



Guideline for USCG Approval of SOLAS Pyrotechnic Signals and Line-Throwing Appliances

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This guideline has been assembled from several relevant sources, in order to present a complete document which fully describes the approval requirements for these products. The source is generally identified at the section heading. In some places referenced material from another place has been inserted for completeness.

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General

- 1 **Scope.**

These guidelines describe the process for U.S. Coast Guard approval of pyrotechnic distress signals meeting the requirements of the International Maritime Organization's (IMO) Lifesaving Appliances Code (LSA Code). These devices are generally known as "SOLAS" pyrotechnic devices because the International Convention for the Safety of Life at Sea (SOLAS) requires commercial ships on international voyages to carry signals which meet the IMO LSA Code.

Transportation of hazardous materials in the United States is governed by the Department of Transportation's Hazardous Materials Regulations at Title 49 of the Code of Federal Regulations, Subchapter C (Parts 171 to 180). The regulations are based in part on the Recommendations of the United Nations Committee of Experts on the Transport of Dangerous Goods. Nothing in these guidelines pre-empts the manufacturer from any additional requirements or tests necessary to offer pyrotechnic devices for transportation in the United States.

3 Incorporations by reference.

(a) "The Universal Color Language" and "The Color Names Dictionary" in Color: Universal Language and Dictionary of Names, National Bureau of Standards Special Publication 440, December 1976.

(b) NBS Special Publication 440 may be obtained by ordering from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 (Order by SD Catalog No. C13.10:440).

5 Marking. *(46 CFR 160.021-5, 160.022-5, 160.036-5, 160.040-5, and 160.057-5)*

Each [pyrotechnic device] shall be legibly marked or labeled with the following, as appropriate:

- Company name, location, and brand or style designation
- Type of pyrotechnic device
- Intensity in candela (for flares only)
- Burning time (for flares and smoke signals only)
- "Use Only When Aircraft or Vessel Is Sighted." (for flares and 3-min smoke signals only)
- "Approved for daytime use only" (for smoke signals only)
- Simple operation instructions (in paragraphs or pictographs)
- Expiration Date (month and year to be inserted by manufacturer – not more than 42 months after date of manufacture (48 months in the case of line-throwing appliance components containing pyrotechnic material))
- Date of Manufacture (Month and year to be inserted by manufacturer)
- Lot No. ----
- U.S. Coast Guard Approval No. ----.
- Meets SOLAS-LSA Code

The expiration date, date of manufacture, and lot number must also be marked on or clearly visible through the package in which the device is sold.

Note: Compliance with the labeling requirements of this section does not relieve the manufacturer of the responsibility of complying with the label requirements of 15 U.S.C. 1263, the Federal Hazardous Substances Act.

7 Approval process. **USCG Approval**

Pyrotechnics approved by the U.S Coast Guard are done so under the process described in Title 46 Code of Federal Regulations, Subpart 159.005. The complete approval package should be submitted to

Commandant at the above address and should include all plans, specifications, samples and test reports required by these regulations.

All approval and production testing must be completed by an independent laboratory accepted by the USCG under Subpart 159.010. Production testing of approved pyrotechnics is required under Subpart 159.007. A list of accepted laboratories for each product can be found at our website: <http://www.uscg.mil/hq/g-m/mse4/mse4home.htm>.

Approval through the MRA

All five products covered by this guideline also are included in the Mutual Recognition Agreement for Marine Products that the US and the European Community (EC) agreed to on February 27th, 2004. These products may be tested and reviewed according to the standards used by the EC's Notified Bodies and are then given USCG Approval Numbers by the Notified Body without any additional review by the USCG. Manufacturers may also come to the USCG for approval and receive EC approval without any additional testing by an EC Notified Body thus reducing the redundant testing costs for manufacturers.

Rocket Parachute Flares

10 SOLAS requirements for rocket parachute flares. *(Section 3.1 of the LSA Code)*

3.1.1 The rocket parachute flare shall:

- .1 be contained in a water-resistant casing;
- .2 have brief instructions or diagrams clearly illustrating the use of the rocket parachute flare printed on its casing;
- .3 have integral means of ignition; and
- .4 be so designed as not to cause discomfort to the person holding the casing when used in accordance with the manufacturer's operating instructions.

3.1.2 The rocket shall, when fired vertically, reach an altitude of not less than 300 m. At or near the top of its trajectory, the rocket shall eject a parachute flare, which shall:

- .1 burn with a bright red colour;
- .2 burn uniformly with an average luminous intensity of not less than 30,000 cd;
- .3 have a burning period of not less than 40 s;
- .4 have a rate of descent of not more than 5 m/s; and
- .5 not damage its parachute or attachments while burning.

13 SOLAS approval/production testing of rocket parachute flares.

The required approval testing, to be completed by an accepted independent laboratory, is listed in the Revised Recommendation on Testing of Life-Saving Appliances in the LSA Code under Part 1 Section 4.1, 4.2, 4.3, 4.4, 4.5, and 4.6.

The production testing requirement for all pyrotechnics is described in Part 2 Section 4 of the Revised Recommendation of Testing. These requirements are general in nature and state that a statistically adequate sample of pyrotechnics should be chosen and submitted to the approval tests of Part 1 Section 4 listed above. For guidance on what the USCG considers adequate, the production testing requirements for domestic pyrotechnics found in Title 46 of the Code of Federal Regulations should be used as an example for determining what size sample should be testing based on the lot sizes and how many defects of each type are permitted before the lot is rejected. Section 17, below, is an excerpt from the USCG regulations describing this production testing for domestic pyrotechnics.

17 Coast Guard requirements for production testing of rocket parachute flares.

(Title 46 C FR. 160.036-4(b) & (c)).

(b) Production inspections and tests. Production inspections and tests of each lot (batch) of signals produced must be conducted under the procedures in 46 CFR 159.007. Signals from a rejected lot must

not be represented as meeting Coast Guard requirements or as being approved by the Coast Guard. If the manufacturer identifies the cause of the rejection of a lot of signals, the signals in the lot may be reworked by the manufacturer to correct the problem. Samples from the rejected lot must be retested in order to be accepted. Records shall be kept of the reasons for rejection, the reworking performed on the rejected lot, and the results of the second test.

(1) Lot size. For the purposes of sampling the production of signals, a lot must consist of not more than 30,000 signals. Lots must be numbered serially by the manufacturer. A new lot must be started with:

- (i) Any change in construction details,
- (ii) Any changes in sources of raw materials, or
- (iii) The start of production on a new production line or a previously discontinued production line.
(Weekend, holiday, and overnight production stoppages are not considered as discontinued production.)

(2) Inspections and tests by the manufacturer. The manufacturer's quality control procedures must include inspection of materials entering into construction of the signals and inspection of the finished signals, to determine that signals are being produced in accordance with the approved plans. Samples from each lot must be tested in accordance with the operational tests in paragraph (c) of this section.

(3) Inspections and test by an independent laboratory. An independent laboratory accepted by the Commandant under 46 CFR 159.010 must perform or supervise the inspections and tests under paragraph (b)(2) of this section *[whenever the tests under section 13 above are conducted.]* If a lot of signals tested by the independent laboratory is rejected, the laboratory must perform or supervise the inspections and tests of the reworked lot and the next lot of signals produced. The tests of each reworked lot and the next lot produced must not be counted for the purpose of meeting the requirement for the annual number of inspections and tests performed or supervised by the independent laboratory.

(c) Operational tests. Each lot of signals must be sampled and tested as follows:

(1) Sampling procedure and accept/reject criteria. A sample of signals must be selected at random from the lot. The size of the sample must be the individual sample size in Table 17(1) corresponding to the lot size. Each signal in the sample is tested as prescribed in the test procedure in paragraph (c)(2) of this section *[Part 1 Section 4 of the Recommendation of Testing]*. Each signal that has a defect listed in the table of defects (Table 17(2)) is assigned a score (failure percent) in accordance with that table. In the case of multiple defects, only the score having the highest numerical value is assigned to that signal. If the sum of all the failure percents (cumulative failure percent) for the number of units in the sample is less than or equal to the accept criterion, the lot is accepted. If this sum is equal to or more than the reject criterion the lot is rejected. If the cumulative failure percent falls between the accept and reject criteria, another sample is selected from the production lot and the operational tests are repeated. The cumulative failure percent of each sample tested is added to that of the previous samples to obtain the cumulative failure percent for all the signals tested (cumulative sample size). Additional samples are tested and the tests repeated until either the accept or reject criterion for the cumulative sample size is met. If any signal in the sample explodes when fired or ignites in a way that could burn or otherwise injure the person firing it, the lot is rejected without further testing. (This procedure is diagrammed in figure 17).

Figure 17 – Operational test procedure

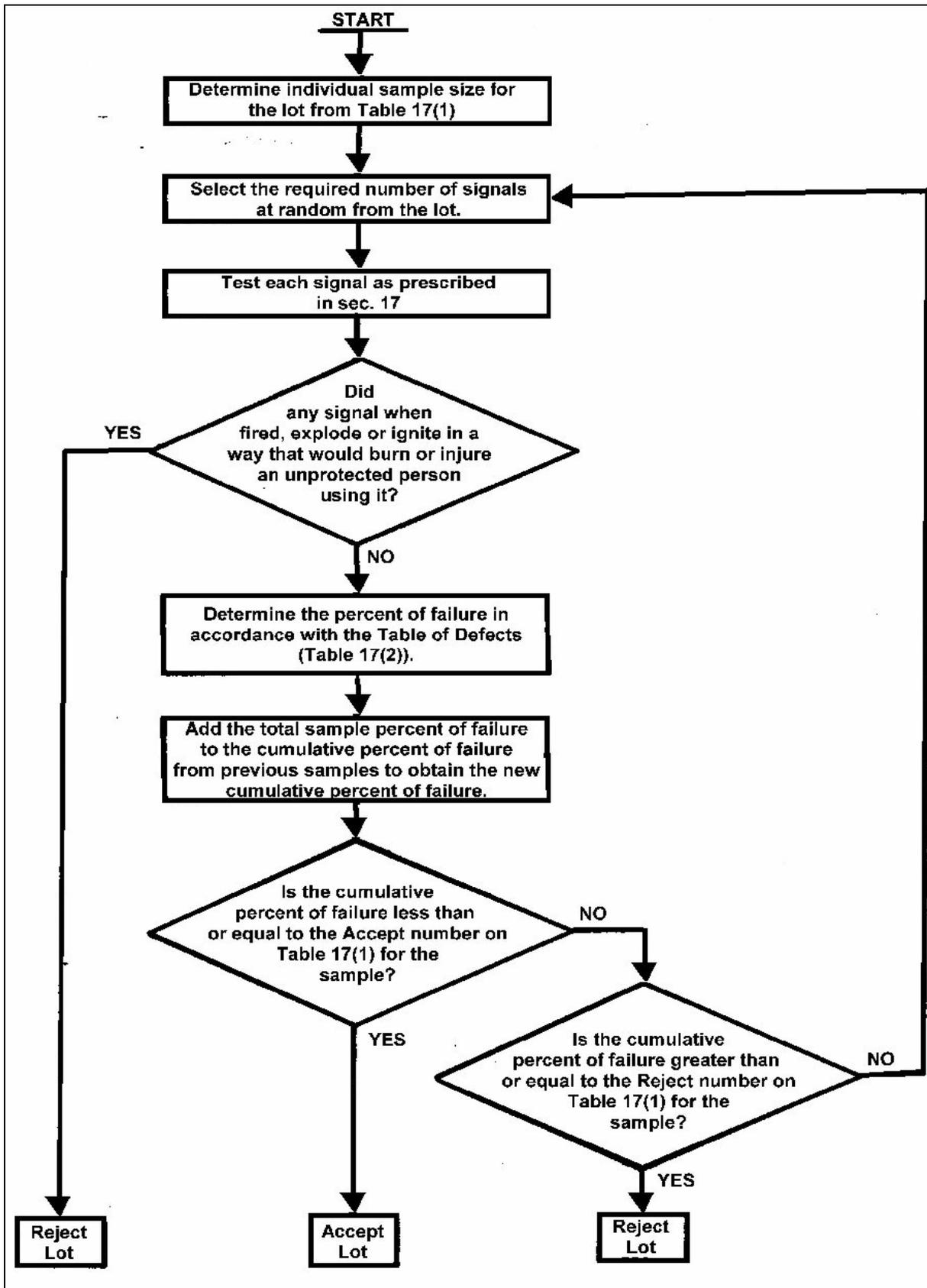


Table 17(1)--Accept and Reject Criteria for Operational Test Lots

Lot Size	Individual sample size	Sample	Cumulative sample size	Accept ¹	Reject ¹
280 or less	8	First	8	-- ²	400
		Second	16	100	500
		Third	24	200	600
		Fourth	32	300	700
		Fifth	40	500	800
		Sixth	48	700	900
		Seventh	56	950	951
281 to 500	13	First	13	0	400
		Second	26	100	600
		Third	39	300	800
		Fourth	52	500	1,000
		Fifth	65	700	1,100
		Sixth	78	1,000	1,200
		Seventh	91	1,350	1,351
501 to 1200	20	First	20	0	500
		Second	40	300	800
		Third	60	600	1,000
		Fourth	80	800	1,300
		Fifth	100	1,100	1,500
		Sixth	120	1,400	1,700
		Seventh	140	1,850	1,851
1,201 to 3,200	32	First	32	100	700
		Second	64	400	1,000
		Third	96	800	1,300
		Fourth	128	1,200	1,700
		Fifth	160	1,700	2,000
		Sixth	192	2,100	2,300
		Seventh	224	2,550	2,551
More than 3,201	50	First	50	200	900
		Second	100	700	1,400
		Third	150	1,300	1,900
		Fourth	200	1,900	2,500
		Fifth	250	2,500	2,900
		Sixth	300	3,100	3,300
		Seventh	350	3,750	3,751

¹ Cumulative failure percent

² Lot may not be accepted. Next sample must be tested.

Table 17(2) – Table of defects

Kind of defect	Percentage of failure
a. Failure to fire	100
b. Failure to eject projectile contents	100
c. Failure to ignite pyrotechnic candle	100
d. Failure of parachute to open completely	75
e. Complete carrying away or destruction of parachute	75
f. Altitude less than 70 % of that required	100
g. Altitude less than 70 % but less than 80 % of that required	75
h. Altitude at least 80 % but less than 90 % of that required	50
i. Altitude at least 90 % but less than 100 % of that required	25
j. Average rate of descent greater than four times maximum permitted	100
k. Average rate of descent less than 4 but greater than 3 times maximum permitted	75
l. Average rate of descent less than 3 but greater than 2 times maximum permitted	50
m. Average rate of descent less than twice but greater than maximum permitted	25
n. Burning time less than 70 % of that required	100
o. Burning time at least 70 % but less than 80 % of that required	75
p. Burning time at least 80 % but less than 90 % of that required	50
q. Burning time at least 90 % but less than 100 % of that required	25

Hand Flares - Red

20 SOLAS requirements for hand flares. (Section 3.2 of the IMO LSA Code)

- 3.2.1 The hand flare shall:
- .1 be contained in a water-resistant casing;
 - .2 have brief instructions or diagrams clearly illustrating the use of the hand flare printed on its casing;
 - .3 have a self-contained means of ignition;
 - .4 be so designed as not to cause discomfort to the person holding the casing and not endanger the survival craft by burning or glowing residues when used in accordance with the manufacturer's operating instructions.
- 3.2.2 The hand flare shall:
- .1 burn with a bright red colour;
 - .2 burn uniformly with an average luminous intensity of not less than 15,000 cd;
 - .3 have a burning period of not less than 1 min; and
 - .4 continue to burn after having been immersed for a period of 10s under 100 mm of water.

23 SOLAS approval/production testing of hand flares.

The required approval testing, to be completed by an accepted independent laboratory, is listed in the Revised Recommendation on Testing of Life-Saving Appliances in the LSA Code under Part 1 Section 4.1, 4.2, 4.3, 4.4, 4.5, and 4.7.

The production testing requirement for all pyrotechnics is described in Part 2 Section 4 of the Revised Recommendation on Testing. See Section 13 and 17 above for specific guidance on USCG production testing. Table 27 below lists the defects specific to hand flares and replaces Table 17(2) for this testing.

Table 27 – Table of defects

Kind of defect	Percentage of failure
a Failure to ignite	100
b Ignites or burns dangerously	50
c Nonuniform burning intensity	50
d Chimneys so as to materially obscure the flame	25
e Fire flashes down between casing and handle so as to endanger burning the hand	50
f Burning time less than 70 pct of specified time	100
g Burning time at least 70 pct but less than 80 pct of specified time	75
h Burning time at least 80 pct but less than 90 pct of specified time	50
i Burning time at least 90 pct but less than 100 pct of specified time	25

Buoyant Smoke Signals – 3 Minute

30 SOLAS requirements for buoyant (3-min) smoke signals.

(Section 3.3 of the IMO LSA Code)

- 3.3.1 The buoyant smoke signal shall:
- .1 be contained in a water-resistant casing;
 - .2 not ignite explosively when used in accordance with the manufacturer's operating instructions; and
 - .3 have brief instructions or diagrams clearly illustrating the use of the buoyant smoke signal printed on its casing.
- 3.3.2 The buoyant smoke signal shall:
- .1 emit smoke of a highly visible colour at a uniform rate for a period of not less than 3 min when floating in calm water;
 - .2 not emit any flame during the entire smoke emission time;
 - .3 not be swamped in a seaway; and
 - .4 continue to emit smoke when submerged in water for a period of 10 s under 100 mm of water.

33 SOLAS approval/production testing of buoyant smoke signals.

The required approval testing, to be completed by an accepted independent laboratory, is listed in the Revised Recommendation on Testing of Life-Saving Appliances in the LSA Code under Part 1 Section 4.1, 4.2, 4.3, 4.4, 4.5, and 4.8.

The production testing requirement for all pyrotechnics is described in Part 2 Section 4 of the Revised Recommendation on Testing. See Section 13 and 17 above for specific guidance on USCG production testing. Table 37 below lists the defects specific to buoyant smoke signals and replaces Table 17(2) for this testing.

Table 37 – Table of defects

Kind of defect	Percentage of failure
a. Failure to ignite.	100
b. Ignites or burns dangerously	50
c. Nonuniform smoke emitting rate	50
d. Smoke-emitting time less than 70 pct of specified time	100
e. Smoke-emitting time at least 70 pct but less than 80 pct of specified time	75
f. Smoke-emitting time at least 80 pct but less than 90 pct of specified time	50
g. Smoke-emitting time at least 90 pct but less than 100 pct of specified time	25

Self-Activating Smoke Signals – 15 Minute

40 SOLAS requirements for self-activating smoke signals.

(Section 2.1.3 of the LSA Code)

2.1.3 Lifebuoy self-activating smoke signals

Self-activating smoke signals required by regulation III/7.1.3 shall:

- .1 emit smoke of a highly visible colour at a uniform rate for a period of at least 15 min when floating in calm water;
- .2 not ignite explosively or emit any flame during the entire smoke emission time of the signal;
- .3 not be swamped in a seaway;
- .4 continue to emit smoke when fully submerged in water for a period of at least 10 s;
- .5 be capable of withstanding the drop test required by paragraph 2.1.1.6.

Note: 2.1.1.6 [Every self-activating smoke signal shall] be constructed to withstand a drop into the water from the height at which it is stowed above the waterline in the lightest seagoing condition or 30 m, whichever is the greater, without impairing either its operating capability or that of its attached components;

43 SOLAS approval/production testing of self-activating smoke signals.

The required approval testing, to be completed by an accepted independent laboratory, is listed in the Revised Recommendation on Testing of Life-Saving Appliances in the LSA Code under Part 1 Section 1.9.

The production testing requirement for all pyrotechnics is described in Part 2 Section 4 of the Revised Recommendation on Testing. See Section 13 and 17 above for specific guidance on USCG production testing. Tables 47(1) and 47(2) below list the requirements specific to self-activating smoke signals and replaces Tables 17(1) and 17(2) for this testing.

Table 47(1)--Accept and Reject Criteria for Operational Test Lots

Lot Size	Individual sample size	Sample	Cumulative sample size	Accept ¹	Reject ¹
150 or less	2	First	2	-- ²	200
		Second	4	-- ²	200
		Third	6	0	200
		Fourth	8	0	300
		Fifth	10	100	300
		Sixth	12	100	300
		Seventh	14	299	300
151 to 500	3	First	3	-- ²	200
		Second	6	0	300
		Third	9	0	300
		Fourth	12	100	400
		Fifth	15	200	400
		Sixth	18	300	500
		Seventh	21	499	500
More than 501	5	First	5	-- ²	300
		Second	10	0	300
		Third	15	100	400
		Fourth	20	200	500
		Fifth	25	300	600
		Sixth	30	400	600
		Seventh	35	699	700

Table 47(2) – Table of defects

Kind of defect	Percentage of failure
a. Failure to ignite.	100
b. Ignites or burns dangerously	100
c. Nonuniform smoke emitting rate	50
d. Smoke-emitting time less than 70 pct of specified time	100
e. Smoke-emitting time at least 70 pct but less than 80 pct of specified time	75
f. Smoke-emitting time at least 80 pct but less than 90 pct of specified time	50
g. Smoke-emitting time at least 90 pct but less than 100 pct of specified time	25

¹ Cumulative failure percent

² Lot may not be accepted. Next sample must be tested.

Line-Throwing Appliances

50 SOLAS requirements for line-throwing appliances. *(Section 7.1 of the LSA Code)*

7.1.1 Every line-throwing appliance shall:

- .1 be capable of throwing a line with reasonable accuracy;
- .2 include not less than four projectiles each capable of carrying the line at least 230 m in calm weather;
- .3 include not less than four lines each having a breaking strength of not less than 2 kN;
- .4 have brief instructions or diagrams clearly illustrating the use of the line-throwing appliance.

7.1.2 The rocket, in the case of a pistol fired rocket, or the assembly, in the case of an integral rocket and line, shall be contained in a water-resistant casing. In addition, in the case of a pistol fired rocket, the line and rockets together with the means of ignition shall be stowed in a container which provides protection from the weather.

51 Additional Coast Guard requirements for line-throwing appliances.

For SOLAS approval of rocket type line throwing appliances the USCG has several additional requirements beyond what is required by the LSA Code in Section 7.1. They are described in Title 46 CFR. 160.040-4 &5 and are excerpted here.

(Title 46 CFR. 160.040-4)

(c) The length of each service line will be assigned in the approval of the appliance as a round number approximately one-third in excess of the average distance the line is carried in the tests required by [Section 53 below]. The end of the line intended to be attached to the projectile shall have securely attached thereto a substantial tag bearing a permanent legend indicating its purpose, and the other end of the line shall be tagged in the same manner to prevent delay in securing proper and immediate action with the equipment. Each line shall be coiled, faked, or reeled in its own faking box or reel in such manner that when all the line leaves the container, it shall automatically become unattached and free from the container. The reel type container shall consist of a reel upon which the line may be readily coiled and a canister or container into which the line may be placed that affords a fair lead through which the line may pay out. Containers of new lines shall bear the name of the manufacturer, date of manufacture, and a statement to the effect that in all respects the line meets the requirements.

(e) – (g) [Line-throwing appliances intended to be cleaned by the user between uses must be provided with appropriate materials, such as brushes, cleaning and preservative oil, wiping patches, etc.]

(h) Maintenance instructions must be provided with the appliance.

(Title 46 CFR. 160.040-5)

(2) Rockets. The use of black powder for the rocket motor is not acceptable. The ignition of the rocket motor shall occur at such a distance from the appliance so as not to spew flame, hot gaseous exhaust, or hot particles of propellant in such a manner as to create a hazard to personnel or the vessel.

53 SOLAS approval/production testing of line-throwing appliances.

The required approval testing, to be completed by an USCG accepted independent laboratory, is listed in the Revised Recommendation on Testing of Life-Saving Appliances in the LSA Code under Part 1 Section 9.

The production testing requirement for all pyrotechnics is described in Part 2 Section 4 of the Revised Recommendation on Testing but does not provide specific information for line-throwing appliances. See Section 57 below for specific guidance on USCG production testing based on domestic regulations for line-throwing appliances and their projectiles.

57 Coast Guard requirements for production testing of line-throwing appliances.

(Title 46 CFR. 160.040-5)

The USCG regulation 160.040-5(b)(1) requires manufactures to conduct the performance tests on each appliance. For SOLAS line throwing appliances this performance test is in the LSA Code Part 1 Section 9.2 – Function Test.

USCG regulation 160.040-5(c)(2) also requires manufactures to select from each 200 rockets manufactured, not less than three rockets for testing by firing with service line attached. These rockets shall be subjected to the LSA Code Part 1 Section 9.2 - Function Test. These three rockets can also be used to test an appliance as required in the previous paragraph.

An USCG accepted independent laboratory must inspect and test appliances and rockets at least once each year. This should include all testing requirements described in the LSA Code Part 1 Section 9.