with terminals and short out the battery.

- (2) Tracking. Battery tracking labels (Data Sheet 9-E(43)) shall be applied to each battery. The appropriate information shall be recorded in the battery tracking log.
- (3) Shelf Life. Lead-acid batteries can remain on the shelf as long as they are maintained at full charge. Therefore, batteries stored on the shelf shall be recharged at 6-month intervals. Records shall be maintained as to which batteries are charged and the date. Batteries that have been in storage should be placed in service before newly received batteries.
- (4) Handling. Servicing personnel should take care to avoid contact with electrolyte and should use eye protection and leather or rubber gloves when handling batteries. When near batteries, do not smoke, light a flame or generate sparks with hand or electric tools as the battery may be venting explosive hydrogen gas. Do not lift batteries by the terminals. Use the supplied handle or a “firewood” type carrier to transport the battery. Friction type carriers and carriers that insert into finger grips are not approved for overhead lifting. Keep liquid electrolyte batteries in

upright position to prevent electrolyte spillage.

- (5) Charging. Batteries shall be fully recharged prior to installation if installed more than two months after manufacture or last documented recharge. Batteries should be charged individually using a Power-Mark MPX1210T (860-927-3930) or equivalent battery charger. Multiple batteries of the same type may be maintained at full charge using the Power-Mark charger after they are charged.

Hydrogen gas is formed during charging of these storage batteries. Some batteries are sealed, but contain pressure vents that open when they are overcharged. In any event, batteries should be expected to vent hydrogen gas when charging. Hydrogen gas is highly flammable, is lighter than air and will rise to the highest available space. Therefore, areas designated for service, storage and charging of batteries must be designed to:

- (a) Vent gas to exterior atmosphere;
- (b) Prevent ignition of such gases that might not be completely vented.

- (5) Charging Area Requirements. Floating units requiring battery charging shall have their batteries charged ashore, on deck or in a designated charging area prior to installation. At shore units, battery charging may take place outdoors under natural ventilation when climate conditions permit. An overhead shelter is recommended to give protection from the elements. At shore units where battery charging can not be accomplished outdoors, a battery charging room, must be provided that meets the requirements of NFPA 303 (available from MLC (mis), Inspection and Safety). These requirements detail ventilation of hydrogen gas to the outside atmosphere, ignition prevention of any unvented gas and other related precautions. Ventilation requirements for battery charging rooms when charging nicad and lead-acid batteries may be calculated as follows:

$$C = 0.00027 \times N \times I \times 60 \times n$$

Where: **C** is the amount of hydrogen produced in ft³/hr/ampere/cell;

9.C.4.e.(6)(cont'd)

0.00027 is the maximum hydrogen production in ft³/min per cell per ampere charge current;

N is the number of cells (use **6** for 12 volt, 100 amp-hour, lead-acid AtoN batteries);

I is the estimated finish charge current in amps which is estimated to be 5% of the battery capacity (5 amps for 12 volt, 100 amp-hour minor aid batteries);

60 is a conversion factor from minutes to hour;

n is the number of batteries being charged.

Knowing the amount of hydrogen produced, the amount of new air required preventing the concentration from exceeding the predetermined level can be calculated:

$$A = C / 0.01$$

Where: **A** is the amount of new air required per hour in ft³/hr;

C is the amount of hydrogen produced in ft³/hr;

0.01 represents the maximum concentration level of 1%.

Example: What safe ventilation is required to charge ten 100 amp-hour, lead-acid batteries?

$C = 0.00027 \text{ ft}^3/\text{min}/\text{amp}/\text{cell} \times 6 \text{ cells}/\text{battery} \times 5 \text{ amps} \times 60 \text{ min}/\text{hr} \times 10 \text{ batteries}$

$C = 4.9 \text{ ft}^3/\text{hr}$ of hydrogen produced

$A = 4.9 \text{ ft}^3/\text{hr} / 0.01$

$A = 490 \text{ ft}^3/\text{hr}$ of fresh air

Therefore, a room 10' x 10' x 10' (volume 1000 ft³) would require approximately 1 air change every 2 hours to meet this criteria.

9.C.4.e.(6)(cont'd)

Safety is a major concern when charging batteries. The following points shall be adhered to:

Smoking in the vicinity of the charging area is prohibited;

Allow enclosures containing charging batteries to vent for 5 minutes before entering and making connections;

Prevent open flames, sparks and electric arcs in the vicinity of any battery (storage, disposal, charging). Do not charge near flammable liquids;

Ambient temperature shall not exceed 96 degrees F when charging batteries;

Use appropriate skin and eye protection when handling batteries (this is especially important when making charging connections as an internal fault in the battery can lead to internal sparks which may ignite hydrogen inside the case, causing the top of the battery to blow off);

Eye wash station and material for neutralizing electrolyte (baking soda for lead-acid batteries) shall be provided in the charging area;

- (7) Personnel Safety. Secondary batteries used for solar powered aids to navigation are designed by their manufacturers to be sufficiently rugged to withstand the normal dangers of aids to navigation service. They are not, however, designed to withstand mishandling or abuse. All batteries shall be handled with care and must not be dropped, thrown or unnecessarily subjected to shocks or impacts. The electrolyte use in lead-acid secondary batteries is sulfuric acid, an extremely strong acid capable of destroying clothes, causing painful skin burns and blindness if allowed to penetrate the eyes. To avoid electrolyte spillage, batteries should always be upright, except when servicing buoys.

and skin. Batteries being removed from service after several years of operation may contain electrolyte on the case. Personnel charging secondary batteries shall wear rubber gloves, splash proof goggles or full-face shield (preferred) and a rubber apron. Personnel handling batteries being installed or removed from service shall wear eye protection and rubber (preferred) or leather gloves (leather gloves should be inspected periodically for deterioration and discarded or cleaned immediately if wetted by electrolyte).

- (b) Treatment for Electrolyte Burns. If lead acid electrolyte comes into contact with skin, the affected area should be washed immediately with freely running water for at least fifteen minutes to dilute and wash away the acid. Compresses of baking soda may be used on electrolyte burns. Severe skin burns should be examined and treated by a doctor. Any electrolyte in the eye should be washed out immediately with large quantities of water using either a potable eye wash station or emergency eye wash station. If not available or contaminated, use clean potable water by gently pouring cupful after cupful of water into the corner of the eye of a prone patient and letting it run off the other side. Continue this process for at least fifteen minutes. Cover both eyes with a sterile compress (to minimize eye movement) and get medical attention at once. Neutralizing solutions should not be placed in the eyes.

- (8) Battery Installation. All solar batteries to be installed at a site should be matched by manufacturer, date of manufacture and recharged at the same time prior to installation. All minor batteries shall be load tested individually in accordance with the Short Range Aids to Navigation Servicing Guide COMDTINST M16500.19A prior to transport to the aid. Batteries should be installed in a level, upright position to prevent premature battery failure. Large, wet solar batteries (Yuasa EJ and FHGS series) should have a containment trough beneath the battery rack to capture and neutralize electrolyte. Wiring between batteries or cells should be made with supplied buss bars or 12/2 SO cable. After connections are made,

coat each terminal with an anti-corrosion agent such as No-Ox grease or petroleum jelly. Place a battery installation label (Data sheet 9-E(42)) on all minor aid solar batteries (optional), and enter the aid location in the battery tracking log.

- (a) Structure Installation. Minor aid batteries shall be installed within standard Coast Guard battery boxes. The small Coast Guard battery box protects batteries from the elements and can hold up to two minor aid batteries, the large battery box up to four batteries. Each battery box has built-in vents to vent hydrogen gas. During installation, ensure that all vents are clear. Chocking of batteries is required on structures subjected to vibrations that could cause significant battery motion inside the box and lead to premature failure due to loose connections. Batteries should be elevated above battery box mounting bolts with plywood to prevent localized cooling of the bottom of the battery in cold climates. Commercially available single battery boxes may be used as long as they are not black (interior gets too hot when in direct sunlight).

Power systems requiring more than 100 ampere-hours will have a number of 12-volt, 100 ampere-hour batteries connected in parallel to provide the proper capacity. For example, an aid requiring 200 ampere-hours of capacity will have two batteries wired in parallel, as shown in Figure 9-13 (note that power cable (SO) is taken from opposite corners of batteries). Shore aids requiring more than 400 ampere-hours should use large secondary batteries (Data Sheets 9-E(46) and 9-E(49)).

Large secondary batteries used on minor aids should be housed in a structure or custom-built vented battery box. Wet batteries (Yuasa, Fulmen) shall only be used on rock-solid platforms. Monopoles are not considered steady enough for these batteries. Wet batteries are preferred over absorbed (GNB, Dryfit) for longevity reasons

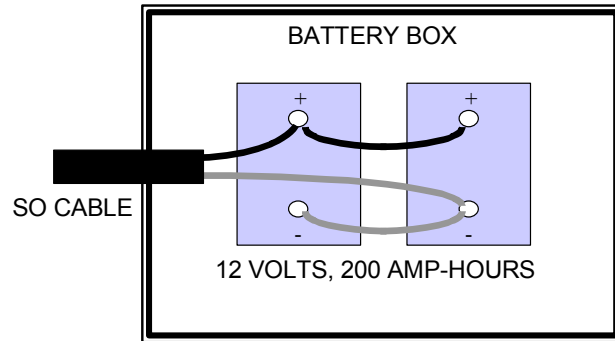


Figure 9-13

- (b) Buoy Installation. Installation of wet batteries (Delco) into the battery rack or battery box requires careful handling and a short laydown time (four hours or less) to reduce the chances of electrolyte leakage. Batteries shall be installed with the axis of the battery length parallel to the buoy deck and the battery vent facing up (Delco) to prevent electrolyte spillage (see Figure 9-14). Up to 10 batteries installed in buoy pockets may be wired in parallel to provide the desired storage capacity or up to two batteries when installed in the whistle stand mounted battery box.

Buoy pockets are vented to allow hydrogen gas to escape. Vent pipes must remain clear and free of obstructions to allow adequate ventilation. Precautions shall be taken to prevent open flames, sparks, electric arcs or smoking in the immediate vicinity of the pocket, especially when first opened. Pockets should be allowed to air out for a few minutes until work is performed on the rack or batteries. If vent pipes become obstructed, hydrogen gas could collect in the pocket and present an explosive hazard.

Battery boxes contain vent and drain holes. Be sure these areas are free of obstructions to allow hydrogen gas to escape and water to drain out of the box.

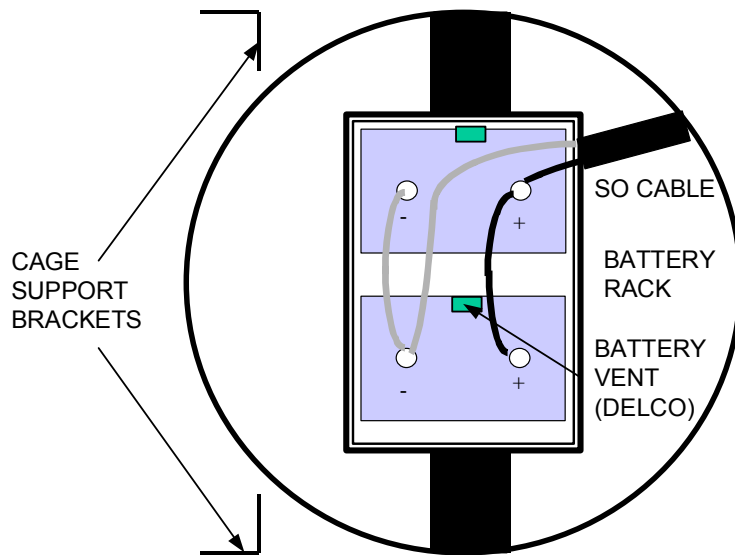


Figure 9-14

Battery pocket counterweights may be necessary depending on the size of the buoy, the number of batteries used and the stability of the buoy.

f. Photovoltaic (Solar) Batteries – Major Aid Systems.

- (1) Storage. Secondary batteries for large PV systems are generally purchased for a specific installation. An inventory of cells is not maintained. In the event the battery is awaiting installation, the storage requirements outlined in section C.4.e.(1) apply.
- (2) Tracking. Battery tracking Labels are not required to be installed on these batteries.
- (3) Installation. Installation of major aid system batteries is detailed in the Short Range Aids to navigation Servicing Guide, COMDTINST M16500.19A.

g. Solar Distribution Box (SDB). The SDB is installed in a shelter near the Solar Charge Controller. The SDB has additional inputs for an auxiliary solar array and emergency battery. Up to ten loads may be connected to the terminal strip. The first three loads (1, 2 & 3) will be disconnected upon main battery failure. The emergency battery powers loads 4 through 10 when this occurs.

9.C.4.g.(cont'd)

- h. Low Voltage Drop Kit. The Low Voltage Drop Kit is installed as close to power/control source (SACII or RPB) and load as possible. Typical wire runs for the 12 AWG legs should not exceed 2.5 feet. The large conductor cable run between the boxes should be calculated, as detailed in COMDINST M16500.24.
- i. Wave Turbine Generators. Due to the limited use of these devices, request a copy of the ELB Users Guide from Commandant (G- SEC-2A) and drawing 140454.

D. Inspection, Maintenance and Repair.

1. Commercial Power Systems.

- a. High Voltage Power Systems (greater than 600V). Maintenance of high voltage systems requires special knowledge, equipment and techniques that are normally beyond the qualification level of assigned aids to navigation personnel. Therefore, a contractor or commercial utility shall perform maintenance and repair. The exception is Coast Guard owned submarine cables where maintenance and repair of deenergized cables is generally performed by Coast Guard personnel.
- b. Low Voltage Systems (600V or less). Maintenance of low voltage systems that are owned by a commercial utility are the responsibility of the utility. Maintenance and repair of Coast Guard owned hardware is covered in Commandant Instructions M16500.17, AC Aids to Navigation Servicing Guide and M16500.10 Lighthouse Preventative Maintenance System.

2. Engine-Generators.

- a. Servicing Intervals. Standard high-endurance engine-generators are designed for up to 90 days of continuous running.
- b. Routine Servicing Items. COMDTINST M16500.10, Lighthouse Preventative Maintenance System manual details servicing of these sets.
- c. Criteria for Removal for Base Overhaul. Are detailed in the Automation Technical Guidelines, COMDTINST M16500.8A.

9.D.2.c.

- d. Base Overhaul Guide Specification. COMDTINST M10500.39, Overhaul Guide Specification for Lister SR Series Diesel Engines gives detailed procedures for base overhaul.
 - e. Accessories. Engine-generator accessories, such as power controllers, starting batteries, battery chargers, fuel daytanks, transfer pumps and environmental controls are routinely serviced as detailed in COMDTINST M16500.10, Lighthouse Preventative Maintenance System Manual.
3. Primary Batteries. Primary batteries are used on a very small population of aids. Their servicing procedures have been deleted from COMDTINST M16500.19A, Short Range Aids to Navigation Servicing Guide. A copy of the following procedures should be brought to the aid if primary batteries are being serviced. Primary batteries shall be replaced before the RBDT is exceeded or when voltage determined during servicing is less than specified in this section.
- a. Routine Service. Fixed and floating aids to navigation batteries shall be serviced at least once every 12 months. Batteries shall be handled with care during servicing to prevent damage. Battery pockets on buoys do not have to be opened if the overall load test voltage is acceptable. The following shall be accomplished:
 - (1) The battery box and batteries shall be leveled.
 - (2) Wiring and wiring connections shall be cleaned of corrosion and tightened, and coated with No-Ox grease or petroleum jelly.
 - (3) A load test shall be performed every time a primary powered aid is visited. The load tester (9-E(44)) is connected across the battery terminals (terminals connected to SO cable) with the load(s) off or disconnected, or to the flasher terminals on buoys. The load tester shall be checked with an AtoN volt-ohm meter prior to each use to ensure the proper resistance is used (see Data Sheet 9-E(44)).
 - (4) Set the load tester to the appropriate setting, 1000 AH - 40 ohms, 2000 AH - 20 ohms or 3000 AH - 13.3 ohms and connect to the battery terminals. Wait ten minutes.
 - (5) Using a calibrated AtoN voltmeter, measure the voltage across the battery terminals with the load tester still attached.

9.D.3.a. (cont'd)

Based on the load test voltage, the following applies:

Assemblies showing less than 11.0 volts shall be replaced or inspected for failed cells.
Assemblies showing less than 11.5 volts containing less than 50%, but more than 20% of the RBDT remaining should be replaced or checked for failed cells, the choice based on operational considerations.

Assemblies showing less than 11.9 volts with more than 50% of the RBDT remaining should be checked for failed cells. Celair batteries measuring less than 1.3 volts for cells connected in parallel, and 2.6 and 3.9 volts for two and three cells connected in series, (with tester still attached) respectively, should be replaced. Saft America batteries measuring less than 1.2 volts for cells connected in parallel, and 2.4 and 3.6 volts for two and three cells connected in series, respectively, should be replaced.

- b. Disposal of Primary Batteries. Primary air-depolarized batteries contain certain hazardous materials and must be transported, stored, handled and disposed of as hazardous waste in accordance with federal, state and local regulations. The following is a summary of the guidelines detailed in COMDTINST M16478.1B: The Resource, Conservation and Recovery Act (RCRA), which amended the Solid Waste Disposal Act, regulates the management of solid waste and hazardous waste (HW). The Hazardous and Solid Waste Amendments (HSWA) of 1984 amended RCRA to include the cleanup, through corrective action, of releases of HW in RCRA-regulated facilities. RCRA requires cradle-to-grave management of HW through record a keeping system that requires manifesting of HW shipments from point of generation to ultimate disposal. HW treatment, storage and disposal facilities are regulated through the issuance of operating permits. RCRA provides that EPA may delegate authority to States to regulate HW under State law in lieu of RCRA. State regulations must be as strict as Federal regulations but may be stricter. EPA has primacy in Alaska, Iowa and Hawaii. Irrespective of whether EPA has delegated hazardous waste authority to a state, state HW substantive and procedural requirements, including the requirements to obtain state permits, are applicable to CG facilities under the Federal Facility Compliance Act. Hazardous waste is either "listed" (specifically named in Federal/State regulations or may exhibit any of the four characteristics: (1) ignitability, (2) corrosivity, (3) reactivity and (4) toxicity (as determined by the Toxicity Character Leaching Procedure (TCLP) or additional procedures under state law) The batteries contain a very caustic (corrosive) electrolyte (potassium hydroxide) with a pH of 13.6-14.0.

9.D.3.b. (cont'd)

Generators (the Coast Guard) are obligated to send their HW to treatment, storage, or disposal (TSD) facilities that comply with RCRA regulations. A generator who generates subject to Federal land disposal restrictions must notify the TSD facility that the waste is a restricted waste or certify that the waste meets the requirements for land disposal. There are two approved methods of accomplishing this:

Use DRMO. The Coast Guard has a Memorandum of Understanding with the Defense & Revitalization and Marketing Service (DRMS) for the DRMO to provide the same level of support offered DOD military services for the disposal of hazardous materials and wastes on a reimbursable basis. Many DRMO facilities accept the spent batteries as hazardous material rather than hazardous waste. This can save significant amounts of time, paperwork and record keeping. DRMO is not the HW generator and assumes none of the HW generator's responsibility for ensuring the wastes are correctly profiled and that manifests and required documentation is accurate and complete.

Use Commercial Facilities. You can contract directly with the chemical landfill. In either case rigorous EPA or state regulations must be complied with and the Coast Guard can not transfer its liability for following them. This liability is placed directly on the hazardous waste generators (i.e., CG units).

Any activity that generates, stores, transports, or disposes of HW must notify the EPA or State environmental Agency of their HW activities, obtain an EPA or State generator identification number. All hazardous waste generators except Conditionally Exempt Small Quantity Generators (CESQG) (less than 100 kg month HW generation) are held responsible under RCRA for using a manifest system, using authorized transporters and disposal facilities, ensuring proper packaging, labeling and marking in accordance with EPA/DOT regulations, record keeping and reporting. It is a Coast Guard policy to allow Groups and Bases to relieve ships and small AtoN units of registering as hazardous waste generators. The host unit registers as the hazardous waste generator for the entire facility. CESQG's are exempt from most of the Federal regulations. As a practical matter, CESQGs in most states will also have to prepare a manifest in order to ship any amount of waste off-site. Most states have stricter requirements for CESQGs than the Federal requirements. Small quantity generators (less than 1000 kg/month HW generation) may accumulate HW without a permit or interim status for up to 180 to 270 days, subject to the requirements of 40 CFR 260-270 and State requirements. Large quantity generators (more than 1000 kg/month HW generation) that store for more than 90 days require a permit.

9.D.3.b. (cont'd)

- c. Prohibited Disposal Methods. The following disposal methods shall not be used:
- (1) Use of local incinerator facilities;
 - (2) Ocean or other water dumping;
 - (3) Disposal by casual inclusion in local trash or refuse;
 - (4) Uncontrolled dumping in local landfills ;
 - (5) Open burning with other refuse of combustibile materials;
 - (6) Abandonment of batteries at or around the site of shore or fixed aids;
 - (7) Use of ballast in a buoy pocket;
 - (8) Neutralization at Coast Guard facilities.
- d. Transportation and Packing. District Commanders shall ensure compliance with Federal, state and local regulations applicable to the handling and transportation of hazardous materials on public highways. The transportation agent or agency shall be properly authorized to transport hazardous material/waste. To prepare spent batteries for shipment, regardless of which disposal method is used, they must be properly labeled as a corrosive and specially packaged in DOT approved containers. However, they can be packaged the same way as when received new (i.e., in plastic bags, sealed, palletized and banded) provided:
- (1) No other hazardous material/waste is transported in the same vehicle;
 - (2) They are separated from other materials;
 - (3) The transport vehicle is carrying no material shipped by any other person other than the shipper of the batteries;
 - (4) Buoy Power Units (BPUs) are packaged as stated in section f, below.

Leaking batteries must be packaged in DOT approved containers and properly labeled. These transportation requirements are found in 49 CFR 170-171. Spent batteries awaiting shipment must be packaged as stated above as soon as possible to satisfy EPA requirements and protect them from the rain.

9.D.3.d. (cont'd)

- e. Material Safety Data Sheet (MSDS). MSDS's are sometimes needed when disposing of or transporting primary batteries. Copies of current MSDS's are available from Commandant (G-SEC-2).
 - f. Handling of Batteries. Batteries (except BPU's) are shipped in heavy plastic bags furnished by the manufacturer. The batteries shall remain in plastic bags during their service life, and during storage and transport to the disposal site. BPU's, because of their size and weight, present additional problems. Upon removal of the expended power unit from a buoy, the steel pocket adapters should be removed from the base of the rack and the Power Assembly Clamp (PAC) removed from the top. The BPU should be draped by heavy polyethylene and the lifting eye replaced. Lift the BPU and place it into a heavy-duty drum liner. Secure the liner around the top of the rack with several lengths of tape.
 - g. Ice Batteries. Consult with COMDTINST M16500.19A, Short Range Aids to Navigation Servicing Guide details servicing requirements for ice buoy batteries.
4. Nickel-Cadmium Batteries. Consult with COMDTINST M16500.10, Lighthouse Preventative Maintenance System manual details the complete servicing requirements for diesel starting and emergency power nicad battery systems.
5. Solar Power Systems. Solar Power systems shall be inspected at least every two years, as determined by the Servicing Interval Flowchart contained in Chapter 7 of COMDTINST M16500.7, Aids to Navigation Manual -Administration. Solar Power systems using large photovoltaic battery systems should be serviced at least semiannually. Consult with COMDTINST M16500.19A, Short Range Aids to Navigation Servicing Guide and COMDTINST M16500.10A. Lighthouse Preventive Maintenance System for details on routine field servicing requirements of solar power systems.
- a. Solar Panels. When a bad diode is identified by the troubleshooting flowcharts detailed in the above instructions, perform the following procedure to replace the diode. The only authorized repairs to solar panels are diode and service cord replacement.

9.D.5.a.

- (1) Diode Replacement. Diodes shall be replaced by personnel familiar with proper soldering techniques and performed in an area designated for these repairs. Diodes are not field replaceable.
- (2) Remove the lid on the junction box located on the back of the solar panel. Panels made by Solarex Corporation contain the letters **SC** next to Manufacturer Code on the nameplate, likewise panels made by Arco/Siemens contain the letters **AS**. The junction box lid on Solarex panels is held on with two screws. Siemens panels have a small rectangular cover in the center of the junction box that must be pried off with a knife or screwdriver.
- (3) Carefully dig out the potting compound inside the junction box until the wires are exposed. Take your time, the wires are easily damaged.
- (4) Cut out the old diode using care not to pull on or damage the wires.
- (5) Diodes are available locally or through the stock system. The suggested replacement for all panels is a Motorola MR-750, NSN 5961-01-097-2514.
- (6) Remove the diode from the package. It has a **Cathode** and an **Anode** side. The **Cathode** side is marked with a stripe, band or circle. Check the diode with your AtoN voltmeter (using the diode test function) to verify the marking.
- (7) On Solarex Panels, the diode is attached to 2 wires. The **Cathode** end of the diode will go to the **Black** wire, the **Anode** to the **Red** wire as shown in Figure 9-15.
- (8) Twist the lead from the diode and the panel wire together, then attach a closed-end connector and crimp securely.

9.D.5.a.

- (9) On Arco/Siemens panels, the Cathode end is attached to the Black wire and the Anode is connected to the metal ribbon strip. The Anode end must be soldered to the ribbon. Obtain assistance from someone who has experience soldering. A heat sink (alligator clip) must be installed between the point soldered and the diode to protect it from heat damage.

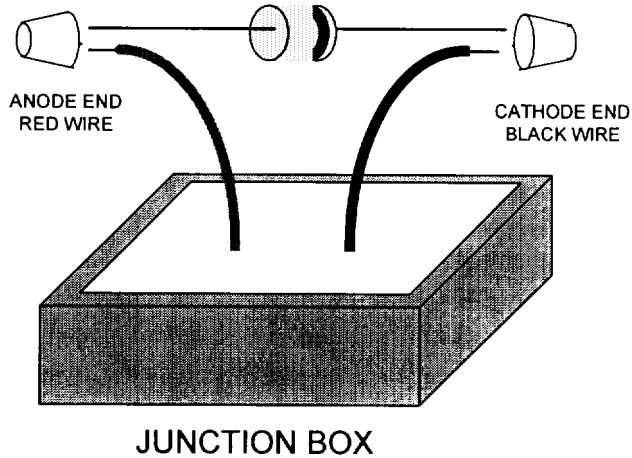


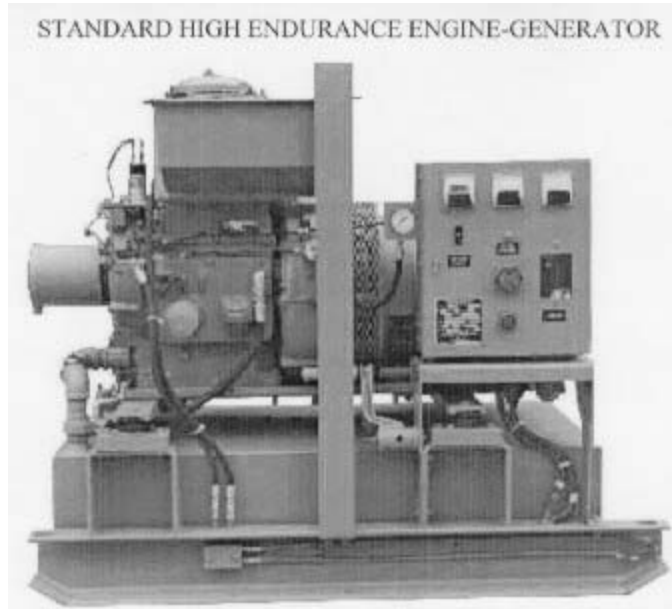
Figure 9-15

- (10) Bring the solar panel outside, during the day and connect the negative lead to a Delco-2000 or similar battery and perform the test detailed in the Solar Panel Servicing Flowchart of COMDTINST M16500.3A, Short Range Aids to Navigation Servicing Guide. The diode test setting in the AtoN voltmeter can not be used once the diode is installed.
 - (11) If the panel successfully passes the test, push the wire back into the junction box and fill the box with enough RTV to cover all components. Let the RTV dry for 24 hours, then reattach the lid.
- b. Photovoltaic (Solar) Batteries - Minor Aid Systems.
- (1) Servicing. Servicing minor aids to navigation solar batteries is detailed in COMDTINST M16500.19A, Short Range Aids to Navigation Servicing Guide.
 - (2) Bench Test. The load test voltage of a battery may fall below the minimum allowed value for reasons other than battery failure. These reasons include wiring, failure of other electrical components, or extensive guano or ice buildup on the solar panel(s), reducing the panel's ability to recharge the battery. These batteries should be replaced at the aid, but may be returned to useful service after they successfully complete the bench test procedure outlined below. This test should be conducted at room temperature (70 +/- 15 degrees F), and batteries should be kept at this temperature for at least 16 hours prior to the test.

9.D.5.(b)(2)(cont'd)

- (a) Recharge the battery to 100 percent state of charge.
 - (b) Connect a CG-6P lampchanger directly to the battery with the positive battery post connected to the RED terminal and the negative post connected to the WHITE terminal on the lampchanger. Install a 12-volt, 2.03 ampere lamp in the operating position and operate the load for exactly 24 hours.
 - (c) Immediately after the 24 hour period, disconnect the load. Wait approximately 15 minutes and measure the battery's open circuit voltage. If the voltage is less than 12.1 volts, the battery should not be returned to service. If the voltage is 12.1 volts or higher, the battery may be reused, after being recharged, taking into account its lost service life when previously used, or it may be retained and used as a hot pack.
- (3) Secondary Battery Disposal. Lead-acid batteries can be salvaged for the scrap value of the lead they contain. Whenever feasible, batteries which are no longer serviceable shall be recycled either through the supplier of new batteries (often done when delivering batteries) or by taking them to a salvage company. A portion of the funds recovered from this action may be used to support the Morale, Welfare and Recreation (MWR) activities at the unit, in accordance with COMDTINST 16477.5, Coast Guard Qualified Recycling Program (QRP) Policy. Batteries that can not be salvaged shall be disposed of in according to EPA/state regulations, as outlined in section D.3.b of this chapter.

9E.



Function. Standard high-endurance engine-generators provide standby power on aids to navigation and are installed in specially built fiberglass containers or in standard volumes fabricated inside structures.

Features.

Constructed in 4.0 (rare), 6.5, 8, 10 and 11 kW nominal ratings, fully assembled on a skid base.
Capable of 90 day unattended operation.

Solid-state voltage regulation to $\pm 1\%$ (steady state-no load to full load).

Frequency regulation to $\pm 3\%$ (steady state-no load to full load).

Air-cooled.

Manual start capability.

Military standard electrical receptacles in electrical panel for power output and control connections.

Nominal 6-ft fuel lift capability with engine mounted fuel pump.

Oil pressure gauge.

Voltmeter.

Frequency meter.

Elapsed time indicator.

Low oil pressure and high oil temperature safety trip sensors.
Circuit breaker (150A) between generator output and power output connector.

Data Sheet 9-E(1) Standard High Endurance Engine-Generator

9E.

Related Equipment (supplied).

Complete ready-to-run engine generator unit (after making fuel, electrical, exhaust and any ventilation connections).

Lifting fixture for single point lift.

Exhaust pipe flexible connection and muffler.

One combination filter/coalescer/separator unit for remote mounting.

Related Equipment (not supplied).

Lighthouse Power Controller (LPC).

24-volt batteries and charger.

Fuel daytank assembly (if needed).

Environmental control unit.

Exhaust piping (additional lengths needed to exit volume).

Electrical power cables fitted with plugs.

Electrical, Mechanical and Physical Characteristics

Nominal Rating	4 kW	6.5 kW	8 kW	10 kW	11 kW
Engine Model	ST-1	SR-2	ST-2	SR-3	ST-3
Number of Cylinders	1	2	2	3	3
Continuous BHP	7.3	12.0	14.6	18.0	20.1
Intermittent BHP	8.0	13.2	16.1	19.8	24.1
Continuous kW	3.9	6.5	8.0	9.8	11.0
Intermittent kW	4.4	7.1	8.8	10.8	13.2
Continuous kVA	4.9	8.1	10.0	12.2	13.7
Intermittent kVA	5.5	8.9	11.0	13.5	15.1
Hertz	60	60	60	60	60
Phase	Single	Single	Single	Single	Single
Voltage (AC)	120	120	120	120	120
Total Dry Weight (lb)	1175	1275	1225	1410	1400
Length (in)	55	55	55	55	55
Height (in)	45	45	45	45	45
Width (in)	30	30	30	30	30

Notes:

Intermittent duty cycle is defined as 1 hour out of every 12 at 110% of maximum continuous load.

The generator is a Lima model SER-005, single phase, rated at 11.0 kW, 13.7 kVA, 0.8 power factor, 105 degrees C rise, continuous duty, with a 73% efficiency.

1 kW = 1.34 BHP

Maximum output from the 11 kW engine-generator is limited by the generator's maximum rating. The Lister ST-3 is actually rated at 21.9 continuous BHP.

Data Sheet 9-E(1) Standard High Endurance Engine-Generator

9E.

Lister Engine Model	Engine Generator Continuous Rating	Fuel Consumption Rates in U.S. Gallons per Hour, Load in % of Full Load							
		100%	90%	80%	70%	60%	50%	40%	30%
ST-1	3.9 kW	0.42	0.38	0.35	0.32	0.29	0.25	0.22	0.17
SR-2	6.5 kW	0.75	0.68	0.62	0.56	0.51	0.45	0.38	0.31
ST-2	8 kW	0.84	0.76	0.69	0.63	0.57	0.5	0.43	0.35
SR-3	9.8 kW	1.1	0.99	0.91	0.82	0.75	0.66	0.56	0.45
ST-3	11 kW	1.24	1.12	1.02	0.93	0.84	0.74	0.63	0.51

Notes:

Fuel consumption rates obtained from Lister service bulletin 268 of Aug 1980.

Fuel consumption rates for 30% and 40% full load are extrapolated from Lister data and represent estimates.

Example: Annual fuel consumption for a ST-2 engine-generator operating at 60% of its rated load (4.8 kW) is: 0.57 gal/hr x 8766 hr/yr = 4997 gal/yr.

Additional Data. Only 8 and 11 kW engine-generator units are currently stocked by Commandant (G-SEC). Requests for units shall be included in the Project Development Submittal (PDS) as part of a modernization request

Data Sheet 9-E(1) Standard High Endurance Engine-Generator



Function. The standard environmental control unit is used with the standard high-endurance engine-generators to filter and temper outside air with warm air inside the prime power shelter or standard volume and to discharge heated air from the space.

Features.

Thermostatically controlled damper system capable of maintaining an inside temperature of 70 F with an outside ambient temperature between -40 F and 60 F (above 60 F, the system will maintain the inside temperature to within +10 F of the outside ambient temperature).

Modulating type low-voltage AC electric damper motors controlled by proportioning thermostats in both intake and exhaust units.

Inertial intake filter removes minute solid particles (no filter element to change).
Stainless steel construction.

Electrical Characteristics.

Blower motor voltage	120 VAC
Modutrol motor voltage	24 VAC

Dimensions and Weight.

	Intake Unit	Exhaust Unit	Intake Hood	Exhaust Hood
Weight (lb)	475	190	65	55
Width (in)	64.5	30.8	28.5	24.5
Height (in)	40.5	21	35.5	21.5
Depth (in)	28.5	30	28.5	19.75

Data Sheet 9-E(2) Standard Environmental Control Unit

9E.

Related Equipment. The following connections are required but not supplied:

Electrical power supply, 7.5 A at 120 VAC.

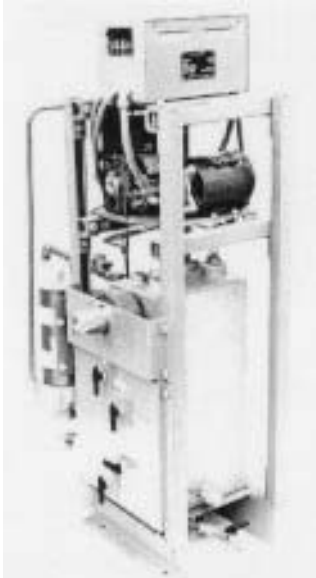
Ducting (8 x 16-in galvanized sheet steel) to connect to engine-generators.

Additional Data. Component part information can be found on standard aids to navigation drawings 130902-1 (sheets 1 & 2), 130902-2 and 130902-3, and installation drawings 130107 and 130108 are available from Commandant (G-SEC-2). Environmental control units are available from Commandant (G-SEC-2) and shall be included in the Project Development Submittal (PDS) as part of the modernization request.

Data Sheet 9-E(2) Standard Environmental Control Unit

9E.

STANDARD FUEL DAYTANK ASSEMBLY



Function. The standard fuel daytank assembly supplies fuel to standard high-endurance engine-generators in locations where the combination of gravity and friction head loss exceeds the lift capacity of the standard high endurance engine-mounted fuel pump (6 ft).

Features.

Two 2-gal/min pumps with automatic sequencing.

Stainless steel 8-gal tank (5-minute fill time).

Hand pump for use during power loss and initial filling.

Two in-line solenoid suction valves on each pump provide daytank shutoff protection.

Combination fuel filter/separator prevents passage of water or solid particles down to 2 m size.

Fully assembled on a metal frame.

Electrical Characteristics.

Pumps 120 VAC, 60 Hz, 7 A

Controls & indicator lights 24 VDC, 6 A

Data Sheet 9-E(3) Standard Fuel Daytank Assembly

9E.

Dimensions & Weight.

Total dry weight (lb)	270
Height (in)	58
Width, less filter (in)	18
Depth (in)	15

Related Equipment (not supplied). In addition to electrical power, the following connections are required but not supplied:

Copper fuel piping (1/2-inch minimum) from main supply tank to daytank.

Fuel overflow piping (1-in minimum) from the daytank to main supply tank.

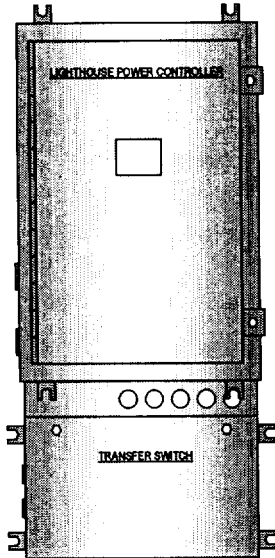
Copper fuel supply and return piping (5/16-inch minimum) between the daytank and the engine.

Additional Data. Component part information can be found on standard aids to navigation drawings 130901 (sheets 1 & 2) available from Commandant (G-SEC-2). Standard fuel daytank assemblies are available from Commandant (G-SEC-2) and shall be included in the Project Development Submittal (PDS) as part of the modernization request.

Data Sheet 9-E(3)

9E.

LIGHTHOUSE POWER CONTROLLER AND TRANSFER SWITCH
CEVV-LPC-20032



Function. The Lighthouse Power Controller (LPC) is a general purpose programmable controller designed to provide monitoring and control for either a pair of diesel-driven alternating generator sets (prime power) or commercial power lines and a single generator set (commercial/standby). The power plants provide both continuous and emergency power for electronic signal equipment, heat, ventilation and lighting. An ancillary Transfer Switch (TS) unit using two AC contactors accomplishes power switching. The Aid Control and Monitoring System (ACMS) receives online, offline and failure status of both power sources.

The system block diagram illustrates the basic controller functions. Following DC power-up, starting the primary generator or closing the main circuit breaker for commercial power initializes the system. The controller ensures that AC power of 110 to 125 V, 60 +-3 Hz is supplied to the load at all times, and checks for proper oil pressure and oil temperature, thus preventing damage to the load or generator. If voltage or frequency exceeds software limits, quick disconnects or delayed disconnects will occur, depending on the range of extremes. The controller then initiates the start up sequence and connects the secondary (standby) generator set to the load, provided the generator is set up properly. Prime power installations require an operator at the controller to restore the primary engine-generator set. However, commercial power installations will automatically be reconnected and the standby generator set stopped when commercial power is restored. Status, alarm and control circuits are available for remote operation. The status circuits provide online and offline power source status and the alarm circuits inform the remote site that a failure has occurred. The control circuit enables the remote operating site to initiate and exercise cycle for the standby generator set.

Data Sheet 9-E(4) Lighthouse Power Controller & Transfer Switch

9E.

In the event both power sources fail, the controller will power itself down in order to conserve DC Power. A 30-minute hold time, prior to full power down, will enable the controller to report alarm and status conditions to the remote operating site. Failure status of both power sources will be displayed when the controller is powered up. A control panel and a 40 character fluorescent display provide manual input to the controller and digital readout of current operating status. The controller is designed to operate effectively in the relatively severe environmental conditions that often exist at installation sites. This controller replaces the Automatic Power System Controller, which is obsolete.

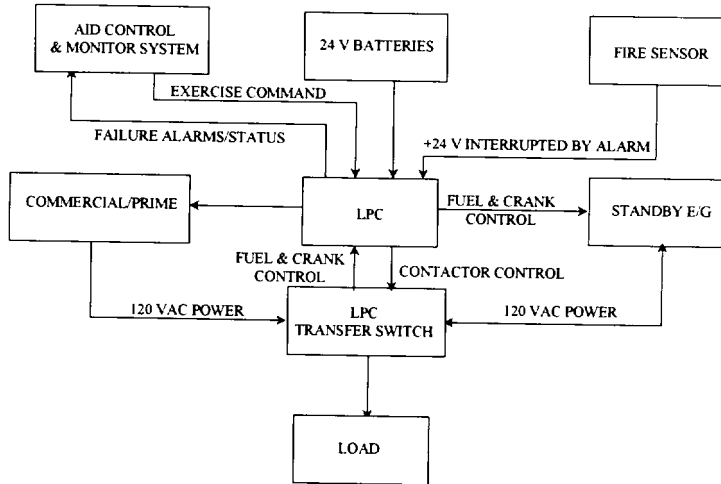
Electrical Characteristics.

Power handling capability	48 kVA at 480 VAC
Solenoid drive capability	10 A, AC or DC, 120 V maximum
Power input	10 to 40 VDC, 20 watts

Dimensions and Weight.

	<u>LPC</u>	<u>Transfer Switch</u>
Weight (lb)	72	50
Height (in)	24	19
Width (in)	24	23
Depth (in)	11	9

Additional Data. Component part information can be found on standard aids to navigation drawings 130418, 130420, 130421 and 130422 available from Commandant (G-SEC-2). Lighthouse Power Controllers are available from Commandant (G-SEC-2) and shall be included in the Project Development Submittal (PDS) as part of the modernization request.



Data Sheet 9-E(4) Lighthouse Power Controller & Transfer Switch

9E.



Function. The 24-volt battery charger is used for charging nickel-cadmium batteries on Category I aids to navigation using a diesel engine-generator(s) and Lighthouse Power Controller.

Features.

Size (max) L W D (in)	24 x 18 x 14
Weight (lbs)	125
Input power	120 VAC, 60 Hz, 450 W
Output voltage	Constant voltage, adjustable float voltage
Output current	10 amps
Equalize	Adjustable with 0-24 hour timer
Temperature Compensated	External probe on battery
Other uses	May be used as a power supply

Additional Data. Past procurement of 24-volt battery chargers have included the McGraw-Edison CDSA-IBC-24-20A and the Saft Nife SCBF101-24-10C. Parts availability for the McGraw Edison is limited; Saft Nife does stock some parts for it. 24-volt battery chargers are available from Commandant (G-SEC-2) for approved projects.

Data Sheet 9-E(5) 24 Volt Battery Charger

9E.

NICKEL-CADMIUM STORAGE BATTERY
FOR DIESEL STARTING



Function. The nickel-cadmium storage battery with pocket-type plates is used to start engine generators at Category I aids using either prime power or standby generators. Twenty cells are connected in series to provide 24 VDC. The HED-100, currently installed in many locations, is discontinued. Replacement batteries are available from Saft Nife, Inc., (SBH102) and Alcad, Inc. (XHP100)

Features.

- Preactivated and fully charged prior to shipment.
- Translucent plastic case.
- Quick connect multicell assembly.
- Low freezing point potassium hydroxide electrolyte.

Electrical Characteristics.

Output voltage	1.2 V per cell (nominal)
Capacity at 5 hour rate to 1.10 VPC	100 amp-hours
Equalize Charge Voltage (77 F)	31-37 VDC (see mfr. instructions)
Float Charge Voltage (77 F)	29-33 VDC (see mfr. instructions)

Dimensions & Weight (per cell).

	<u>XHP100</u>	<u>SBH102</u>
Weight (lb)	22	19
Height (in)	14.72	15.94
Width (in)	7.56	7.68
Length (in)	3.66	2.45

Data Sheet 9-E(6)Nickle Cadmium Storage Battery for Diesel Starting

9E.

Additional Data. HED-100s should continue to be maintained as long as possible. If one or more cells fail, the entire rack must be replaced, as no replacement cells are available. Be sure to order the correct rack with new batteries, as cell dimensions are different. The suggested sources of supply are:

Alcad, Inc.
3 Powdered Metals Drive,
North Haven, CT 06473,

Phone: 203-234-8333,
FAX: 203-234-8255
Web Page: www.alcad.com

Saft America, Inc.,
711 Industrial Blvd.,
Valdosta, GA 31601,

Phone 912-245-2851,
Fax 912-247-848

Data Sheet 9-E(6)Nickle Cadmium Storage Battery for Diesel Starting

9E.

12 VOLT BATTERY CHARGER

Function. The 12-volt battery charger is used for charging nickel-cadmium batteries on Category I and II aids to navigation requiring emergency signal power, remote control and monitor system power and other support system power. 12-volt battery chargers are also used to charge nickel-cadmium batteries for standby power applications on Category IV aids.

Features.

Size (max) L W D (in)	24 x 18 x 14
Weight (lbs)	125
Input power	120 VAC, 60 Hz, 840 W
Output voltage	Constant voltage, adjustable float voltage
Output current	25 amps
Equalize	Adjustable with 0-24 hour timer
Temperature Compensated	External probe on battery
Other uses	May be used as a power supply

Additional Data. Past procurement of 12-volt battery chargers have included the McGraw-Edison CDSA-IBC-12-30A, the Saft Nife SCBF100-12-25 and the La Marche A-11-P-30-12V. Parts availability for the La Marche is non-existent. Parts for the McGraw Edison is limited; Saft Nife does stock some parts for it. 12-volt battery chargers are available from Commandant (G-SEC-2) for approved projects.

Data Sheet 9-E(7) 12 Volt Battery Charger

9.E.

NICKEL-CADMIUM STORAGE BATTERY
FOR EMERGENCY POWER



Function. The nickel-cadmium storage battery with pocket-type plates is used to supply 12-volt DC to electronic and emergency signal equipment at Category I, II and III, Solar Category I and II, and Commercial Day/Night Range Sync Transfer aids to navigation during period of main power loss. **Ten** cells are connected in series to provide 12 VDC.

Features.

- Preactivated and fully charged prior to shipment.
- Extended watering intervals (1-4 years).
- Low freezing point potassium hydroxide electrolyte.
- Replacement for ED-80, 240 and 400 batteries (individual ED cells cannot be replaced with the Sunica-Plus. The entire battery must be replaced.)

Electrical Characteristics.

- | | |
|--------------------------------------|---|
| • Output voltage | 1.2 V per cell (nominal) |
| • Capacity at 120 hr rate to 1.0 VPC | SUN+ 90 90 amp-hrs
SUN+ 275 275 amp-hrs
SUN+ 415 415 amp-hrs |
| • Equalize Charge Voltage (77° F) | 15.4 VDC |
| • Float Charge Voltage (77° F) | 14.4 VDC (15.0-15.5 for solar) |

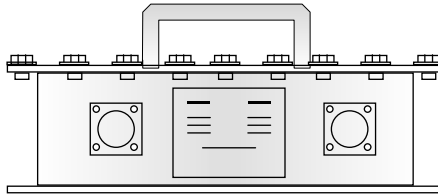
Dimensions & Weight (per cell).

	SUN+ 90	SUN+ 275	SUN+ 415
• Weight (lb)	10.8	25.4	40.4
• Height (in)	15.9	15.9	15.9
• Width	7.68	7.68	7.68
• Length (in, # of cells)	14.6 (10)	17.2 (5)	11.0 (2)

Additional Data. Sole source justifications are available from Commandant (G-SEC-2). Sunica-Plus batteries are available from: Saft America, Inc., 3 Powdered Metal Drive North Haven, CT 06473, Phone 203-239-4718, ask for your regional sales representative.

9.E.

STANDARD AIDS TO NAVIGATION POWER SUPPLY



Function. The power supply converts 120 VAC to 12 VDC power for use by DC powered aids to navigation equipment. The current, high-wattage power supply replaces all previously manufactured versions, which are no longer supported.

Features.

- Self contained in a steel case suitable for outdoor use.
- No exposed electrical contacts.
- Mil-Spec weather proof connectors for input and output.
- Automatic overload reset after fault is cleared.
- Adjustable output voltage.

Electrical Characteristics.

- Input voltage range 90-145 VAC
- Output voltage range 11-24 VDC (factory setpoint 12.5 VDC)
- Output regulation + 0.05% of selection
- Ripple Less than 2 millivolts RMS
- Output current 25 amps (max).
- Operating temperature -30° F to 120° F
- Connectors Supplied with 10AWG pigtails

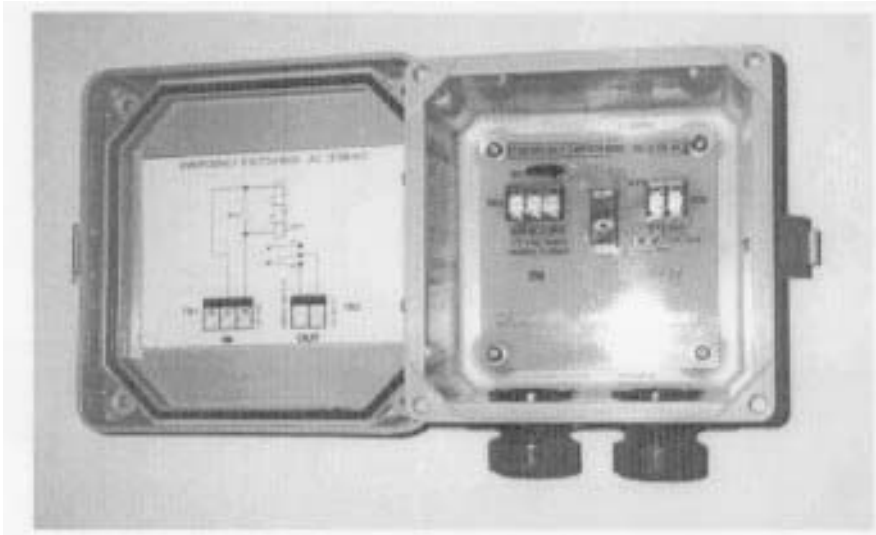
Physical Characteristics.

- Case Size (L W H in inches) 13 x 13 x 6 (including handle)
- Material Stainless steel
- Weight 35 lbs
- Mounting Holes located on bottom plate
- Terminal Configuration (input) A = Ground
B = Neutral
C = Hot (120 VAC)
- Terminal Configuration (output) A = Positive (12 VDC)
B = Negative

Additional Data. Power supplies are available from Commandant (G-SEC-2) for approved projects. This item is XB repairable through the ELC.

9E.

EMERGENCY SWITCH BOX-AC



Function. The Emergency Switch Box - AC (ESB-AC) is used at commercially powered 120VAC day/night ranges that have a separate and independent 12VDC backup power source (e.g., battery) to support an optional 12VDC-powered emergency range light. The ESB-AC continuously monitors the 120VAC commercial power entering an RSB-AC. Then, during a power outage, it activates a contact closure to enable the 12VDC emergency range light.

Features.

- Rainproof, corrosion resistant fiberglass enclosure with hinged cover.
- Small physical size.
- 120 VAC caution label in red ink.
- Stuffing tubes included (and installed).

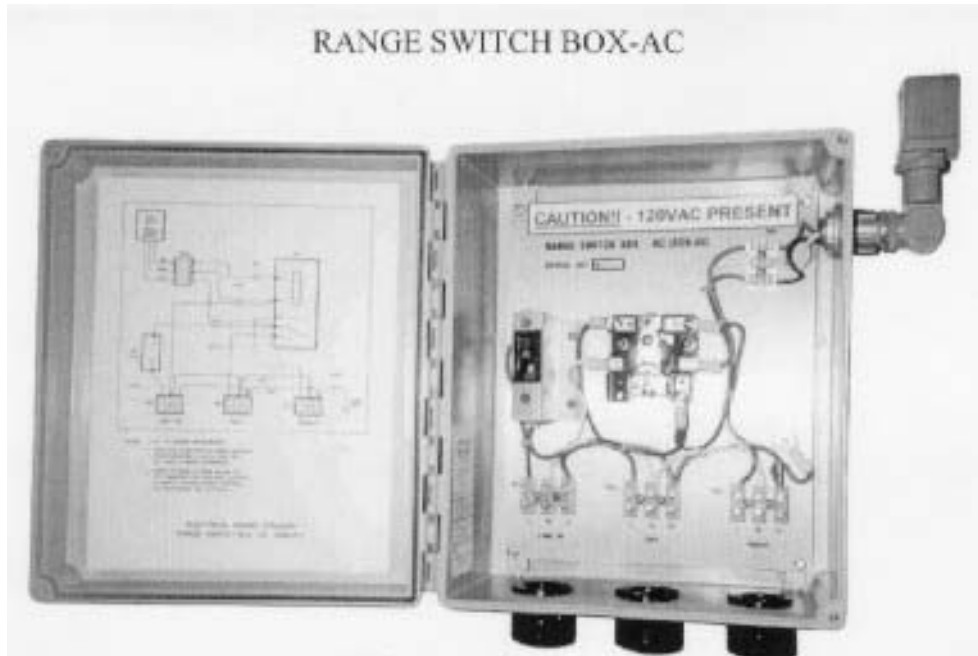
Electrical Characteristics.

- Simple electrical circuit.
- Surge suppressor on 120VAC input side.
- Contacts rated for 12VDC emergency backup range lights of up to 120W.

Additional Data. Refer to Commandant (G-SEC) drawing 130505. Emergency Switch Boxes are stocked at the ELC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for an Emergency Switch Box-AC should be addressed to Commandant (G-SEC-2).

Data Sheet 9-E(10) Emergency Switch Box-AC

9E.



Function. The Range Switch Box - AC (RSB-AC) is used at commercially powered 120VAC day/night range lights to perform the day-to-night-to-day switching function. The RSB-AC uses a very simple switching technique to toggle between the daytime and nighttime signals: A photoelectric sensor/switch mounted on the side of the switch box continuously monitors nearby ambient light levels. When ambient light falls below a preset threshold, the photoelectric switch activates a power relay to turn on the nighttime light and simultaneously turn off the daytime light.

Features.

- Rainproof, corrosion resistant fiberglass enclosure.
- Swivel-mount photoelectric switch.
- Euro-style terminal blocks.
- Stuffing tubes included (and installed in some earlier models).
- Failsafe to nighttime mode (given that the photoelectric switch's failsafe (deenergized) mode is the "closed" position).

Electrical Characteristics.

- Simple 120 VAC electrical control circuit.
- Up to 5 minute delay in switching after photoresistor is covered/uncovered.
- 20-amp power relay routes power to either the day or nighttime signal.
- 25-amp circuit breaker with high in-rush rating on LINE-IN power.
- Powers daytime and nighttime range lights of up to 2000 Watts each.

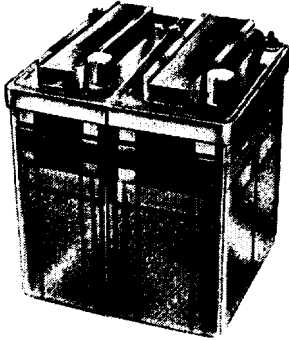
Additional Data. Refer to Commandant (G-SEC) drawing 130503. Range Switch Boxes are stocked at the ELC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for a RSB-AC should be addressed to Commandant (G-SEC-2).

Data Sheet 9-E(11) Range Switch Box-AC

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9E.

SAFT AMERICA AIR DEPOLARIZED PRIMARY BATTERY (STA-2-1000)



Function. The STA-2-1000 air depolarized batteries are used to supply power to fixed aids to navigation that can not be solarized. Five 2.5-volt cells are wired in series to supply 12.5 volts, 1000 amp-hours.

Features.

- Two cells connected in series
- Transparent plastic case
- Liquid electrolyte
- Carbon dust cover with filter
- Maximum 1 year shelf life
- Maximum 3 year service life
- Stud type 3/16-in terminals
- Mercury-free

Electrical Characteristics.

Voltage	2.50 volts
Capacity	1000 amp-hours
Maximum Continuous load	@ 70 F - 1.25 A
	@ 25 F - 0.75 A
	@ 0 F - 0.5 A

Dimensions & Weight.

Weight (lb)	30
Height (in)	10-5/8
Width (in)	7-7/8
Length (in)	8-5/8

Additional Data. The STA-2-1000 air-depolarized batteries are manufactured by Saft America, Inc., 711 Industrial Blvd., Valdosta, GA 31601, Phone: 912-245-2851

Data Sheet 9-E(12) Saft America Air Depolarized Primary Battery (STA-2-1000)

9E.

SAFT AMERICA AIR DEPOLARIZED PRIMARY BATTERY (STA-2-2000)

Function. The STA-2-2000 air depolarized batteries are used to supply power to fixed aids to navigation that can not be solarized. Ten 1.25-volt cells are wired in series to supply 12.5 volts, 2000 amp-hours.

Features.

Two cells connected in parallel
Transparent plastic case
Liquid electrolyte
Carbon dust cover with filter
Maximum 1 year shelf life
Maximum 3 year service life
Stud type 3/16-in terminals
Mercury-free

Electrical Characteristics.

Voltage	1.25 volts
Capacity	2000 amp-hours
Maximum Continuous load	@ 70 F - 2.5 A
	@ 25 F - 1.5 A
	@ 0 F - 1.0 A

Dimensions & Weight.

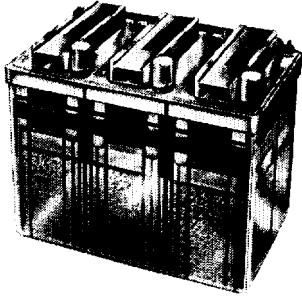
Weight (lb)	30
Height (in)	10-5/8
Width (in)	7-7/8
Length (in)	8-5/8

Additional Data. The STA-2-2000 air-depolarized batteries are manufactured by Saft America, Inc., 711 Industrial Blvd., Valdosta, GA 31601, Phone: 912-245-2851

Data Sheet 9-E(13) Saft America Air Depolarized Primary Battery (STA-2-2000)

9E.

SAFT AMERICA AIR DEPOLARIZED PRIMARY BATTERY (STA-3-3000)



Function. The STA-3-3000 air depolarized batteries are used to supply power to fixed aids to navigation that can not be solarized. Ten 1.25-volt cells are wired in series to supply 12.5 volts, 3000 amp-hours.

Features.

- Three cells connected in series
- Transparent plastic case
- Liquid electrolyte
- Carbon dust cover with filter
- Maximum 1 year shelf life
- Maximum 3 year service life
- Stud type 3/16-in terminals
- Mercury-free

Electrical Characteristics.

Voltage	1.25 volts
Capacity	3000 amp-hours
Maximum Continuous load	@ 70 F - 3.75 A
	@ 25 F - 2.25 A
	@ 0 F - 1.50 A

Dimensions & Weight.

Weight (lb)	48
Height (in)	10-5/8
Width (in)	7-7/8
Length (in)	12-3/4

Additional Data. The STA-3-3000 air-depolarized batteries are manufactured by Saft America, Inc., 711 Industrial Blvd., Valdosta, GA 31601, Phone: 912-245-2851

Data Sheet 9-E(14) Saft America Air Depolarized Primary Battery (STA-3-3000)

9E.



Function. The AS10-4 air alkaline batteries are used to supply power to fixed aids to navigation that can not be solarized. Nine 1.5-volt batteries are wired in series to supply 12.5 volts, 2000 amp-hours.

Features.

- Two cells connected in parallel
- Paste electrolyte
- Maximum 2 year shelf life
- Maximum 3 year service life
- Stud type 3/16-in terminals
- Mercury-free

Electrical Characteristics.

Voltage	1.5 volts
Capacity	2000 amp-hours
Maximum load	1.0 A continuous
	2.0 A continuous & daylight controlled
	6.0 A flashed at 12% duty cycle & daylight controlled

Dimensions & Weight.

Weight (lb)	20
Height (in)	9-1/4
Width (in)	4-1/2
Length (in)	8-7/8

Additional Data. The AS10-4 air-alkaline batteries are distributed by Celair, Inc., 1455 Oakbrook Drive, Suite 200, Norcross, GA 30093, Phone: 770-449-8998, Fax: 770-449-8781.

Data Sheet 9-E(15) Celair Air-Alkaline Primary Battery (AS10-4)

9E.

CELAIR AIR ALKALINE PRIMARY BATTERY (AS10-6)

Function. The AS10-6 air alkaline batteries are used to supply power to fixed aids to navigation that can not be solarized. Nine 1.5-volt batteries are wired in series to supply 12.5 volts, 3000 amp-hours.

Features.

Three cells connected in parallel
Paste electrolyte
Maximum 2 year shelf life
Maximum 3 year service life
Stud type 3/16-in terminals
Mercury-free

Electrical Characteristics.

Voltage	1.5 volts
Capacity	3000 amp-hours
Maximum load	1.5 A continuous 3.0 A continuous & daylight controlled 9.0 A flashed at 12% duty cycle & daylight controlled

Dimensions & Weight.

Weight (lb)	30
Height (in)	9-1/4
Width (in)	4-1/2
Length (in)	13-1/8

Additional Data. The AS10-6 air-alkaline batteries are distributed by Celair, Inc., 1455 Oakbrook Drove, Suite 200, Norcross, GA 30093, Phone: 770-449-8998, Fax: 770-449-8781

Data Sheet 9-E(16) Celair Air-Alkaline Primary Battery (AS10-6)

9E.

CELAIR AIR ALKALINE PRIMARY BATTERY (3AS10-2)

Function. The 3AS10-2 air alkaline batteries are used to supply power to fixed aids to navigation that can not be solarized. Three 4.5-volt batteries are wired in series to supply 12.5 volts, 1000 amp-hours.

Features.

Three cells connected in series
Paste electrolyte

Maximum 2 year shelf life
Maximum 3 year service life

Stud type 3/16-in terminals
Mercury-free

Electrical Characteristics.

Voltage	4.5 volts
Capacity	1000 amp-hours
Maximum load	0.5 A continuous 1.0 A continuous & daylight controlled 3.0 A flashed at 12% duty cycle & daylight controlled

Dimensions & Weight.

Weight (lb)	30
Height (in)	9-1/4
Width (in)	4-1/2
Length (in)	13-1/8

Additional Data. The 3AS10-2 air-alkaline batteries are distributed by Celair, Inc., 1455 Oakbrook Drive, Suite 200, Norcross, GA 30093, Phone: 770-449-8998, Fax: 770-449-8781

Data Sheet 9-E(17) Celair Air-Alkaline Primary Battery (3AS10-2)

9E.



Function. The Celair 9AS10-2 buoy power unit supplies power to floating aids to navigation that can not be solarized. The BPU consists of three 1.5-volt cells wired in series to supply 12.5 volts, 1000 amp-hours.

These cells are housed in a plywood enclosure for installation in 22 and 24-inch buoy battery pockets.

Features.

- Positive and negative connections at top of rack.
- Rack mounted lifting eye.
- Rack mounted reversible pocket spacers
- Paste electrolyte
- Maximum 2 year shelf life
- Maximum 3 year service life
- Mercury-free.

Electrical Characteristics.

Output voltage	12.5 volts.
Capacity	1000 amp-hours
Maximum load	0.5 A continuous
	1.0 A continuous & daylight controlled
	3.0 A flashed at 12% duty cycle & daylight controlled

Dimensions & Weight.

Weight (lb)	112
Height (in)	20
Width (in)	16-1/8
Length (in)	17-1/4

Additional Data. The 9AS10-2 buoy power unit is distributed by Celair, Inc., 1455 Oakbrook Drive, Suite 200, Norcross, GA 30093, Phone: 770-449-8998, Fax: 770-449-8781

Data Sheet 9-E(18) Celair Buoy Power Unit (9AS10-2)

9E.



Function. The Celair 9AS10-4 buoy power unit supplies power to floating aids to navigation that can not be solarized. The BPU consists of eighteen 1.5-volt cells wired in series-parallel to supply 12.5 volts, 2000 amp-hours. These cells are housed in a plywood enclosure for installation in 22 and 24-inch buoy battery pockets.

Features.

- Positive and negative connections at top of rack.
- Rack mounted lifting eye.
- Rack mounted reversible pocket spacers.
- Paste electrolyte
- Maximum 2 year shelf life
- Maximum 3 year service life
- Mercury-free

Electrical Characteristics.

Output voltage	12.5 volts.
Capacity	3000 amp-hours
Maximum load	1.0 A continuous
	2.0 A continuous & daylight controlled
	6.0 A flashed at 12% duty cycle & daylight controlled

Dimensions & Weight.

Weight (lb)	218
Height (in)	33
Width (in)	16-1/8
Length (in)	17-1/4

Additional Data. The 9AS10-4 buoy power unit is distributed by Celair, Inc., 1455 Oakbrook Drive, Suite 200, Norcross, GA 30093, Phone: 770-449-8998, Fax: 770-449-8781

Data Sheet 9-E(19) Celair Buoy Power Unit (9AS10-4)

9E.



Function. The Celair 9AS10-6 buoy power unit supplies power to floating aids to navigation that can not be solarized. The BPU consists of twenty-seven 1.5-volt cells wired in series-parallel to supply 12.5 volts, 3000 amp-hours. These cells are housed in a plywood enclosure for installation in 22 and 24-inch buoy battery pockets.

Features.

- Positive and negative connections at top of rack.
- Rack mounted lifting eye.
- Rack mounted reversible pocket spacers.
- Paste electrolyte
- Maximum 2 year shelf life
- Maximum 3 year service life
- Mercury-free

Electrical Characteristics.

Output voltage	12.5 volts.
Capacity	3000 amp-hours
Maximum load	1.5 A continuous
	3.0 A continuous & daylight controlled
	9.0 A flashed at 12% duty cycle & daylight controlled

Dimensions & Weight.

Weight (lb)	313
Height (in)	46-1/4
Width (in)	16-1/8
Length (in)	17-1/4

Additional Data. The 9AS10-6 buoy power unit is distributed by Celair, Inc., 1455 Oakbrook Drive, Suite 200, Norcross, GA 30093, Phone: 770-449-8998, Fax: 770-449-8781

Data Sheet 9-E(20) Celair Buoy Power Unit (9AS10-6)

9.E.21.

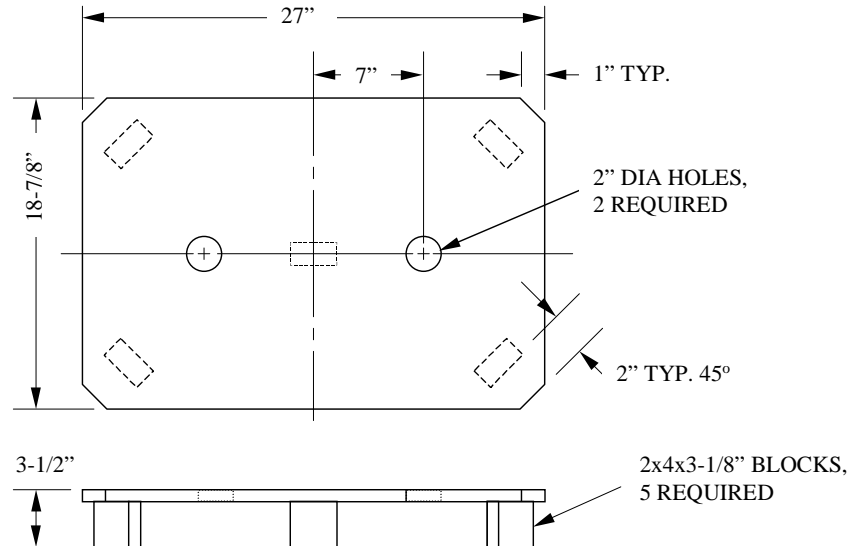
21. LITHIUM ICE BUOY BATTERY



- a. Function. The lithium-thionyl-chloride ice buoy battery is prepackaged and sealed 12 volt, 96 amp-hour power source for seasonal aids and for use in the 6x16 and 7x20 LI ice buoys.
- b. Features.
- (1) Positive and negative leads attached to case,
 - (2) No buoy pocket venting necessary,
 - (3) Lightweight (less than 8 pounds),
 - (4) Mounts directly to the pocket cover for increased rigidity (as pictured),
 - (5) 2-year shelf life.
- c. Electrical Characteristics.
- | | |
|--------------------|---------------|
| (1) Output voltage | 12-volts |
| (2) Capacity | 96 amp-hours* |
- *Two battery packs are needed for Mo(A) and Q flash rhythms. Be sure to order enough battery packs for the ice season.
- d. Dimensions & Weight.
- | | |
|-------------------|---------|
| (1) Weight (lb) | 8 |
| (2) Height (in) | 2-11/16 |
| (3) Diameter (in) | 9-1/2 |
- e. Additional Data. Order on MILSTRIP from SFLC (ACN CG 6135-01-106-5542). Due to the long lead time (about one year), the SFLC solicits orders from cutters/districts and consolidates an order with the vendor. NOTE: These batteries have a high energy density. Do not allow leads to short together during installation, storage or disposal otherwise the battery may overheat and ignite.

9.E.22.

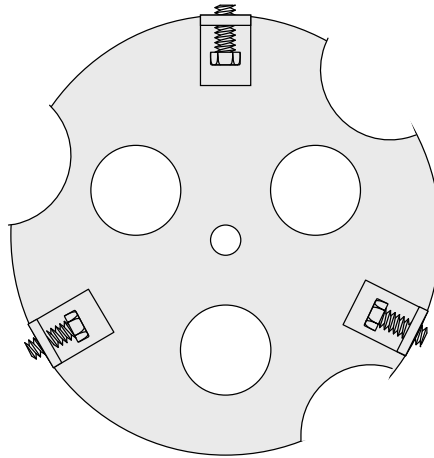
22. CG BATTERY BOX INTERIOR PLATFORM



- a. **Function.** The CG battery box interior platform is manufactured by the unit and used to raise five STA-3-3000 3-1/2 inches to allow installation in one battery box. Ten STA-3-3000 batteries are used on fixed aids requiring 12 volts, 3000 amp-hours. Therefore, two platforms should be constructed, one for each box, if using these batteries. This platform may also be used to isolate solar batteries from a cold, steel structure.
- b. **Features.**
- (1) Plywood and 2 x 4 construction lumber.
 - (2) Ease of manufacturing.
 - (3) Two holes for ease of handling.
- c. **Materials Required.**
- | | | |
|-------------------|--------|-------------------|
| (1) Legs (in) | 5 each | 3-1/2 x 2 x 4 |
| (2) Platform (in) | 1 each | 3/8 x 18-7/8 x 27 |
- d. **Additional Data.** The platform is fabricated by units as needed. Its legs are mounted with waterproof glue (Titebond II or Liquid Nails) and two galvanized 1-1/4 inch drywall screws.

9.E.23.

23. BUOY POWER UNIT ASSEMBLY CLAMP.



- a. Function. The buoy power unit assembly clamp is attached to the top of a buoy power unit before installation in the buoy battery pocket. After installation, the clamp positioning bolts are tightened against the pocket walls to prevent movement inside the pocket which could damage the battery and leads.
- b. Features:
- (1) Access hole for terminal board.
 - (2) Anti-rotation lock for BPU.
 - (3) Heavy duty positioning bolts.
- c. Dimensions:
- | | |
|---|----------------------|
| (1) Plate diameter (in) | 21-1/4 or 23-1/4 |
| (2) Center hole diameter (in) | $\frac{3}{4}$ |
| (3) Number and location of positioning bolts | 3, 120° apart |
| (4) Number, diameter and location of access holes | 3, 5 in., 120° apart |
- d. Additional Data: Positioning bolts are welded to the steel plate. The power unit assembly clamp is a standard item fabricated by CG industrial facilities per Commandant (CG-432) Drawing 107391.

9.E.24.

24. SOLAR PANELS [10 WATT, 20 WATT, AND 40 WATT (PREVIOUSLY 35 WATT)]



a. Function. Solar Panels convert energy from the sun directly into electricity (DC) for recharging batteries. Depending on the power requirements of the aid, an array may consist of any combination of 10, 20, and/or 40-watt (previously called 35-watt, although it produced 40 watts) marine solar panels. These marine solar panels are approved for use on all aids to navigation.

b. Features.

- (1) Mono- or poly-crystalline silicon solar cells.
- (2) Tempered glass cover.
- (3) Anodized aluminum bezel and backplate.
- (4) Potted and sealed junction box.
- (5) Replaceable blocking diode installed.
- (6) High-density, UV-stabilized black PVC cable.

c. Electrical Characteristics (under bright sunlight conditions).

	<u>10 Watts</u>	<u>20 Watts</u>	<u>40 Watts</u>
Open circuit voltage (Vdc)	17	17	17
Output current (A)	0.6	1.3	2.3
Rated output power (W)	10	20	40*
Weight (lb)	7	12	22
Length/square (in)	16	22	28
NSN CG 6117-01-	145-7152	145-7153	148-7879

* Although no longer in stock nor in production, Siemens Solar Industries' 35-watt marine solar panels (MAR 35) produced 40 watts. There are many of these 35-watt solar panels currently installed and operating at numerous lighted aids to navigation producing 40 watts of electricity.

d. Additional Data. These marine solar panels must meet the requirements of Commandant (CG-432) Specification 401 (series). Panels can be ordered from SFLC Baltimore.

9.E.25.

25. HIGH-DENSITY SOLAR PANEL (SL54-SR)



- a. Function. High-density solar panels are used on fixed aids to navigation requiring a large array and have a limited area for installation of the array. The panels are not suitable for use on aids subjected to wave action as their physical design is noticeably weaker than the standard 40-watt marine solar panel.
- b. Features.
- (1) High-efficiency single crystalline silicon solar cells.
 - (2) High-density packaging of cells.
 - (3) Tempered glass cover.
 - (4) Anodized aluminum bezel.
 - (5) Weather resistant junction box.
 - (6) Moisture-tight strain relief connector.
 - (7) Bypass diode not installed.
 - (8) Blocking diode not installed (blocking diodes are installed in the LTB-d).
- c. Electrical Characteristics (under bright sunlight conditions).
- | | |
|--------------------------------|--------------|
| (1) Open circuit voltage (Vdc) | 18.3 |
| (2) Output current (A) | 3.92 |
| (3) Rated output power (W) | 54* |
| (4) Weight (lb) | 12.5 |
| (5) Length/Width (in) | 13.5 x 44.38 |
- * SM46 panels produce 46 watts and the old M65 panels produced 43 watts. SM-46 panels are still available from Commandant (CG-432) (see below).
- d. Additional Data. High-density solar panels are available from Commandant (CG-432). Requests for high-density panels must be made with a Project Development Submittal (PDS) with justification that an array of standard 40-watt solar panels is not feasible.

9.E.26.

26. SOLAR PANEL FOR EMERGENCY BATTERIES (SW50A)

(Previously used were the Siemens SM50-H and M75 solar panels)

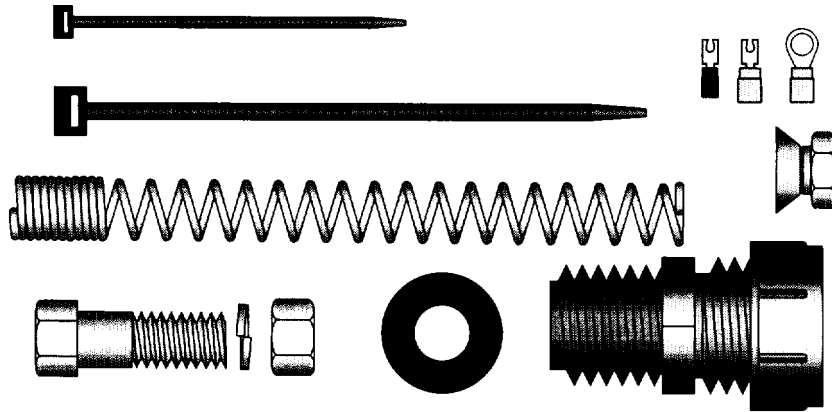


- a. Function. The SunWize SW50A solar panel is used at solar powered aids to navigation to recharge the Saft America Sunica-Plus series NiCad batteries. The higher voltage of the SW50A solar panel makes it ideally suited for recharging NiCad batteries. One solar panel is installed at installations requiring an emergency solar array.
- b. Features.
- (1) High-efficiency single crystalline silicon solar cells.
 - (2) High-density packaging of cells.
 - (3) Tempered glass cover.
 - (4) Anodized aluminum tubular frame.
 - (5) Weather resistant junction box.
 - (6) Moisture-tight strain relief connector.
 - (7) Bypass diodes installed in junction box.
 - (8) Blocking diode not installed (blocking diode is in Solar Distribution Box).
- c. Electrical Characteristics (under bright sunlight conditions).
- | | |
|--------------------------------|---------------|
| (1) Open circuit voltage (Vdc) | 21.0 |
| (2) Output current (A) | 3.4 |
| (3) Rated output power (W) | 50 |
| (4) Weight (lb) | 13.22 |
| (5) Length/Width (inches) | 35.11 x 22.59 |
- d. Additional Data. The SW50A solar panel can be purchased directly from SunWize Technologies, Inc., 1155 Flatbush Road, Kingston, NY 12401, Phone: 1-800-817-6527, Web Page: www.sunwize.com.

Data Sheet 9.E.26. Solar Panel for Emergency Batteries (SW50A)

9E.

SOLAR INSTALLATION KIT



Function. The Solar Installation Kit contains the necessary hardware to install one solar panel on a buoy or structure. The dissimilar metals of the solar panel (aluminum) and structure (steel) must be kept separate to prevent galvanic corrosion. Stainless steel fasteners and plastic spacers are used to accomplish this task.

Kit Contents:

Bird springs.

3/8" stainless steel mounting hardware.

Vandal resistant nuts.

Plastic spacers.

Solderless terminals.

3/4" NPT stuffing tube for solar panel cable.

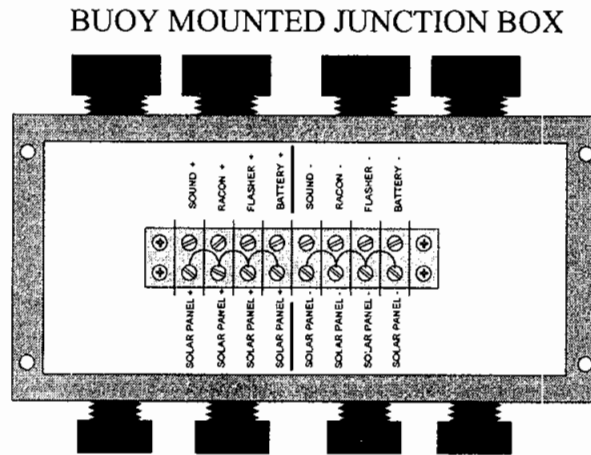
Nylon cable ties.

Battery warning label.

Instructions.

Additional Data. The Solar Installation Kit is available from ELC Baltimore. The NSN is CG-5340-01-17-4179

Data Sheet 9-E(27) Solar Installation Kit



Function. The Buoy Mounted Junction Box is used on buoys containing two, three or four solar panels. The box provides a convenient place to terminate multiple solar panels, the battery leads and up to three loads. Stuffing tubes are provided, half are plugged in case they are not needed, however packings are included if they will be utilized.

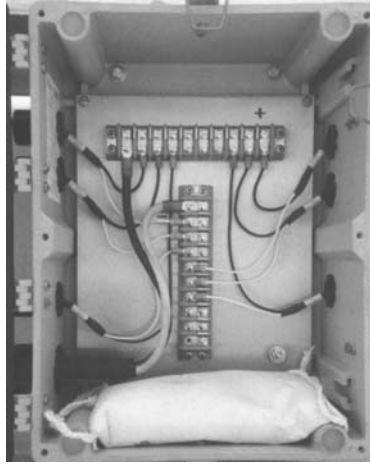
Features.

- Diecast aluminum NEMA 4X enclosure (raintight).
- One eight-pole barrier terminal strip.
- Four stuffing tubes sized for 12/2 SO cable.
- Four stuffing tubes sized for solar panel cable
- Size: L W D (inches) 10.25 x 6.30 x 3.54

Additional Data. Buoy Mounted Junction Boxes are still being tested. Until ELC Baltimore is capitalized with these items, contact Commandant (G-SEC-2A) for sources of supply.

9.E.29.

29. LOCAL TERMINAL BOX (LTB)



- a. Function. The Local Terminal Box is used for large 12-volt solar lighthouse systems to combine inputs from up to ten solar panels (6 panels typical because of wire size limitations) for power distribution to the PV Combiner Box.
- b. Features.
 - (1) Fiberglass NEMA 4X enclosure (raintight)
 - (2) Two ten pole barrier terminal blocks
 - (3) Size: L W D (inches) 14 x 10.5 x 7.5
- c. Additional Data. Local Terminal Boxes are stocked at the SFLC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for LTBs shall be addressed to Commandant (CG-432). Installation and servicing information is included in the Short Range Aid to Navigation Servicing Guide, COMDTINST M16500.19 (series). Refer to Commandant (CG-432) 140400 and 140500 series drawings for standard configurations.

9.E.29A.

29A. LOCAL TERMINAL BOX – diode (LTB-d)



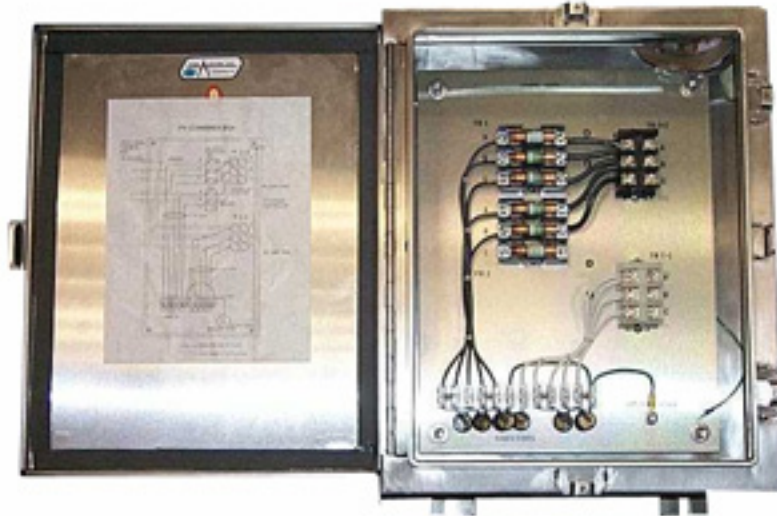
- a. Function. The Local Terminal Box – diode is used on large 12-volt solar power systems to combine inputs from up to ten high-density (HD) solar panels (6 panels realistically because of wire size limitations) for power distribution to the PV Combiner Box. Since HD solar panels contain no blocking diodes, blocking diodes are pre-installed in each of the ten negative-side circuit legs of the LTB-d to prevent battery discharge through the solar array at night.

- b. Features.
 - (1) Fiberglass NEMA 4X enclosure (rain tight).
 - (2) Three ten pole barrier terminal strips.
 - (3) One blocking diode installed in each of ten negative-side circuit leg.
 - (4) Size: L W D (inches): 14 x 10.5 x 7.5.

- c. Additional Data. Local Terminal Boxes – diode are not stocked at the SFLC Baltimore warehouse. However, they are Headquarters controlled and available for approved projects. Requests for LTB-d's should be addressed to Commandant (CG-432). Refer to Commandant (CG-432) 140400 and 140500 series drawings for standard configurations.

9.E.30

30. PV COMBINER BOX



- a. Function. The PV Combiner Box is used in large 12-volt solar lighthouse systems to combine inputs from multiple Local Terminal Boxes (LTBs) and provide up to three outputs for the charge controller.
- b. Features:
 - (1) Fiberglass NEMA 4X enclosure (raintight).
 - (2) 30 amp fuse protection.
 - (3) Convenient disconnect for solar panel diode testing.
 - (4) Terminal blocks allow up to 1/0 AWG wire to charge controller.
 - (5) Size: L W D (inches) 18 x 14.5 x 7.5
- c. Additional Data. PV Combiner Boxes are stocked at the SFLC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for PV Combiners shall be addressed to Commandant (CG-432). Installation and servicing information is included in the Lighthouse Manual, COMDTINST M16500.8 (series) and the Major Aids to Navigation Lighthouse Preventative Maintenance System Guide, COMDTINST 16500.10 (series). Refer to Commandant (CG-432) 140400 and 140500 series drawings for standard configurations.

9.E.31.

31. SOLAR CHARGE CONTROLLER



- a. Function. The Solar Charge Controller is used in large (> 10 solar panels) 12-volt solar powered lighthouses and ranges to protect the main battery from overcharge and deep discharge.
- b. Features:
 - (1) Fiberglass NEMA 4X enclosure (raintight).
 - (2) 60 amp circuit breaker protection.
 - (3) Three array inputs (one string designed to float charge the battery)
 - (4) Load and battery outputs.
 - (5) Temperature compensated with remote battery temperature sensor.
 - (6) Terminal blocks allow up to 1/0 AWG wire.
 - (7) Selectable charge termination setpoints.
 - (8) Adjustable low voltage disconnect setpoints (may be bypassed if SDB is installed).
 - (9) Size: L W D (inches) 20 x 16.5 x 9
- c. Additional Data. Solar charge controllers are stocked at the SFLC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for controllers shall be addressed to Commandant (CG-432). Installation and servicing information is included in the Lighthouse Manual, COMDTINST M16500.8 (series) and the Major Aids to Navigation Lighthouse Preventative Maintenance System Guide, COMDTINST 16500.10 (series). Refer to Commandant (CG-432) 140400 and 140500 series drawings for standard configurations.

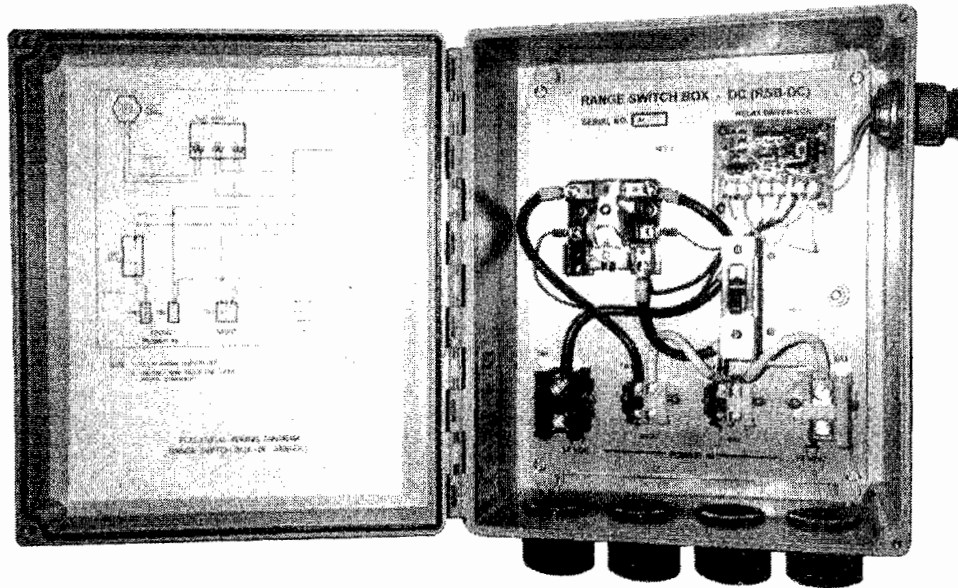
9.E.32.

32. RANGE POWER BOX (RPB)



- a. Function. The Range Power Box (RPB) is used on solar powered day/night range systems to protect the main battery from overcharge and deep discharge. It may also be used on small solar lighthouses with solar panel systems (up to 10 solar panels) that require regulation.
- b. Features:
- (1) Fiberglass NEMA 4X enclosure (rain tight).
 - (2) Size: L W D (inches) 12 x 10 x 6.
 - (3) Efficient PWM constant-voltage charge regulation prevents heating and excessive battery gassing.
 - (4) Array, load, and reverse polarity circuit protection with auto recovery.
 - (5) Temperature compensated with remote battery temperature sensor.
 - (6) Terminals allow up to 6 AWG wire.
 - (7) 3-position battery type selector switch for optimized battery charging (gel, sealed, and flooded).
 - (8) Low voltage disconnect setpoint is 11.4 volts to protect battery from deep discharge; battery reconnects at 12.6 volts.
 - (9) 4 LED indicators show system status and various faults.
 - (10) Simple push-button electrical disconnect of load and array.
 - (11) Digital meter scrolls through battery voltage, array current, and load current.
 - (12) Replaces the Specialty Concepts PPC-50 Charge Controller
- c. Additional Data. Refer to Commandant (CG-432) drawing 140414, 140502, and 140503. Range Power Boxes are stocked at the SFLC Baltimore warehouse, are Headquarters controlled, and available for approved projects. Requests for RPB's shall be addressed to Commandant (CG-432). Installation and servicing information is included in the Short Range Aid to Navigation Servicing Guide, COMDTINST M16500.19 (series).

RANGE SWITCH BOX-DC



Function. The Range Switch Box - DC (RSB-DC) is used at solar powered or power supply-driven 12VDC day/night range lights to perform the day-to-night-to-day switching function. The RSB-DC uses a very simple switching technique to toggle between the daytime and nighttime signals: A type L photoresistor mounted on the side of the switch box continuously monitors nearby ambient light levels. When ambient light rises above a preset threshold, a relay driver circuit activates a power relay to turn on the daytime light and simultaneously turn off the nighttime light.

Features.

- Single watertight, corrosion resistant fiberglass enclosure.
- Easy to install, easy to service.
- Light level switching thresholds meet requirements of the CG-181 flasher spec.
- Uses CG standard type L photoresistor.
- Rugged Buchanan section terminal blocks.
- Stuffing tubes included (and installed in some earlier models).
- Instant mode switching when photoresistor is covered/uncovered.
- Failsafe to nighttime mode (the lower intensity light).

Electrical Characteristics.

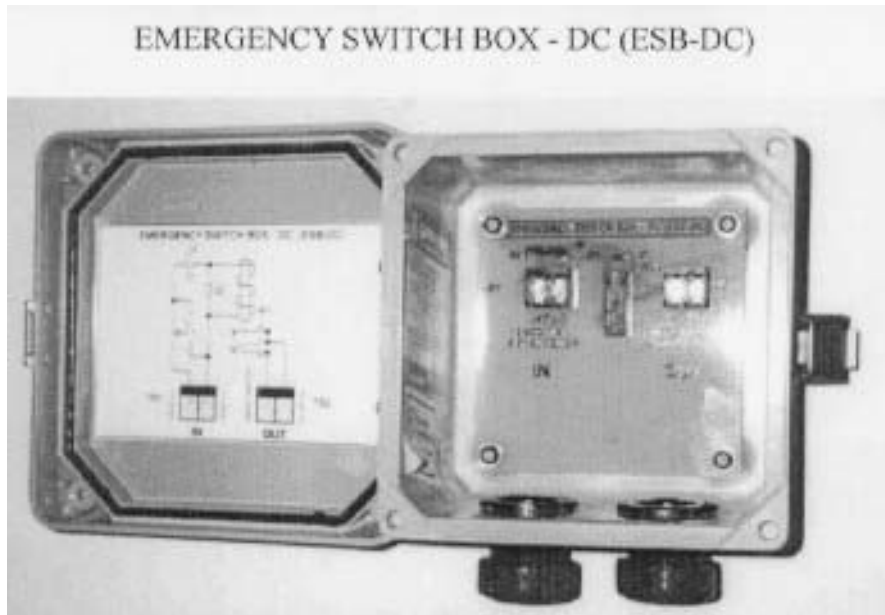
- Relay Driver circuit is surge and reverse polarity protected.
- 20-amp power relay routes 12VDC power to either the day or nighttime signal.
- 30-amp circuit breaker with a high in-rush rating on +12VDC Power In.
- Powers 12VDC daytime and nighttime range lights of up to 240 Watts.

9E.

Related Equipment. The RSB-DC will usually control the on/off toggle operation between standard day and night RL-14 range lights containing standard CG-181 or CG-481 flashers and lamps of up to 110 watts each (240 watts max total when paralleling two RL-14's). A comprehensive spare parts kit for standard ranges containing replacement parts for the Range Switch Boxes (both RSB-AC and RSB-DC) is also available.

Additional Data. Range Switch Boxes are stocked at the ELC Baltimore warehouse under APA Commodity M stock and are Headquarters controlled. Requests for a Range Switch Box - DC should be addressed to Commandant (G-SEC-2A). Requests for a spare parts kit for standard ranges should be addressed to Commandant (G-SEC-2A) as well.

9E.



Function. The Emergency Switch Box - DC (ESB-DC) is used at 12VDC day/night ranges that have a separate and independent 12VDC backup power source (e.g., battery) to support an optional emergency range light. The ESB-DC continuously monitors the actual main 12VDC power entering the RSB-DC from either the RPB (solar power) or power supply and activates a contact closure to enable the emergency range light during a battery/power failure.

Features.

Single watertight, corrosion resistant fiberglass enclosure with hinged cover.

Small physical size.

Stuffing tubes included (and installed).

Electrical Characteristics.

Simple electrical circuit.

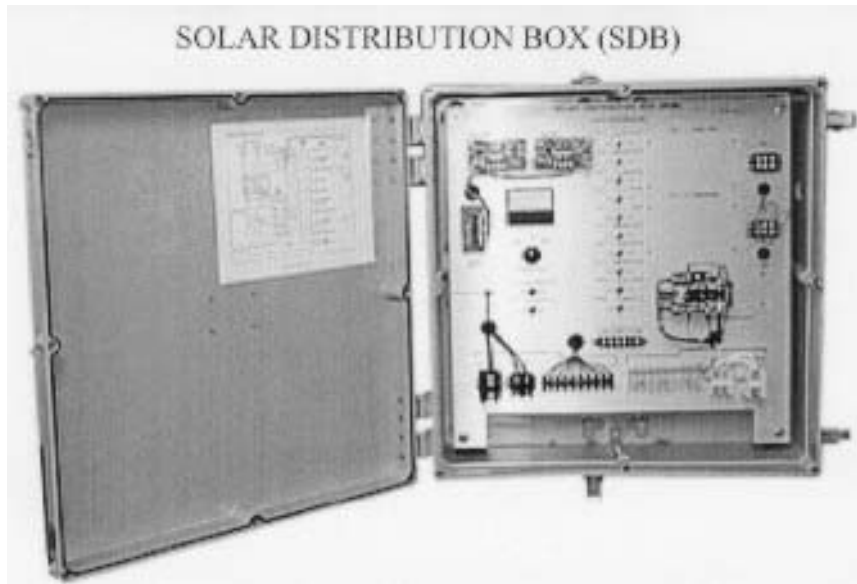
Surge suppressor on 12VDC input side.

Powers 12VDC emergency backup range lights of up to 60 Watts.

Additional Data. Refer to Commandant (G-SEC) drawing 140505. Emergency Switch Boxes are stocked at the ELC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for an Emergency Switch Box - DC should be addressed to Commandant (G-SEC-2)

Data Sheet 9-E(33) Emergency Switch Box-DC (ESB-DC)

9E.



Function. The Solar Distribution Box (SDB) acts as a load center and battery transfer device at solar powered lights. It has provisions for mounting the SACII, inputs for main power, auxiliary solar array, auxiliary battery and provides status to LEACMS for low battery and battery transfer functions.

Features:

- Fiberglass NEMA 4X enclosure (raintight).
- Three 20 amp and seven 10 amp load circuit breakers.
- Main terminal blocks accept up to 1/0 AWG wire.
- Auxiliary power blocks accept up to 6 AWG wire
- Load terminal blocks accept up to 10 AWG wire.
- Preset low voltage alarm setpoint (11.5 volts).
- Preset low voltage disconnect setpoint (11.0 volts).
- Size: L W D (inches) 24 x 24 x 9

Operation. Incoming power is monitored by the SDB and routed to all loads. If main battery voltage falls to 11.5 volts, a low alarm is posted to the LEACMS (if installed). When main battery voltage falls to 11.0 volts, the battery transfer relay is activated, switching power to the emergency battery and turning off loads 1, 2 and 3 (main light & sound). All SDBs contain an Auxiliary Reset Module (ARM) which resets the SACII upon battery re-transfer (back to main) so that the main signals resume operation. The SDB may be used with an AtoN power supply as long as the Power Supply Monitor Box (PSMB) is installed.

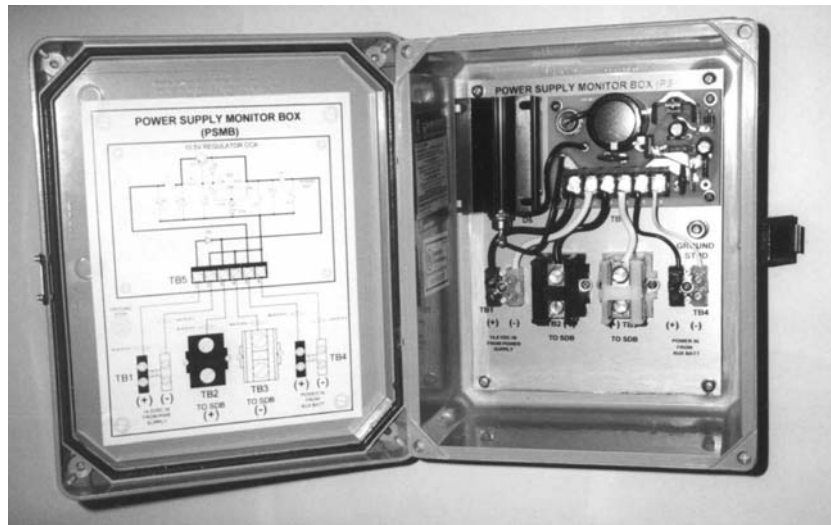
Additional Data. SDBs are stocked at the ELC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for SDBs shall be addressed to Commandant (G-SEC-2).

36. SOLAR AID CONTROLLER III (SACIII)

- a. Function. The Solar Aid Controller III (SACIII) controls and monitors the operation of 12 VDC powered aids to navigation of up to 20 amps. The SACIII monitors current to the aid, rotation of the lens (if required), and provides an F-signal pulse (if required) to a CG-6PHW lampchanger when lamp failure is sensed.
- b. Features:
- (1) Extremely low power consumption and internal resistance.
 - (2) Choice of two power input terminals: one activates a built-in voltage regulator for stable system operation while the other enables lampchanging function.
 - (3) On-board lampchanging circuitry (for use when no flasher at main light).
 - (4) Two dedicated, non-polarized emergency signal control dry contact closure terminals.
 - (5) Modular, disposable, and potted.
 - (6) Standardized size for mounting in the Solar Distribution Box.
 - (7) Clamp style terminals (no lugs needed).
 - (8) Rotation detector bypass jumper wire preinstalled.
 - (9) Four status output terminals.
 - (10) Initial power-on resets the SACIII.
 - (11) Sealed pushbutton also resets SACIII (field service).
 - (12) Test point and current threshold adjustment to monitor and set threshold.
- c. Additional Data. SACIII's are stocked at the SFLC Baltimore warehouse under ACN 0000-XF-C17-1810, are Headquarters controlled, and available for approved projects. Requests for SACIII's should be addressed to Commandant (CG-432). Consult with the Commandant (CG-432) Web Site ([http://www.uscg.mil/systems/gse/gse2/2adwg.htm#Technical Data Sheets](http://www.uscg.mil/systems/gse/gse2/2adwg.htm#Technical%20Data%20Sheets)) for important Technical Data Sheets regarding the SACIII and SACIII (and SACII) threshold adjustments.

9.E.37.

37. POWER SUPPLY MONITOR BOX (PSMB)



- a. Function. A Power Supply Monitor Box (PSMB) is required to ensure proper system operation during a commercial power outage when using a Solar Distribution Box in a commercially-powered lighthouse system. The PSMB provides 10.5VDC power to the SDB during power outage thus enabling the SDB to continue operating in the "Battery Transfer" alarm mode. Then, when commercial power is restored, the PSMB removes the 10.5VDC and reconnects power supply power back to the SDB automatically resetting it and bringing the entire system back to primary mode of operation. Without a PSMB the SDB would become non-operational immediately upon commercial power failure causing all auxiliary and emergency systems to become non-operational as well.
- b. Features.
 - (1) Single raintight, corrosion resistant fiberglass enclosure.
 - (2) Reverse polarity and surge protection in place.
 - (3) Purely solid state operation (no relays or other moving parts).
 - (4) Powered continuously and independently by an external auxiliary battery.
- c. Electrical Characteristics.
 - (1) Operating Voltage: 12VDC nominal.
 - (2) Inputs: 30 amps max in from power supply.
18 amps max in from auxiliary battery.
 - (3) Output: 30 amps out to SDB.
- d. Additional Data Refer to Commandant (CG-432) drawing 130426. Power Supply Monitor Boxes are stocked at the SFLC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for Power Supply Monitor Boxes should be addressed to Commandant (CG-432).

9E.



Function. The Sound Signal Current Detector (SSCD) is used to monitor the operation of Coast Guard standard FA-232 and FA-232/02 sound signals. The SSCD monitors the actual 390Hz signal going to the drivers (horns) of the sound signals and provides an electronic "contact closure" (channel activity) to external monitoring equipment when sufficient current is detected. The SSCD provides a higher degree of reliability in sound signal monitoring as compared to the older method in which only the dc current draw on the 12VDC power supply line is monitored.

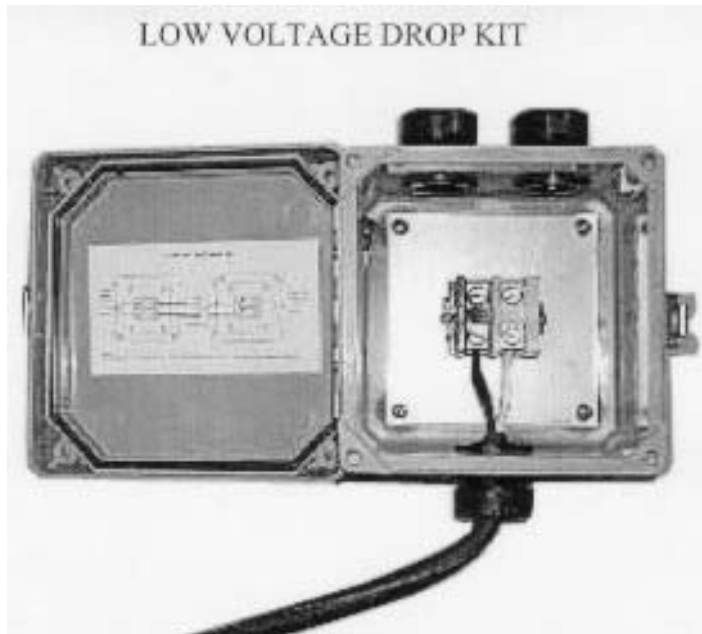
Features.

Compact, lightweight, rugged, potted package.
Mountable inside the sound signal housing.
Solid State electronics (no moving parts).
Non-polarized input and output
Wires are color coded: output/yellow, input/purple.
Packaged with matching crimp-terminals for output wire connections.
Crimped, soldered, and insulated ring and spade terminals on input wire.
Two are required for a FA-232/02: one for the top unit & one for the lower.

Electrical Operation. Potted inside the SSCD is a small electrical transformer which generates current during a sound signal blast to turn on a bi-polar LED. The LED lights up and shines on the light-sensitive surface of a CdS cell (photoresistor) that's optically-coupled to the LED. The output resistance of the photoresistor goes low during the sound blast simulating a contact closure. This output is then combined with the output of the second SSCD if monitoring a FA-232/02 and routed back to the electronic monitoring equipment, usually a SACII.

Additional Data. Sound Signal Current Detectors are stocked at the ELC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for Sound Signal Current Detectors should be addressed to Commandant (G-SEC-2).

9E.



Function. The Low Voltage Drop Kit is used to reduce voltage loss in 12-volt DC applications by running up to 1/0 AWG wire vice 12/2 SO cables between the beacon and power source (Range Power Box or Solar Distribution Box). With the exception of day/night ranges using a Range Switch Box, which can readily accept up to 1/0 AWG wire, two Low Voltage Drop Boxes are used, one near the Solar Distribution Box and the other (if used) near the light. Consult with COMDTINST M16500.24, Solar Design Manual for proper placement and wire sizing when using this kit.

Features.

Consists of two fiberglass NEMA 4X terminal boxes.

Two six ft lengths of 12/2 SO cable.

Three watertight stuffing tubes.

User supplies appropriate size and length conduction between boxes.

Size: L W H (inches) 6 x 6 x 4

Additional Data. Low Voltage Drop Boxes are stocked at the ELC Baltimore warehouse, are Headquarters controlled and available for approved projects. Requests for Kits shall be addressed to Commandant (G-SEC-2).

Data Sheet 9-E(38) Low Voltage Drop Kit

9.E.

12-VOLT MAINTENANCE-FREE
SECONDARY BATTERY
(DELCO 2000, DELCO S-2000, DELPHI BU31SP-115S)



Function. These 12-volt, 100 amp-hour batteries may be used alone or connected in parallel to provide the proper current capacity as required by solar design program (see COMDTINST M16500.24) for use on fixed and floating aids to navigation. The Delco 2000, S-2000 and Delphi BU31SP-115S are identical in performance. The only difference is the nameplate.

Features.

- Fully charged prior to shipment.
- Designed for photovoltaic applications.
- Liquid electrolyte with semi-sealed* vent.
- Low state of charge indicator.
- Electrolyte freezing temperature at 50% state of charge: -4°F.
- Stainless steel 3/8 inch positive and negative terminals.
- Shelf life - indefinite with recharge at 6 month intervals.
- Maximum service life – 6 years.

*Vent seal will prevent splash spillage, but will leak electrolyte if tipped for an extended period.

Characteristics.

Output voltage (VDC)	12-15
Capacity at 100 hour discharge rate (amp-hours)	115
Dimensions (L W H in inches)	13 x 6-3/4 x 9-3/8
Weight (lb)	60

Additional Data. Individual Delco or Delphi batteries are available from your local warehouse. A minimum order is required for free delivery. Refer to the Ocean Engineering website <http://www.uscg.mil/systems/gse/gse2>, Products/Services, AtoN Equipment List for a list of suppliers.

9.E.

12-VOLT MAINTENANCE-FREE
SECONDARY BATTERY
(GNB SUNLYTE 12-5000)



Function. These 12-volt, 100 amp-hour batteries may be used alone or connected in parallel to provide the proper current capacity as required by solar design program (see COMDTINST M16500.24) for use on fixed and floating aids to navigation.

Features.

- Fully charged prior to shipment.
- Designed for photovoltaic applications.
- Absorbed electrolyte, spill-proof case.
- Will gas only if overcharged.
- Freeze tolerant.
- 3/8" threaded inserts for terminals.
- Rope handle for ease of transport.
- Shelf life - indefinite with recharge at 6 month intervals.
- Maximum service life – 6 years.
- Not recommended for use in hot climates.

Characteristics.

Output voltage (VDC)	12-15
Capacity at 100 hour discharge rate (amp-hours)	100
Dimensions (L W H in inches)	12-3/4 x 6-3/4 x 8-1/2
Weight (lb)	63

Additional Data. Refer to the Ocean Engineering website <http://www.uscg.mil/systems/gse/gse2>, Products/Services, AtoN Equipment List for a list of suppliers.

9.E.

ATON LABELS



Function. The battery installation label is an optional label for use on secondary batteries to indicate the month and year the battery is installed. This provides a quick, visual indication of the age of the battery. The other labels are optional and are used to inform the public of intended use of the solar batteries and the possible fine for damaging AtoN.

Features.

- Vinyl substrate.
- Adhesive backed.
- Easily punched.

Additional. The labels are available from Nutron Nameplate, Inc., 31269 Lorrain Road, North Olsted, OH 44070-0477, Phone 440-777-6660, FAX: 440-770-6664, Internet: www.nutronnameplate.com, or from UNICOR, contact: Mr. Abe Burgess, UNICOR Federal Prison Industries, Inc., 320 First Street, NW, Washington DC 20534, Phone: 202-305-3752, FAX: 202-305-7354, email: aburgos@central.unicor.gov

9.E.

BATTERY TRACKING LABEL



Function. The battery tracking label is a mandatory label for use on minor aid secondary batteries to document them from “cradle to grave”. Battery tracking labels are installed on a battery upon receipt, document where the battery is (physically) and updated as the battery moves from the unit to the aid and finally disposal.

Features.

- Vinyl substrate.
- Adhesive backed.
- Waterproof adhesive
- Sequentially numbered by district.

Additional. The battery tracking labels are available from Nutron Nameplate, Inc., 31269 Lorrain Road, North Olsted, OH 44070-0477, Phone 440-777-6660, FAX: 440-770-6664, Internet: www.nutronnameplate.com, or any local nameplate company using the statement of work available from Commandant (G-SEC-2A).

9E.

SINGLE BATTERY LOAD TESTER



Function. The Single Battery Load Tester is used to test 12 volt solar batteries used in aids to navigation. The tester is especially useful for solar power aids when just one secondary battery is installed as it is smaller, lighter and cheaper than the solar battery load tester (next Data Sheet).

Features.

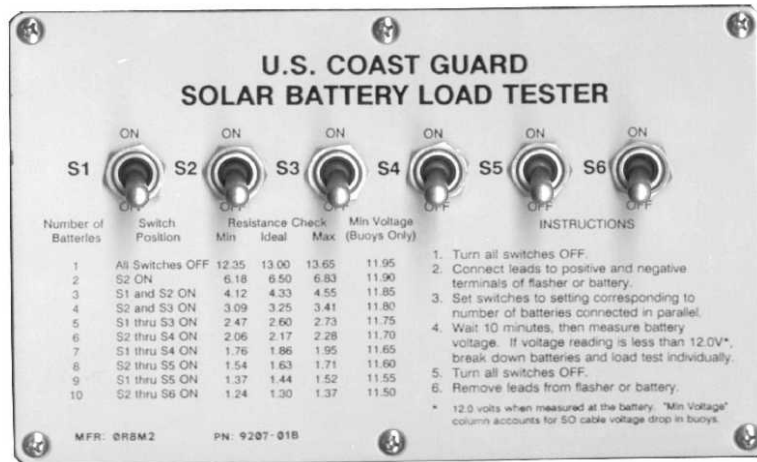
- Two 24 inch wires with alligator clips.
- Operating instructions on unit.

Characteristics.

- Grey enameled case, 3-1/2x 1-1/2 x 1-1/4 (LWH in inches).
- 13 ohm, 5%, 11 watt, molded vitreous enamel type resistors

Additional Data. The Standard Battery Load Tester is available from Delta Integration, Inc., Phone: 717-392-2701.

SOLAR BATTERY LOAD TESTER



Function. The Solar Battery Load Tester is used to test 12-volt secondary batteries used in aids to navigation.

Features.

- Can test up to ten batteries at once.
- Two 36 inch wires with alligator clips.
- Carrying strap.
- Operating instructions on unit.
- Separate values for testing batteries at lantern on buoys.
- Calibration values printed on cover (unit should be checked for accuracy monthly).

Characteristics.

- Grey enameled case, 7-1/2 x 4-1/2 x 4 (LWH in inches).
- Sealed toggle switches.
- Vitreous enamel type resistors.
- NSN CG 6625-01-361-1357

Electrical. The load tester should be checked monthly to determine its accuracy. Using an AtoN voltmeter in the resistance mode (Ω), measure the resistance in each of the switch positions. Replace the load tester if the readings are outside the range printed on the cover.

Additional Data. The preferred method of load testing batteries is to test each battery individually. In the event this is impractical, then use of this tester on the parallel string is acceptable. The Solar Battery Load Tester is available from ELC Baltimore.

9.E.

CAT V LOAD CENTER



Function. The CATV Load Center is used in 12 VDC lighthouses to provide a simple load center to protect circuits provide disconnects for up to pieces of equipment. The center does not have provisions for emergency signals nor emergency power systems; use a Solar Distribution Box (SDB) for aids with this hardware.

Features.

- Fiberglass NEMA 4X (raintight).
- 20 amp circuit breaker protection.
- Input terminal block accepts up to 1/0 AWG wire.
- Main light terminal block accepts up to 1/0 AWG wire
- Three remaining terminal block accepts up to 10 AWG wire.
- Size: (L W D) 14" x 10.5" x 7.5"

Additional Data. CAT V Load Centers are stocked at the ELC warehouse, are Headquarters controlled and available for approved projects. Requests for CAT V Load Centers shall be addressed to Commandant (G-SEC-2). See www.uscg.mil/systems/gse/gse2, look under Products/Services, Aids to Navigation Equipment List for ordering information.

9.E.

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9.E.

LARGE LEAD-ACID BATTERY (Classic OPzS Solar)



Function. These lead acid batteries are connected in series of six 2-volt cells to supply 12-volts DC to power fixed solar powered aids to navigation requiring more than 400 amp-hours. Exide Corporation imports these cells from France, therefore ensure adequate lead-time is planned when scheduling a project. The Classic OPzS are identical in construction to the discontinued Yuasa EI/EJ/FHGS cells and Fulmen Solar.

Features.

- Clear plastic case.
- Shipped filled with liquid electrolyte.
- Dry wet charged batteries are also available.
- Supplied with interconnection straps.
- Sizes from 550 Ah to 4600 Ah.
- Carrying device is needed for heavier cells.
- Fragile cell jars require careful handling and rock steady platforms.
- Freshening charge required on-site.
- Semiannual/annual watering required.
- Most reliable technology.
- Service life 10+ years

9.E.

Characteristics.

TYPE	NOM A.H. CAPACIT Y	Dimension per Cell (6 required)				INTERNAL RESISTANCE mΩ*
		LENGTH In.	WIDTH In.	HEIGHT In.	WEIGHT Lbs.	
OPzS 550	550	5.35	8.19	20.47	58	0.63
OPzS 660	660	6.18	8.19	20.47	68	0.56
OPzS 765	765	7.01	8.19	20.47	78	0.50
OPzS 985	985	6.18	8.19	27.36	97	0.47
OPzS 1080	1080	6.18	8.19	27.36	101	0.43
OpzS 1320	1320	8.86	7.60	27.36	132	0.30
OpzS 1410	1410	8.86	7.60	27.36	139	0.27
OpzS 1650	1650	8.86	9.25	27.36	161	0.26
OpzS 1990	1990	8.86	10.91	27.36	190	0.23
OpzS 2350	2350	8.86	10.91	33.27	238	0.24
OpzS 2500	2500	8.86	10.91	33.27	251	0.22
OpzS 3100	3100	8.86	15.75	32.09	332	0.16
OpzS 3350	3350	8.86	15.75	32.09	348	0.14
OpzS 3850	3850	8.86	19.29	32.09	405	0.12
OpzS 4100	4100	8.86	19.29	32.09	420	0.11
OpzS 4600	4600	8.86	2.83	32.09	477	0.11

*May be used later to determine the health of the battery.

Additional Data. Classic OPzS cells are ordered from your nearest Exide distributor. Refer to the Ocean Engineering website <http://www.uscg.mil/systems/gse/gse2>, Products/Services, AtoN Equipment List for a list of suppliers.

9.E.

LARGE LEAD-ACID BATTERY
(Sonnenschein Dryfit A600)



Function. These lead acid batteries are connected in series of six 2-volt cells to supply 12-volts DC to power fixed solar powered aids to navigation requiring more than 400 amp-hours. The cells contain gelled electrolyte housed in steel cases. This technology is sensitive to overcharge and therefore longevity is not as good as wet type batteries, but considered better than “absorbed” (Absolyte) batteries, however their construction is suitable for “active” platforms, Exide Corporation imports these cells from Germany, therefore ensure adequate lead-time is planned when scheduling a project.

Features.

- Plastic case.
- Shipped filled with liquid electrolyte.
- Supplied with interconnection straps.
- Sizes from 500 Ah to 3500 Ah.
- Carrying device is needed for heavier cells.
- Durable cell containers can be installed on active platforms.
- Freshening charge required on-site.
- Spillproof technology.
- Service life 10+ years.

9.E.

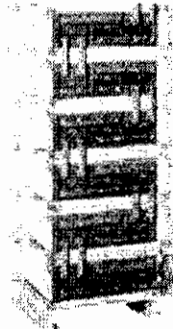
Characteristics.

TYPE	NOM A.H. CAPACITY	Dimension per Cell (6 required)			
		LENGTH* In.	WIDTH In.	HEIGHT In.	WEIGHT Lbs.
6/500	500	5.79	8.19	18.7	80
7/600	600	6.61	8.19	18.7	92
6/720	720	5.79	8.19	25.59	110
8/960	960	8.46	7.6	25.59	150
10/1200	1200	8.46	9.25	25.59	180
12/1400	1400	8.46	10.91	25.59	213
12/1700	1700	8.46	10.91	31.5	264
16/2300	2300	8.46	15.75	30.51	352
20/2900	2900	8.46	19.29	30.51	440
24/3500	3500	8.46	22.83	30.51	528

*Per 12 volt battery

Additional Data. Sonnenschein Dryfit cells are ordered from the Exide Corporation. Refer to the Ocean Engineering website <http://www.uscg.mil/systems/gse/gse2>, Products/Services, AtoN Equipment List for a list of suppliers.

LARGE LEAD-ACID BATTERY (GNB Absolyte IIP)



Function. These lead acid batteries are connected in series of six 2-volt cells to supply 12-volts DC to power fixed solar powered aids to navigation requiring more than 300 amp-hours. The cells contain absorbed electrolyte housed in steel cases. This technology is sensitive to overcharge and therefore longevity is not as good as Yuasa type batteries, however their construction is suitable for “active” platforms. Also, since any orientation of the cells is possible, the battery can be stacked vertically, if floor loading permits. Due to the narrow footprint of the Absolyte IIP series batteries, the cases should be anchored to the floor and walls to prevent tipping.

Features.

- Steel case.
- Shipped filled with liquid electrolyte.
- Supplied with interconnection straps.
- Sizes from 340 Ah to 5700 Ah
- Carrying device is needed for heavier cells.
- Durable cell containers can be installed on active platforms.
- Freshening charge required on-site.
- Spillproof technology.
- Service life 10+ years.

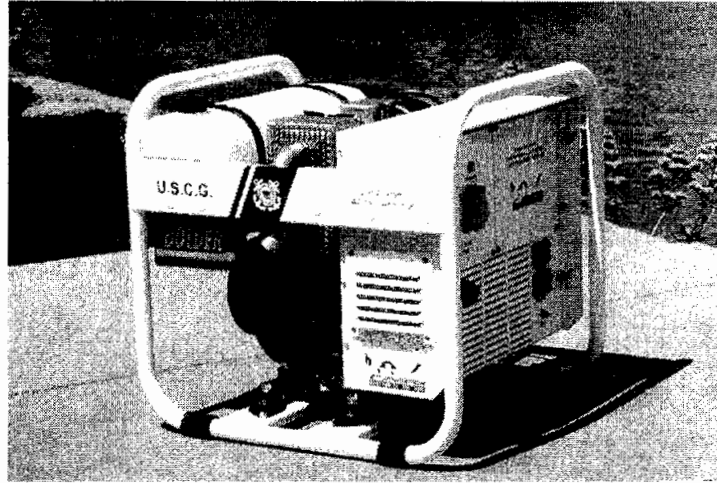
9E.

Characteristics.

TYPE	VOLTS	NOM A.H. CAPACITY	LENGTH in	WIDTH in	HEIGHT in	WEIGHT lbs
6-90A09	12	460	26.19	8.53	23.56	396
6-90A11	12	570	30.69	8.53	23.56	477
6-90A13	12	690	35.19	8.53	23.56	557
6-90A15	12	800	39.69	8.59	23.56	637
3-90A17	6	920	24.50	8.59	23.56	376
3-90A19	6	1000	26.75	8.59	23.56	416
3-90A21	6	1100	29.00	8.59	23.56	456
3-90A23	6	1200	31.25	8.59	23.56	497
3-90A25	6	1300	33.50	8.59	23.56	538
3-100A25	6	1400	33.50	8.59	26.38	608
3-90A27	6	1500	35.75	8.59	23.56	578
3-100A27	6	1600	35.75	8.59	26.38	653
3-100A29	6	1700	38.00	8.59	26.38	704
3-100A31	6	1800	40.25	8.59	26.38	750
3-100A33	6	1900	42.50	8.59	26.38	795
3-100A39	2	2200	19.93	8.53	26.38	328
3-100A45	2	2600	22.18	8.59	26.38	374
3-100A51	2	2900	24.50	8.59	26.38	424
3-100A57	2	3300	26.75	8.59	26.38	470
3-100A63	2	3600	29.00	8.59	26.38	515
3-100A69	2	3900	31.25	8.59	26.38	561
3-100A75	2	4200	33.50	8.59	26.38	608
3-100A81	2	4800	35.75	8.59	26.38	653
3-100A87	2	5100	38.00	8.59	26.38	704
3-100A93	2	5400	40.25	8.59	26.38	750
3-100A99	2	5700	42.50	8.59	26.38	795

Additional Data. GNB Absolyte IIP cells are ordered directly from the manufacturer.
 GNB Industrial Battery Company, 829 Parkview Blvd., Lombard, IL 60148-3249, Phone:
 708-629-5200, Fax: 708-629-2635, Internet: www.gnb.com/industrial/photo.htm.

12-VOLT PORTABLE DIESEL ENGINE-GENERATOR



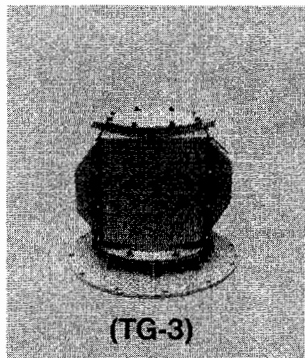
Function. The function of this generator is to provide battery recharging at remote lighthouses and major aids to navigation which have large capacity lead-acid batteries. The generator may also be used to provide a freshening charge to batteries at initial installation.

Features.

- Size: L W H (inches) 24.8 x 18.0 x 21.8
- Weight: 99 lbs
- Fuel – Diesel, 2 gallons, 6 hour run time.
- Recoil start.
- Adjustable voltage up to 15 VDC.
- Current: up to 100 amps continuous.
- 25-ft quick disconnect 1/0 AWG cables provided.
- Two 120 VAC, 20A convenience outlets (Can't be used when charging).

Additional Data. Portable engine-generators are stocked at the Engineering Logistics Command Baltimore under APA Commodity M stock and are Headquarters controlled. Requests for generators shall be addressed to Commandant (G-SEC-2A).

WAVE TURBINE GENERATOR (WTG)

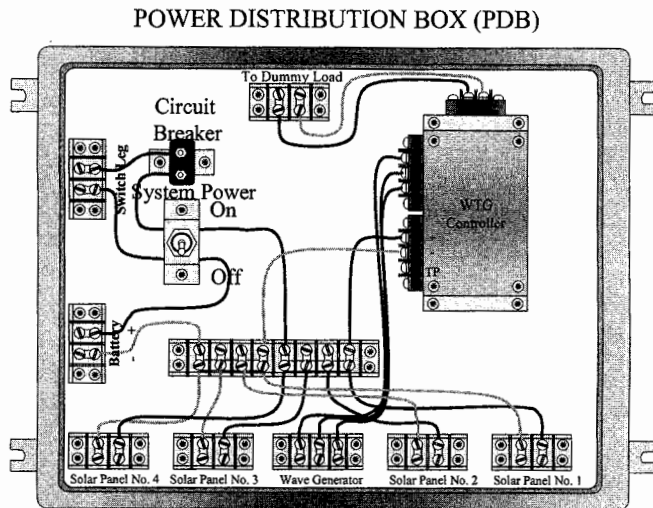


Function. The WTG is used to generate 12-volt DC power on exposed location buoys whose signal suite can not be powered by solar alone. The WTG consists of an air driven turbine and an AC alternator. Air compressed above the water column in the tailtube of 8x26 and 9x35 buoys drive the turbine. Two versions of the turbine are currently used: the TG-3 is the older type that uses check valves to route the air in the correct direction through the turbine. The TGW-3 features a bi-directional turbine that does not require these valves.

Features.

	<u>TG-3</u>	<u>TGW-3</u>
• Size: Height/Diameter (inches):	32 x 29	16 x 13
• Weight (lbs., w/o CG flange):	132	17
• Power Output: 12 volts, 100 watts, 3 phase AC		
• Flange provided for mounting on 8x26 or 9x35 buoys		
• External rectification & regulation required (accomplished in Power Distribution Box; next Data Sheet)		

Additional Data. The suggested overhaul interval is 2 years. Units are expected to overhaul the rotational spare WTG at a local motor/armature shop until not longer serviceable. Spare parts are available from Nichimen America (312-425-4600). Lead-time for parts is long, as they must be shipped from Japan. Complete WTGs are stocked at the Engineering Logistics Command Baltimore under APA Commodity M stock and are Headquarters controlled. Requests for WTGs shall be addressed to Commandant (G-SEC-2A).



Function. The PDB is on 8x26 and 9x35 buoys when a Wave Turbine Generator (WTG) is installed. The PDB provides rectification of the WTGs output from AC to DC, provides overspeed protection of the turbine and regulates output to prevent overcharging the batteries. The PDB has inputs for up to 4 solar panels and the WTG. All loads are terminated at the battery rack, however a switch leg is provided in the PDB allowing the loads to be turned off without opening the battery pocket.

Features.

- Stainless steel NEMA 4X (raintight) enclosure
- Size: L W D (inches): 12 x 16 x 6
- Weight (lbs): 60
- Access port on box allowing voltage checks on-station (remote meter req'd)
- Flange provided for mounting on 8x26 or 9x35 buoys.
- Stuffing tubes for WTG, solar panel, battery and switch leg are installed.

Additional Data. PDBs have a service life of 6 years (coinciding with buoy hull relief). Used PDBs may be refurbished at a fraction of the cost of new boxes. Contact Commandant (G-SEC-2A) when used boxes are available and deemed rebuildable. PDBs are stocked at the Engineering Logistics Command Baltimore under APA Commodity M stock and are Headquarters controlled. Requests for PDBs shall be addressed to Commandant (G-SEC-2A).