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## **ABYC A-24**

# **CARBON MONOXIDE DETECTION SYSTEMS**

For Reference Only

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This standard was developed under procedures accredited as meeting the criteria for American National Standards. The Project Technical Committee that approved the standard was balanced to ensure that individuals from competent and concerned interests have had an opportunity to participate.

This standard, which is the result of extended and careful consideration of available knowledge and experience on the subject, is intended to provide minimum performance requirements.

ABYC's Project Technical Committee meetings are open to the public. All inquiries regarding standards activity, interpretations, or meeting attendance should be directed to the ABYC Technical Department at [comments@abycinc.org](mailto:comments@abycinc.org).

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### **REQUEST FOR INTERPRETATIONS**

Upon written request the Gas Detectors PTC will render an interpretation of any requirement of the standard. The request for interpretation should be clear and unambiguous. Requests should be presented to the PTC in a manner in which they may be answered in a yes or no fashion.

The committee reserves the right to reconsider any interpretation when or if additional information which might affect it becomes available to the PTC. Persons aggrieved by an interpretation may appeal to the Committee for reinterpretation.

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## A-24 CARBON MONOXIDE DETECTION SYSTEMS

Based on ABYC's assessment of the existing technology, and the problems associated with achieving the goals of this standard, ABYC recommends compliance with this standard for all boats, associated equipment, and systems manufactured after July 31, 2016.

### 24.1 PURPOSE

These standards are guides for the design, construction, and installation of carbon monoxide detection systems on boats.

### 24.2 SCOPE

These standards apply to carbon monoxide detection systems on boats.

### 24.3 REFERENCES

The following references form a part of this standard. Unless otherwise noted the latest version of referenced standards shall apply.

24.3.1 ABYC – American Boat & Yacht Council, Inc., 613 Third St., Suite 10, Annapolis, MD 21403. Phone: (410) 990-4460. Fax: (410) 990-4466. Web site: [www.abycinc.org](http://www.abycinc.org).

[ABYC E-11, AC & DC Electrical Systems on Boats](#)

[ABYC TH-22, Educational Information about Carbon Monoxide](#)

[ABYC TH-23, Design, Construction, and Testing of Boats in Consideration of Carbon Monoxide](#)

[ABYC T-24, Owner/Operator's Manual](#)

24.3.2 UL – Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096. Obtain standards from Global Engineering Documents, Inc., 15 Inverness Way East, Englewood, CO 80112. Phone: (800) 854-7179 (US and Canada), (303) 397-7956 (outside US and Canada), Fax: (303) 397-2740. Website: [www.ul.com](http://www.ul.com).

UL 2034, *Single and Multiple Station Carbon Monoxide Alarms*

### 24.4 DEFINITIONS

For the purpose of this standard, the following definitions apply.

24.4.1 "β" (Beta) – An arbitrary variable name chosen to represent the mathematical calculation of the absolute worst case predicted %COHb levels in a typical individual exposed to the factors (parts per million of carbon monoxide level and minutes of exposure to that CO level) used in that calculation. For the purposes of this standard, "β" is calculated from the following expression:

$$"β" = [218 (0.0003 + P/1316)] [1 - e^{-T/96.8792}]$$

where  $P$  = CO concentration in PPM,

$e$  = base natural logarithm (approx. = 2.71828)

$T$  = time of exposure in minutes

NOTE: For reference purposes, the "β" (Beta) equation solved for  $T$  or  $P$  is as follows:

$$P = \frac{6.0367 \beta}{1 - e^{-T/96.8792}} - 0.3948$$

$$T = -96.8792 \ln[1 - \beta / (0.0654 + 0.166P)]$$

24.4.2 CO – An abbreviation for carbon monoxide. For the purposes of this standard, the CO level is always expressed in terms of parts per million (PPM) total volume of CO in air.

24.4.3 Carboxyhemoglobin – Abbreviated as COHb; also called Carbonmonoxyhemoglobin, CO-Hemoglobin, blood-COHb, and blood-CO – a stable combination of carbon monoxide and hemoglobin formed in the blood when carbon monoxide is inhaled.

24.4.4 %COHb – The degree to which the oxygen carrying capacity of blood is impeded by the union of carbon monoxide to the hemoglobin in the blood expressed as a percentage.

24.4.5 Enclosed accommodation compartment – One contiguous space, surrounded by permanent structure that contains all the following:

- a. designated sleeping accommodations,
- b. a galley area with sink, and
- c. a head compartment.

*NOTE: A cuddy intended for gear storage and open passenger cockpits, with or without canvas enclosures, are not considered to be enclosed accommodation compartments.*

#### 24.5 **DESIGN AND CONSTRUCTION**

24.5.1 Detectors shall be certified by an independent third party to meet the requirements of UL 2034, *Single and Multiple Station Carbon Monoxide Detectors* including the applicable sections pertaining for use on recreational boats.

24.5.1.1 Design operating temperature range = -22°F to +158°F (-30°C to +70°C).

24.5.2 An audible alarm shall be provided.

24.5.2.1 If detectors include a switch to mute only the audible alarm, then warnings or other means shall be provided to protect such a switch from casual use, and

24.5.2.1.1 the switch shall not reset the detector, and

24.5.2.1.2 the switch shall not mute the alarm for more than six minutes.

24.5.3 There shall be no power switch on the detector.

24.5.4 A non-mechanical indicator, e.g., some type of visual electrical indicator (lamp, LED, LCD, etc.), shall be provided on the detector to indicate that it is in operation.

24.5.5 A circuit self-check shall be provided that will also give an alarm for an electrically defective sensor.

24.5.5.1 A testing procedure or test switch shall be provided for checking the alarm circuitry.

24.5.6 Detectors shall be designed and marked as drip proof or watertight as per UL 2034, *Single and Multiple Station Carbon Monoxide Detectors* including the applicable sections pertaining to use on recreational boats.

24.5.7 Detectors shall be powered by the boat's DC electrical system, or

24.5.7.1 by a self-contained battery.

#### 24.6 **PERFORMANCE SPECIFICATIONS**

24.6.1 The device shall be tested to UL 2034, *Single and Multiple Station Carbon Monoxide Detectors* including the applicable sections pertaining to use on recreational boats.

24.6.2 "β" (Beta) = 10% maximum (see [24.4.1](#))

24.6.3 An alarm condition must occur at some point within the shaded area of the curve shown in [FIGURE 1](#).

## 24.7 **INSTALLATION**

24.7.1 A carbon monoxide detection system shall be installed on all boats with an enclosed accommodation compartment(s).

24.7.2 Detectors shall be located to monitor the atmosphere in the main cabin and each sleeping area.

24.7.3 The detector shall be mounted and located to avoid areas subject to:

24.7.3.1 physical damage, including harm from rain, water, or sunlight, and

24.7.3.2 dilution of sampled air (e.g., near hatches, ports, or forced ventilation openings), and

24.7.3.3 inadequate natural air circulation, e.g. in corners.

24.7.4 The detector system shall be installed in accordance with [ABYC E-11, AC and DC Electrical Systems on Boats](#).

*EXCEPTION: Detectors powered by a self-contained battery.*

24.7.5 If a circuit breaker is installed, it shall include a block or other multi-step means to prevent it from being inadvertently turned off.

*NOTE: The power source for the detector is permitted to be the energized side of the battery switch (see [ABYC E-11, AC and DC Electrical Systems on Boats](#)).*

24.7.6 Boat manufacturer shall provide instructions in the operator's manual as to what action should be taken in the event the CO alarm sounds. See [ABYC TH-23, Design, Construction, and Testing of Boats in Consideration of Carbon Monoxide](#) and [ABYC T-24, Owner/Operator's Manual](#).

## 24.8 **INSTRUCTIONS**

24.8.1 Instructions covering the installation and operation shall be provided with each detector.

24.8.2 The following information shall be included in the instructions:

24.8.2.1 Mounting location requirements consistent with the requirements in [A-24.7](#);

24.8.2.2 Actions to be taken when the alarm system sounds, wherein the order of action is evacuate, ventilate, investigate, and take corrective action;

24.8.2.3 The manufacturer's service policy;

24.8.2.4 The manufacturer's recommendation for overcurrent protection shall specify the current rating and type of overload protection device in the branch circuit;

24.8.2.4.1 If a fuse is to be used, its current rating shall be permanently marked where it will be visible if the fuse is replaced.

24.8.2.5 The manufacturer's recommendation for operational testing and frequency for such test in accordance with [A-24.5.5](#);

24.8.2.6 General educational material about carbon monoxide as found in [ABYC TH-22, Educational Information About Carbon Monoxide](#);

24.8.2.7 The detector's performance specifications in accordance with this standard; and

24.8.2.8 Information on the detector's ability to sense only the air in the vicinity of the detector's sensing element.

24.9 **MARKINGS**

24.9.1 Detectors shall be marked with the following:

24.9.1.1 Name of certifying body,

24.9.1.2 “Marine Carbon Monoxide Alarm” or equivalent as tested to A-24,

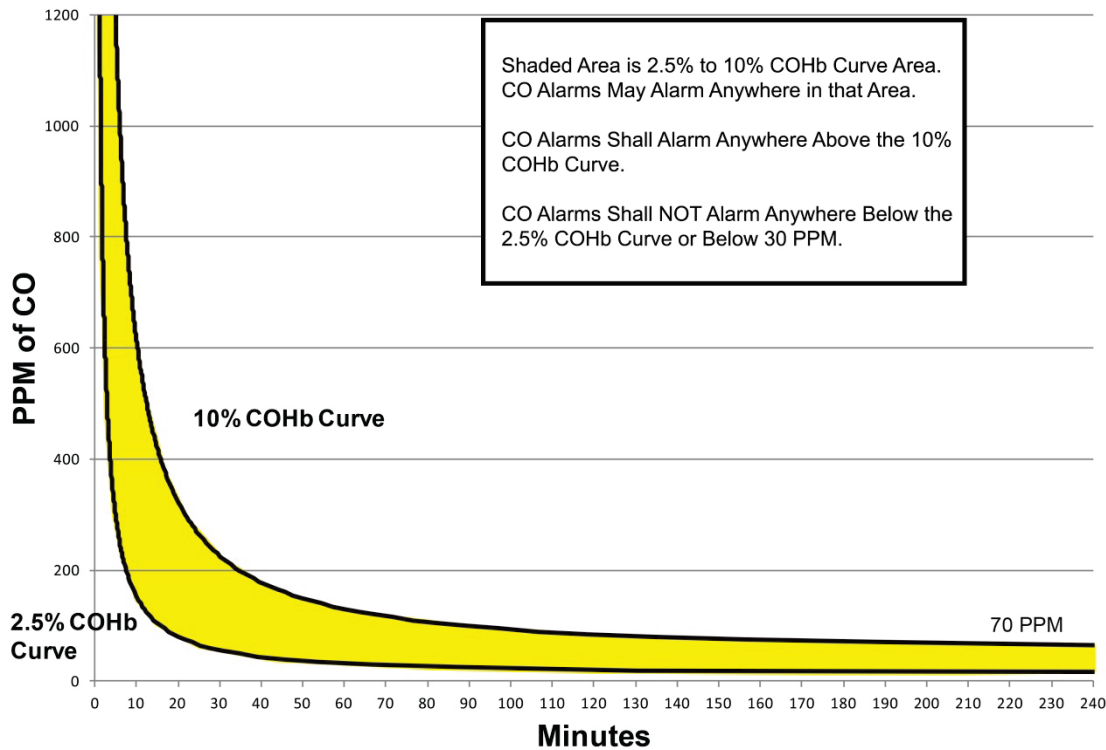
24.9.1.3 Replace by date – MM/YYYY or

24.9.1.3.1 Replace by: XX months after retail sale as determined by the manufacturer.

24.9.2 The markings shall be clearly visible as installed.

*NOTE: These markings are in addition to markings required under UL 2034, Single and Multiple Station Carbon Monoxide Detectors including the applicable sections pertaining to use on recreational boats.*

**FIGURE 1 – BETA Curve for 2.5% to 10% COHb Level – PPM CO vs. Minutes**



**NOTES:**

1. This figure is for illustrative purposes only.
2. The formula under the A-24 definition of “ $\beta$ ” (Beta) shall be used to determine “ $\beta$ ” (Beta).

24.10 **OWNERS/OPERATOR’S MANUALS**

24.10.1 Sections of this document require inclusion in an Owner/Operator’s Manual. See sections: [24.7.6](#) and [24.8](#).

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*Origin and Development of ABYC A-24, Carbon Monoxide Detection Systems*

ABYC first published A-24 in 1992. Subsequent revisions were published in 1997, 2002 and 2007. The 2015 update is the work of the Gas Detectors Project Technical Committee.

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