Appendix C
Flare Incidents

Recommended procedures and guidance for flare case planning are provided in this Appendix.

Section C.1
Flare Incidents

C.1.1 Response to Flares

Red and orange flares are recognized as marine and aviation emergency signals. Reported sightings of red/orange flares must be treated as distress situations unless sufficient other available information indicates no distress exists. Examples of other information that might lead to such a conclusion include, but are not limited to, positive indications the sighted object was not a flare, notification that an exercise involving flares or objects that could be mistaken for flares is underway in the same area, etc. Unresolved (insufficient information to either close or suspend) red or orange flare reports require first-light searches. Continued searches and searches in response to other than red or orange flares will depend on the specifics of the case.

If a flare is reported that is other than red or orange and there is reason to believe it could have originated from a distress situation, it should be treated the same as a red/orange flare sighting. Reasons for believing a flare that is not red or orange may indicate a distress situation include, but are not limited to, unresolved MAYDAY calls, ELT/EPIRB/PLB transmissions in the vicinity, proximity to a known hazard to navigation, poor weather, and a craft being reported overdue in the general area of the flare sighting. Otherwise, there is no requirement to send assets to the scene. However, further investigation short of launching assets should be considered. In any case, the sighting information shall be recorded.

Other considerations on the Great Salt Lake would be duck hunting season, brine shrimp season, and the military air corridor.

C.1.2. Importance of Accurate Information

The nature of flare distress signaling makes planning and execution of searches difficult due to wide variations in flare types, possible altitudes, skill and position of the reporting source, and weather as well as many other factors. For that reason the accuracy of the initial information received from a reporting source is most critical. For example, a hand-held flare in a recreational boat seen on the horizon by a reporting source standing on the beach, assuming the observer's eye and the flare are both six feet above the water, will be approximately 5.75 NM away, while a parachute flare rising to 1200 feet and seen on the horizon by the same reporting source could be more than 40 NM away.

C.1.3 Importance of a Prompt Response

As with all SAR cases, a prompt, thorough and proper response yields the greatest chance of a rescue. Otherwise, the search planner may have no choice but to expand and/or extend the search, dispatching additional SRUs to search larger areas.

C.1.4 Skills Needed for Taking a Flare Sighting Report

Persons taking a flare report should have a good understanding of the applicable principles and procedures. The inquiry process requires patience and good interpersonal skills since reporting sources are rarely familiar with the terminology or procedures for prosecuting flare sightings. A flare reporting checklist must be used to ensure that a proper report is taken to get all the facts.

C.1.5 Sightings That Can Be Mistaken for Distress Flares

There are a number of situations that may be mistaken for distress flares, especially by untrained observers. Determining whether there is a high probability for the reporting source to have actually seen something other than a distress flare requires a combination of interviewing skills and comparison of the report with data from other sources.

C.1.5.1 Meteor Showers and Shooting Stars

Meteor showers occur when the earth passes through the debris field of a comet. This "Space Trash" burns up as it moves through the atmosphere, leaving behind several "wakes" of light. Most wakes last from one to ten seconds. Some brighter meteors can leave behind a "persistent train" that can last up to 320 minutes. Meteor wakes are normally white, but may appear in nearly every color of the spectrum.

(a) While a sporadic meteor can appear anytime, most meteor showers occur on a regular basis every year. These showers are named after the nearest constellation from where they seem to originate. The origin is also referred to as the shower's radiant. Table C-1 provides information on major meteor shower activities and can be used to help correlate a suspected false flare sighting with a meteor.

Name/Radiant	Annual Occurrence	Peak Occurrence	Average Per Hour
Quandranids	Dec 28-Jan 7	Jan 3-4	45 – 200 +
Lyrids	Apr 16-25	Apr 21-22	100 +
Eta Aquarids	Apr 21 – May 12	May 5	20 +
Southern Delta Aquarids	Jul 14 – Aug 18	May 15-20	10 +
Northern Delta Aquarids	Jul 16 – Sept 10	Aug 13	10 +
Perseids	Jul 23 – Aug 22	Aug 12-13	80 +
Southern Iota Aquarids	Jul 1 – Sept 18	Aug 25	10 +
Northern Iota Aquarids	Aug 11 – Spet 10	Aug 25	10 +
Alpha Capricornids	Jul 15 – Sept 11	Aug 1	14 +
Orionids	Oct 15-29	Oct 21	20 +
Leonids	Nov 14-20	Nov 17	15 +
Geminids	Dec 6-19	Dec 13-14	100 +

b. If it is suspected that a flare sighting report was actually a meteor shower, begin by correlating the bearing of the report with the meteor shower's radiant. The American Meteor Society's web site (found at http://comets.amsmeteors.org/meteors/calendar.html) provides a useful Observer's Guide that describes where a meteor shower's radiant can be located. The radiant will be described in true degrees and declination above the horizon. Start by correlating the reported flare to a meteor by matching the direction and angle of elevation of the flare sighting with a meteor's radiant and declination.

c. Matching the report's bearing with a meteor shower's radiant is not enough to assume the sighting was a meteor. During the interview additional clues should be actively sought. Without putting words in the reporting source's mouth ask the caller to describe what they saw.

d. A meteor's wake normally "streaks" across a portion of the sky in a n apparent straight line, as opposed to a meteor or parachute flare's vertical arch of trajectory. A meteor's wake can appear at any angle above the horizon. Only flares launch very close to the observer will appear to rise more than 8 degrees above the horizon. Unlike a meteor or parachute flare, there is no "burst" or flame associated with a meteor sighting. Because meteors travel across hundreds of miles of sky at high altitudes, they can be seen at greater distances by multiple observers. Flares on the other hand, can only be seen by observers within the flare's nominal range because of their limited height. Meteors require a relatively clear sky to be seen. If a sighting was observed in an overcast sky, it is not likely a meteor. During a meteor shower, the observer will normally witness several wakes track across the sky. Mariners have a limited number or flares available.

If it is reasonably certain the reporting source mistook a meteor shower as a flare, conclude the interview by asking if it is possible that what was seen could have actually been a shooting star. Some callers might become embarrassed or even defensive at this point. It's important to reassure the caller that meteors are often confused with flares, and that the Division appreciates the caller's effort none the less.

C.1.5.2 Military Operations

Military flight operations are often the source of flare sightings. This is the case of most flare sightings on the Great Salt Lake. Military aviators will sometimes deploy red or white flares during the course of a training mission. Military commands that may be operating assets in the vicinity of the flare sighting when it is reported should be queried regarding the nature of their operations.

The military sometimes uses various pyrotechnic devices in various colors and combinations corresponding to specific situations and meanings. Again, military commands that may be operating assets in the vicinity of the flare sighting when it is reported should be queried regarding the nature of their operations and any flare signals that may have been used at or near the time and place of the sighting reports.

C.1.5.3 Distant Vessels

Commercial fishing vessels illuminate their decks with powerful deck lights when performing work on deck or while at anchor. These lights may appear reddish-orange in color and may be confused with a handheld flare. When a report is received where the origin appears to be near known commercial vessel traffic, try to establish communication with those vessel(s) using VHG Marine Band channel 16. If a vessel is in the area answers, request the operator to turn the deck lights off and on while the reporting source remains on the phone to correlate the sighting with the vessel.

C.1.5.4 Aids to Navigation

Under limited visibility, a distant aid to navigation's beacon may be reported as a distress signal. Ruling out a flare is as simple as asking the reporting source to describe exactly what is seen, including interval between sightings. If the sighting appears and disappears at regular timed intervals (without a rise and fall) that match the light characteristics of an aid on the line of bearing, it can be safely assumed that the origin is an aid to navigation.

C.1.5.5 Fireworks Displays

Distant aircraft (beyond aural range) taking off or approaching a runway can often appear to be a flare. The airplane's landing gear lights can appear similar to a flare's trajectory as it flies near the airport. If the report plots near an airport's approach pattern, consider calling the Air Traffic Control Center to correlate the report with any aircraft in the vicinity. If an aircraft was present in the area, ask the reporting source if they might have confused the sighting with an aircraft.

C.1.5.6 Fireworks Displays
Fireworks, whether part of a professional display or those set off by private citizens, are easily mistaken for flares. Local authorities should be queried regarding the possibility of fireworks displays near the time and place of the reported flare sighting.

C.1.6 Assessing Reporting Source Reliability
The reliability of the reporting source should be confirmed whenever possible. Caller ID, if available, should be checked against the information given by the reporting source. An immediate call back to the reporting source should be considered to determine whether the person who answers is the same as the reporting source or can confirm that the reporting source was there and made the call. It may be appropriate to request local law enforcement authorities visit the reporting source, confirm their presence, interview them, and report their assessment of the reporting source's reliability. However, if in doubt, consider the reports reliable.

Section C.2
Definitions

C.2.1 Meteorological Visibility
The greatest distance, at which a black object of suitable dimensions can be seen and recognized by day against the horizon sky, or, in the case of night observations, could be seen and recognized if the general illumination were raised to the normal daylight level.

C.2.2 Nominal Range
The maximum distance at which a light can be seen in clear weather as defined by the International Visibility Code (meteorological visibility of 10 nautical miles).

C.2.3 Luminous Range
The maximum distance, at which a light can be seen *under existing visibility conditions.* Luminous Range does not take into account the elevation of the light, the observer's height of eye, the curvature of the earth, or interference from background lighting.

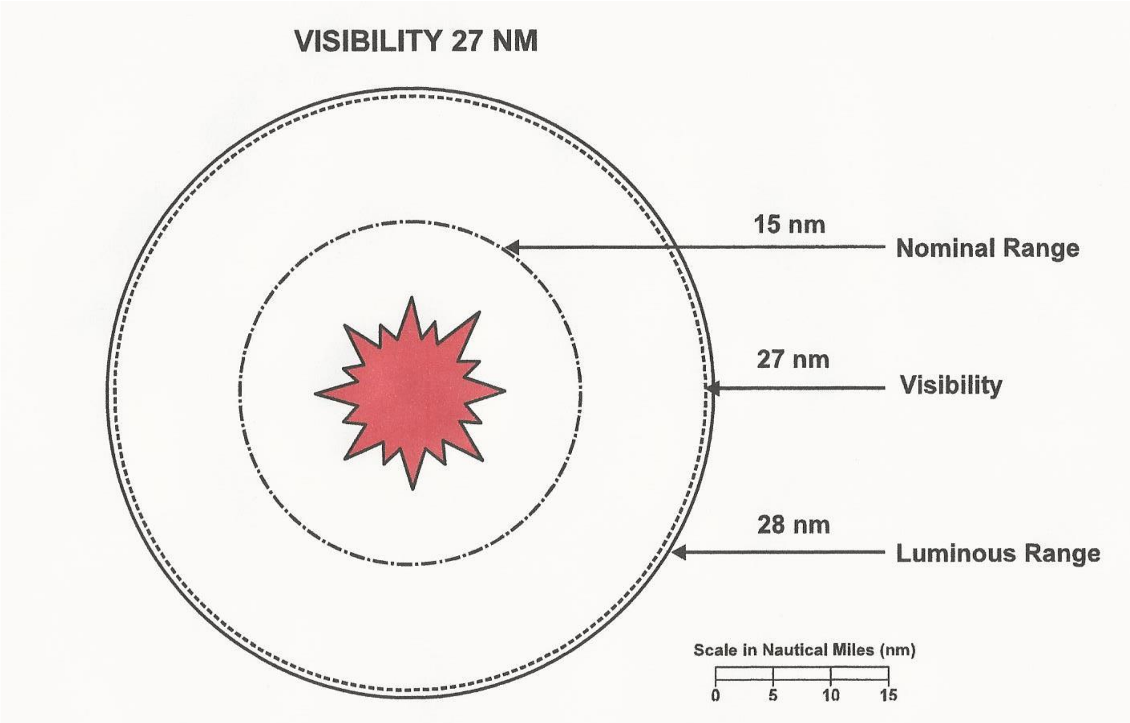

Figure C-1a
Luminous Range and Visibility, example with visibility of 27NM

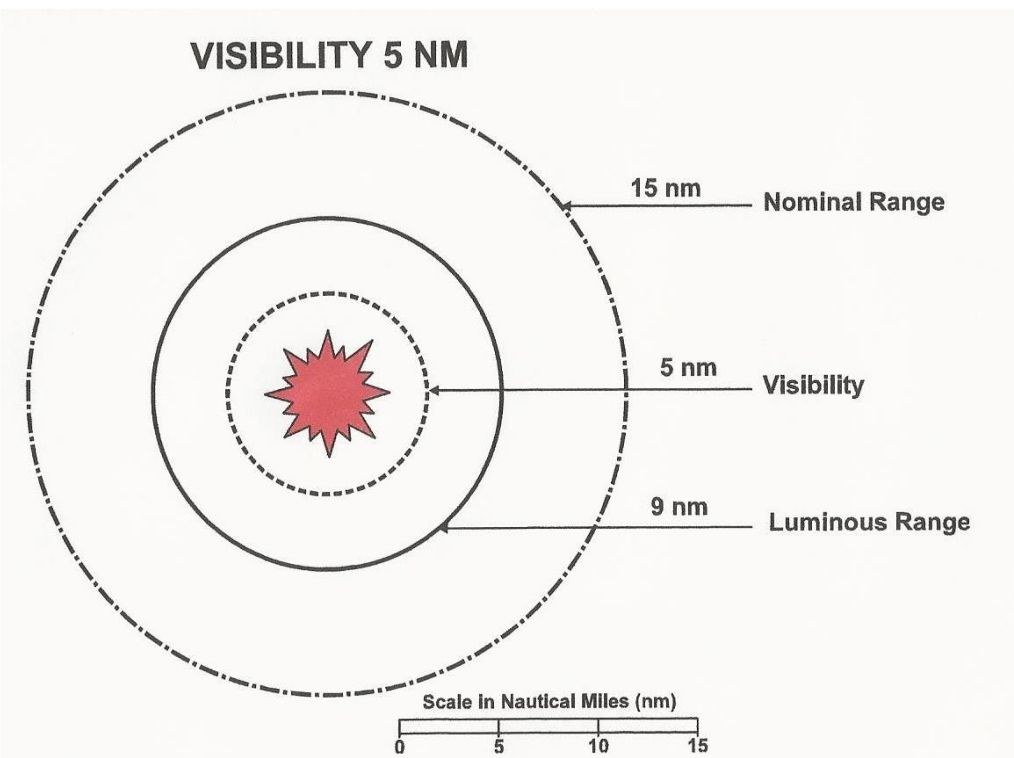

Figure C-1b Luminous Range and Visibility, example with visibility of 5nm

C.2.4 Geographic Range

The maximum distance at which the curvature of the earth permits a light to be seen from a particular height of eye *without regard to the luminous intensity of the light*. Geographic range can be determined by adding the distance of the horizon from the observer and the distance of the horizon form the light.

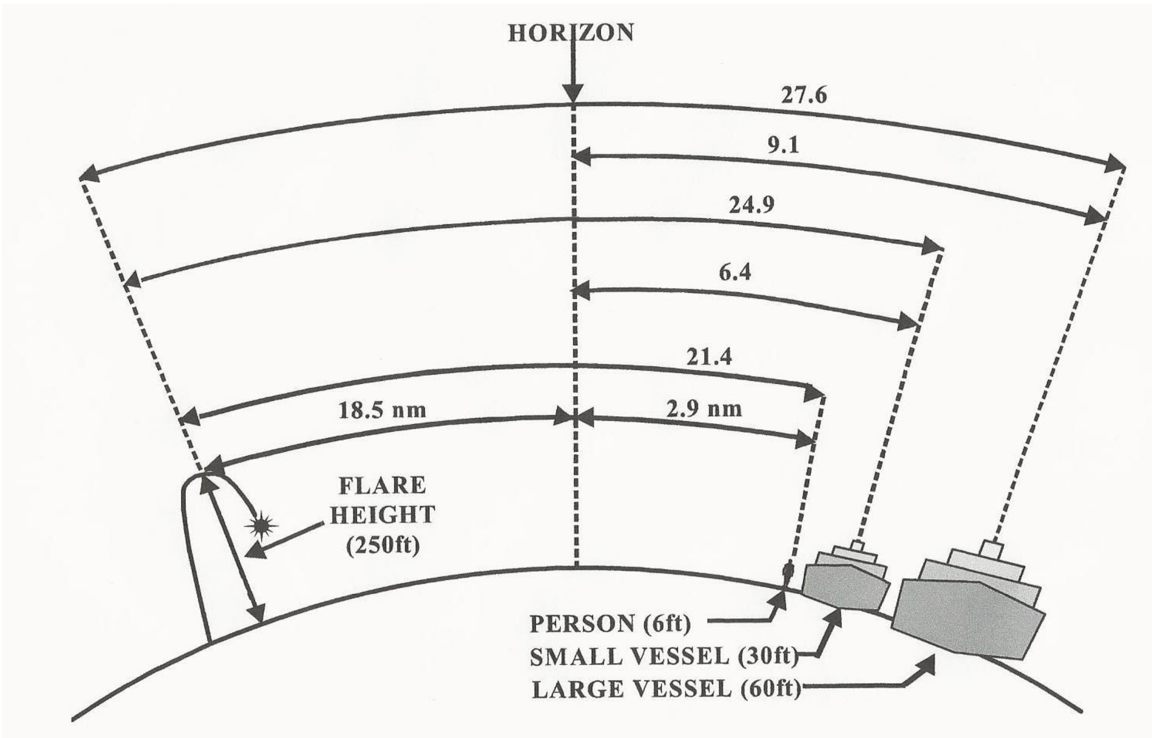

Figure C-2 Geographic Range of a flare by Height of Eye

Section C.3
Obtaining Sighting Data

C.3.1 Reporting Source

The following information about the reporting source should be obtained:

C.3.1.1. Position

Reporting source position is the point form which distance and direction are measured. Attempt to obtain: Latitude/longitude; bearing and range from a prominent landmark; or street address.

NOTE: A latitude and longitude can often be derived from a reporting source's street address through the use of geo-location services provide on the internet. In the event that no street address is available, consider dispatching local LE personnel with a hand held GPS to the reporting source location to obtain a GPS position. These practices will reduce the position error of the reporting source to virtually zero.

C.3.1.2 Height of eye
To most accurately estimate the range to the flare from the reporting source, the height of eye of the reporting source is important. If the reporting source is in a tall building, record the floor number and estimate 10 feet per floor above the height of eye at ground level.

C.3.2 Flare Characteristics
Characteristics can aid in determining the distress location, and may correlate with other sightings, phenomena, or military exercise. Flares can be identified primarily by trajectory and duration of burn. As Table C-2 describes, meteor flares have a rapid rise and rapid fall. Parachute flares exhibit a rapid rise and slow descent. These characteristics can be observed by an astute reporting source. Judging the height of the flare is much more difficult, even for a trained eye. It is important to note that the height of a flare significantly affects the size3 of the search area. If the type of flare can be determined to be a meteor flare, rather than a parachute flare, the search area can be significantly reduced since meteor flares can achieve only about 1/3 the maximum height of parachute flares. Parachute flares are rare among recreational boaters. If a flare is determined to be a parachute flare, a major search effort may be needed to cover a large geographic area. Table C-2 lists the characteristics by flare type, but additional information can also be helpful. As much of the following information as possible should be collected:

C.3.2.1 Color
It is critical in assessing urgency. Red and orange flares must be treated as distress cases until proven otherwise.

C.3.2.2 Number of flares, time(s) of sighting(s), and intervals between flares.

C.3.2.3 Apparent origin of the flare
Did the reporting source see where the flare came from? If so, was it near the horizon or definitely between the reporting source and the horizon? Did the flare illuminate any objects? If so, what were they?

C.3.2.4 Trajectory
The nature of the flare's trajectory is an extremely important clue. Every effort should be made to obtain accurate answers to the following questions: Did the reporting source se the flare both rise and fall? Rising only? Falling only? What were the rates of rising and falling (rapid rise and fall; rapid rise, slow fall, etc.)? Was the trajectory steep (mostly vertical) or flat (mostly horizontal)? Answers to these questions will help establish the type of flare and therefore the possible heights it could reach as well as provide some additional clues about its location. Table C-2 show the characteristics of some common types of flares.

C.3.2.5. Time intervals and duration of burn
This also aids in determining the type of flare. However, a flare may burn longer than the minimum duration. A flare may also burn less than the required time if the flare was fired incorrectly or if it was beyond its expiration date.

TYPE	TRAJECTORY	AVERAGE HEIGHT	CANDLEPOWER NOMINAL RANGE	MINIMUM PEAK BURN DURATION
METEOR*	RAPID RISE RAPID DESCENT	250 – 400 FT	1000 -3000 15 – 17 NM	5.5 Seconds

PARACHUTE**	RAPID RISE SLOW DESCENT	1000 -1200 FT	20000 -40000 14 – NM 20 NM	30-40 Seconds
HAND-HELD***	STEADY	ASSUME 10 FT	500 – 15000 8 – 16 NM	50 – 120 Seconds

*Meteor flares have no minimum altitude requirements.
**Parachute flare requirements by SOLAS: 300 meters (990') height, 30K candlepower.
***Hand-held candlepower requirements: USCG-500; SOLAS-15000.

C.3.2.6 Angle of observation

Often the reporting source will not be able to accurately estimate the angle of elevation without some assistance. The angle of elevation is the angle measured from the horizon to the top of the trajectory.

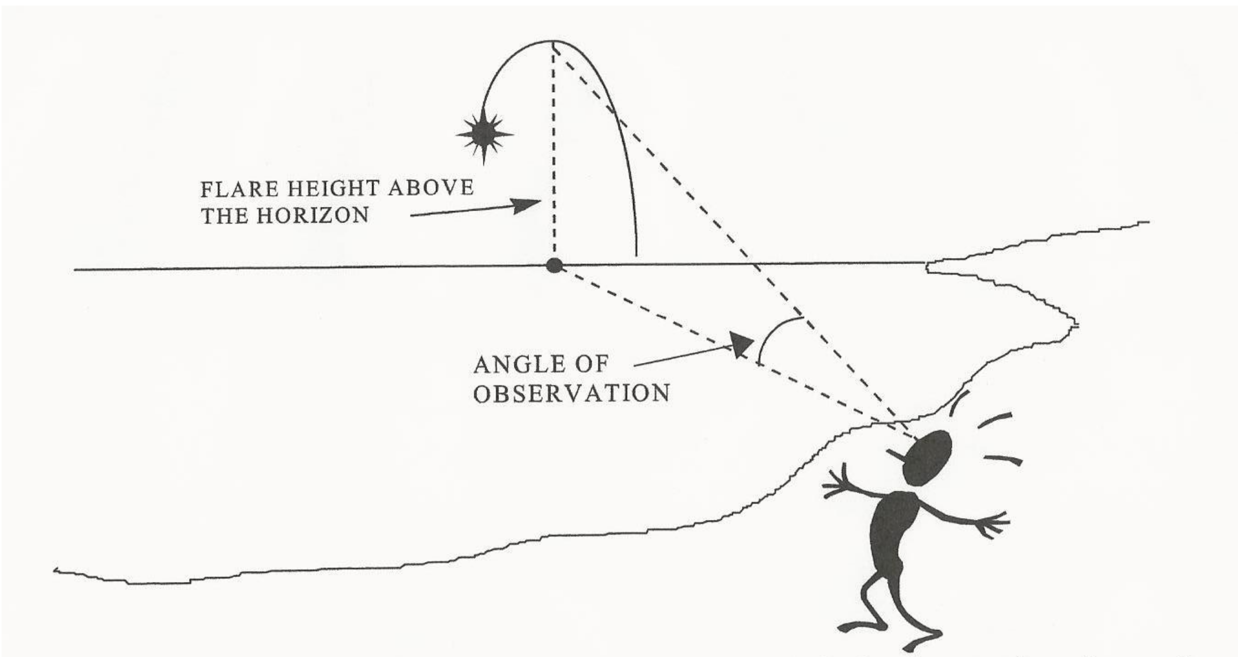

Figure C-3a
Example of angle when flare origin is beyond the horizon and unobserved

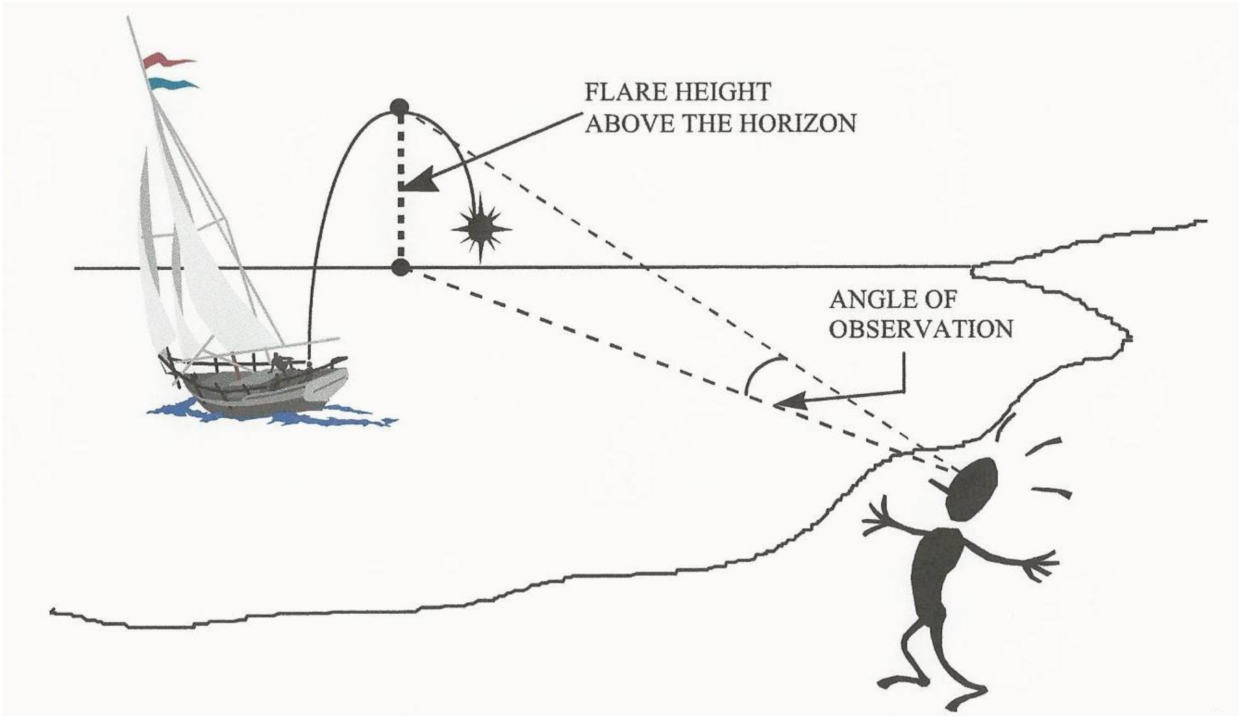

Figure C-3b
Example of angle when flare origin is observed

If the origin of the flare is observed, the reporting source may measure the angle form the origin to the top of the trajectory. This method of determining the angle may be helpful when the horizon cannot be seen or used as reference.

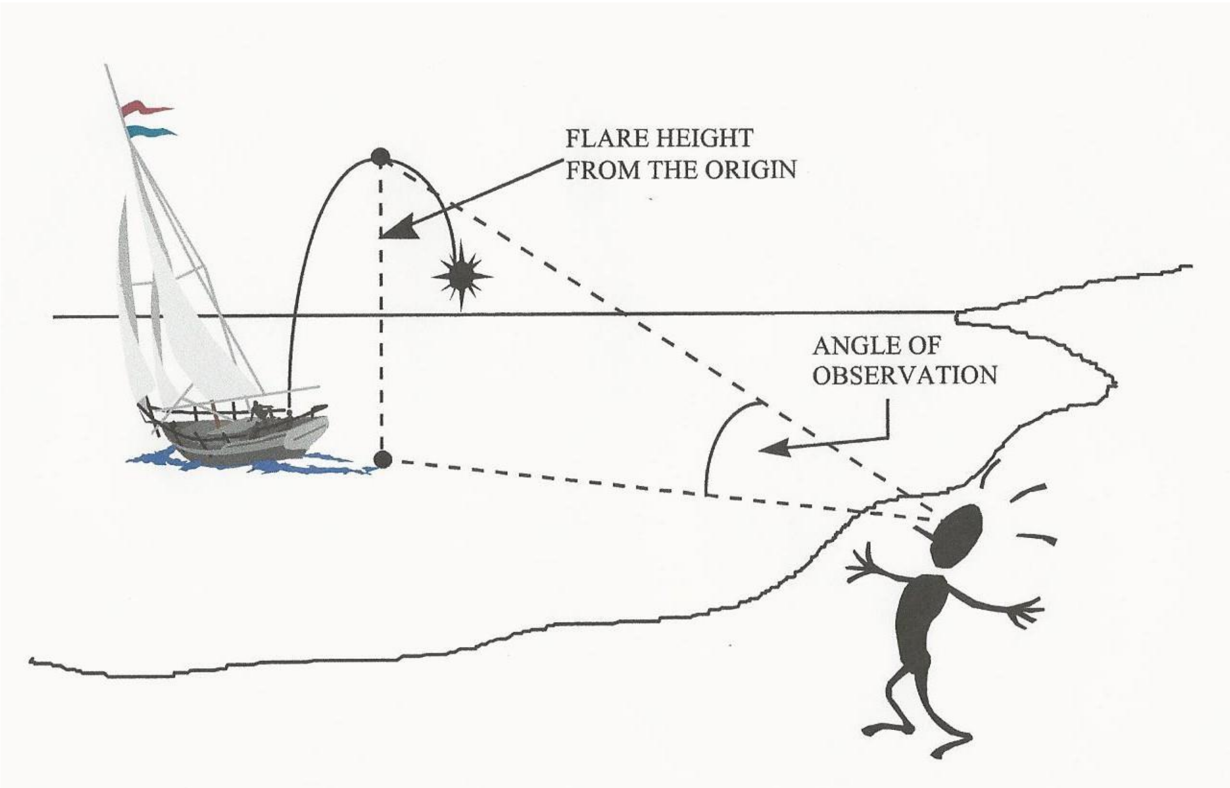

Figure C-3c
Example of angle measured form flare origin to top of trajectory

The person taking the report should be sure to determine exactly what angle is measured. "Is the angle form the horizon to the top of the trajectory or form the point where you saw the flare take off to the top of the trajectory?" This distinction will become important in the planning stage.

a. A major point to remember is that for any flare sighting with an angle of elevation of more than 8 degrees, the distance of the flare from the reporting source is less than 1.4 nm
b. Closed Fist Method. A closed fist held at arm's length with the thumb side up represents approximately 8 degrees of arc.

Unless the reporting source's height of eye is greater than the height of the flare at the top of its trajectory, the flare will normally appear to rise above the horizon. In this situation, when the bottom of the fist is aligned on the horizon relatively accurate estimates of small vertical angles can be made. Brief the reporting source on this reference system. "If you hold your fist at arm's length, with your thumb on top and the bottom of your fist on the horizon, was the top of the trajectory above or below the top of our fist?" If the flare was sighted below the top of the fist, have the reporting source attempt to more accurately estimate the angle with the horizon.

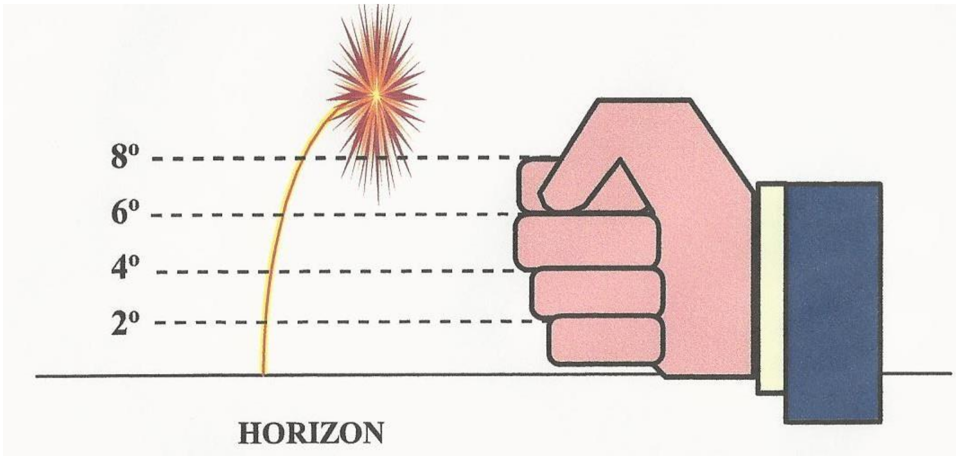

Figure C-4a
Fist Method for measuring flare angle above horizon

An estimate of three fingers or half a hand can be extremely useful. Obtain the final estimate in terms such as “not less than ½ hand and not more than 1 ½ hands.” Convert numbers of fingers or factions of hands to degrees based on Figure C-4a above.

Estimates collected from untrained reporting sources are necessarily fraught with uncertainty. Search planners must carefully question reporting sources of flares to remove as much of the uncertainty as possible without encouraging the reporting source unjustifiably precise estimates. Search planners must then develop search plans that reflect the actual uncertainties. Failure to do so can result in searching either too small or too large an area and missing the target. An estimate of “definitely less than a fist, but definitely more than a quarter of a fist,” translated to degrees as definitely less than 8 degrees but more than 2 degrees, can tremendously limit the datum area as compared with, “I can only say less than a fist.” The objective is to “bracket’ or estimate the bounds of the area containing the sighted flare without covering substantially too much or too little area.

With hand-held flares, and even meteor flares if the reporting source is high enough, the flare may not rise above the visible horizon if it originates between the reporting source and the horizon. In this case, the reporting source should be asked to align the top of the index finger with the horizon and estimate the apparent distance *below* the horizon using the fist method described above. See Figure C-4b.

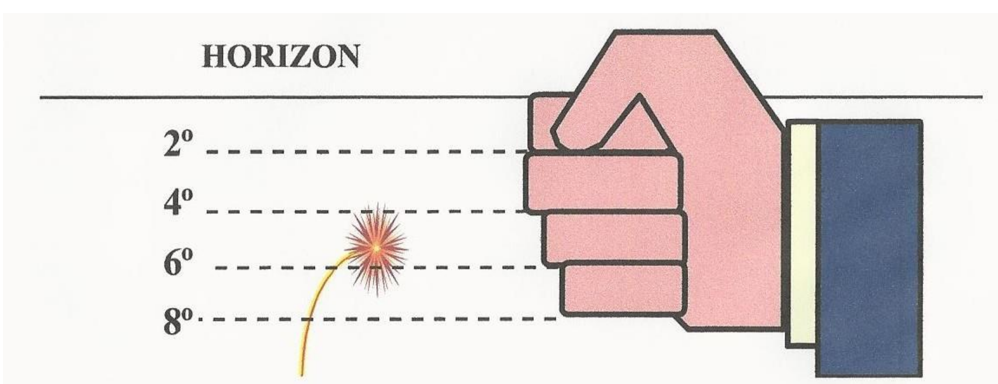

Figure C-4b
Fist Method for measuring flare angles below the horizon

a. Clock method, (Figure C-5 shows how to determine the line of bearing by referring to the direction as points on a clock, with twelve o'clock being perpendicular to the reporting source in relation to the shore line or building where the reporting source is located. Most buildings along the shoreline will be aligned with the shore. If the "clock" is being referenced to a building's walls that are not aligned with the shoreline, then the search planner will need to determine the orientation of the building.)
b. Gyro/magnetic compass,
c. Reference object,
d. Seaman's eye, or
e. A guess.

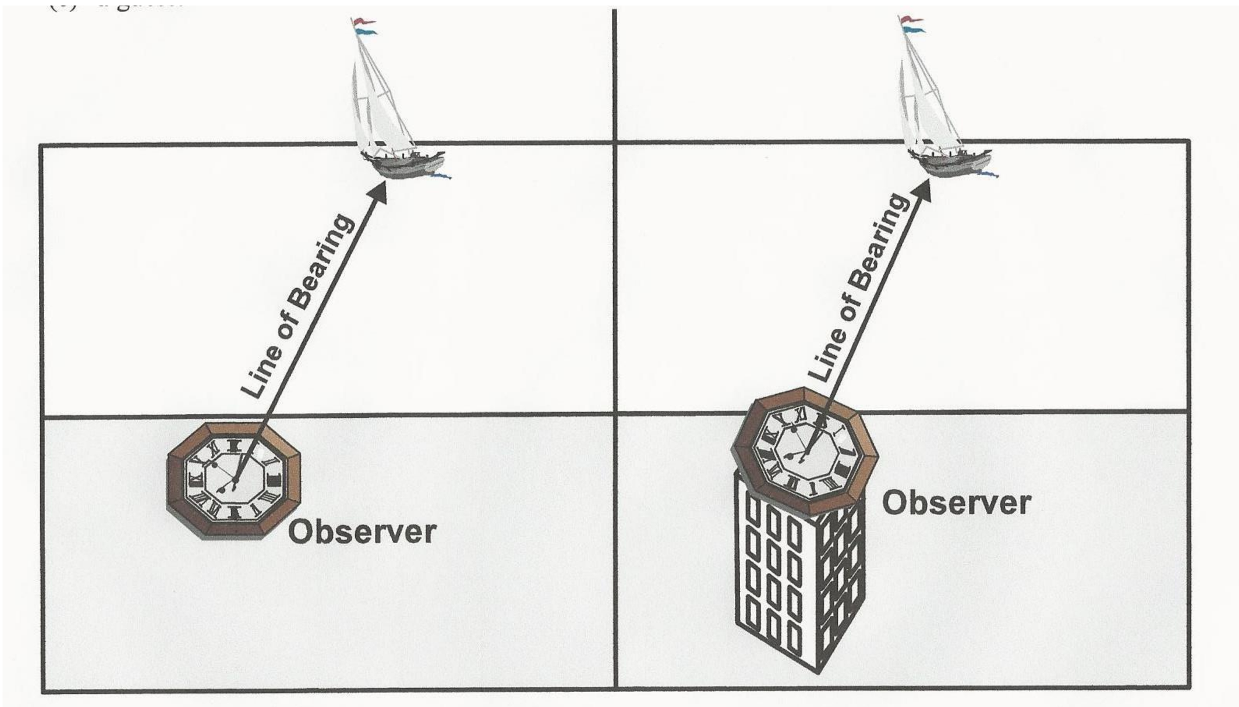

Figure C-5

Clock Method for determining bearing. Reporting source aligned with shore (left), bearing 1 o'clock; reporting source not aligned with shore (right), bearing 12 o'clock

If the reporting source has difficulty in confidently estimating direction, amplifying information, such as the following, should be obtained:

a. Direction relative to the street direction,
b. Direction relative to a line passing through reporting source's position and another prominent landmark or reference point,
c. Identity of prominent landmarks on either side of the line of bearing from the reporting source to the flare,
d. Direction relative to the trend of the shoreline in that area, or
e. Direction relative to the line between the reporting source and the moon or a star or constellation the reporting source can confidently identify.

The search planner should estimate the degree of uncertainty in the form of bearing errors to the right and left of the reporting bearing. These will establish rightmost and leftmost bearings from the reporting source. Datum estimates must reflect real doubts. Failure to reflect realistic uncertainties can lead to false confidence in a search's chances for success.

C.3.2.8 Distance

Estimating distance directly from an observation, without recourse to vertical angles and tables, is difficult for even an accomplished seaman. Data developed in research conducted by the Coast Guard Research and Development Center (Robe, R.Q., et al., 1985) has shown that in most cases reporting sources tend to underestimate distance. Most estimates of distance should not be given significant consideration unless the reporting source is basing the estimate on the distance to a known object on or near flare's line of bearing.

C.3.3 Helpful Information to Obtain

C-3-3-1 Aircraft/vessels seen in vicinity

If the reporting source can see the vessel being illuminated by the flare then the flare is inside the horizon. If an aircraft was seen, it may be possible to correlate this report with reports, if any, from the aircraft. It may also be possible to correlate the report with aircraft positions (from radar or radar playback) at the time of the sighting.

C.3.3.2 Obstructions

Information about obstructions can be of value in several ways.

a. **Gauging Distance.** For example, a flare seen to rise/descend in front of an island clearly indicates the maximum distance to the flare is the distance to the island. If seen behind an obstruction it clearly indicates the minimum distance is the obstruction distance.
b. **Determining Direction**. Flares seen over or between identifiable obstructions give the reporting source a reference for determining direction.
c. **Estimating angle of elevation.** For example, a flare seen over the top of a nearby stand of 60 foot trees by a reporting source standing on the ground (assuming level terrain) means the flare could not have been fired from a distance very far beyond the tree line.

C.3.3.3 On-Scene Weather and Visibility

This can be useful in limiting the area to be searched. Ascertain how visibility was determined, such as from objects that are just visible at a known range. Keep in mind that horizontal visibility factors, such as ground fog, may not limit the visibility for a meteor or parachute flare as much as for a hand-held flare.

Section C.4
Estimating Distances

Estimating the distance of the flare from the reporting source is one of the more difficult problems in search planning. Flare sightings are generally made by untrained, inexperienced reporting sources. While any information they can provide is helpful, it also has a large associated uncertainty. However, the reporting source is not the only source of uncertainty. The actual height of the observed flare at the top of its trajectory is also subject to a large uncertainty. For reports of less than 4 degrees (1/2 fist), the range of distances increases very rapidly. Planners must use all means to obtain accurate information to establish a manageable search plan.

Before presenting the actual step-by-step procedures for using the distance tables for estimating minimum and maximum distances from the reporting source, an explanation of the rationale behind these procedures and tables is in order.

C.4.1 Angle Above the Horizon

If the flare is observed above the horizon at the apex of its trajectory, then its distance from the reporting source will depend on the reporting source's height of eye, the observed angle above the horizon and the height of the flare above the surface. Assuming that information about the first two factors can be obtained from the reporting source, this leaves the height of the flare as the only "unknown." For flares that are fired in the air, the maximum height is assumed to be 1200 feet for parachute flares and 500 feet for meteor flares. The minimum height for both types of flares is assumed to be 250 feet or 10 feet above that of the reporting source for heights of eye greater than 240 feet. A flare that rises only 250 feet must be much closer to a given observer (e.g. height of eye 20 feet) in order to produce a given observed angle above the horizon (e.g. 1 degree) than a flare rising to 1200 feet which produces the same angle from the same point of observation. The distance in the first case is 2.31 nm while the distance in the second case is 10.98 nm. Therefore, the minimum distance table (Table C-3a) is based on the assumed minimum flare heights and the maximum distance tables (Tables C-3b and C-5) are based on the assumed maximum flare heights. The procedures presented later in this appendix also show how to account for realistic limitations in the ability of reporting sources to estimate vertical angles and to identify different types of flares.

Example: If a reporting source with a sextant whose height of eye is 20 feet observes a flare rise to one degree above the horizon, it would be about 1 nm away if it rose to 1200 feet but only 2.3 nm away if it rose to only 250 feet. However, if the reporting soured could only estimate the angle as between 0.5 and 2 degrees, then the minimum and maximum ranges would become 1.2 nm and 19.2 nm.

C.4.2 Angle Below the Horizon

If the reporting source is high enough, and the flare is low enough at the top of its trajectory, then it will not appear to rise above the horizon. If this happens, then the flare must be between the reporting source and the horizon. However, for large heights of eye, the distance to the horizon can be quite substantial. The datum area can be reduced significantly if angles *below* the horizon can be measured or estimated. In this case, for a given height of eye and angle below the horizon, the higher the flare rises above the surface, the close it must be. This is exactly opposite to the situation described in the preceding paragraph. Since a flare that does any rising at all and fails to cross the horizon line must be quite close, the minimum distance was computed by assuming the maximum flare height was 10 feet below that of the reporting source for heights of eye up to 240 feet and 250 feet for greater heights of eye. A minimum flare height of zero was used to determine the maximum distance from the reporting source.