BOOMING OPERATIONS

General Information

Booming operations are necessary for the containment and concentration of spilled oil on water. By containing product, potential damage to the environment can be averted. History has shown that when the slick is allowed to spread out of control without containment, then the task of pooling the oil for eventual recovery is time consuming, labor intensive and expensive. Additionally, if the oil impacts the shoreline, environmental damage increases as well removal and disposal costs. Booming operations also helps to concentrate spill product to allow for easier recovery. The following Chapter covers issues involving booming operations in the following sections-

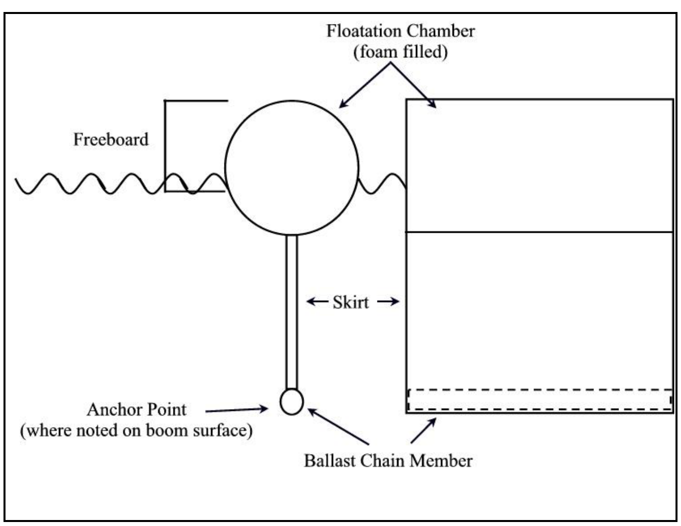
- Containment Boom
- Boom Holding Capacity
- Current Considerations
- Off Shore & Near Shore Boom Configurations
- Shoreline Booming Configurations
- Anchoring Systems

Containment Boom

SEAPRO has both foam filled flotation boom and inflatable boom systems.

SEAPRO has three different brands of rolled foam floatation boom. These booms are designed primarily for deployment in protected water as either containment boom or deflection/exclusion booms for shoreline protection. Each of these booms have an 8” x 74” closed poly propylene cell “log” for floatation, and a 12” skirt with ballast chain to limit entrainment. The boom lengths are standard 100 feet/sections. These booms are mutually compatible die to their ASTM standard slide connectors, and have anchoring points as well.

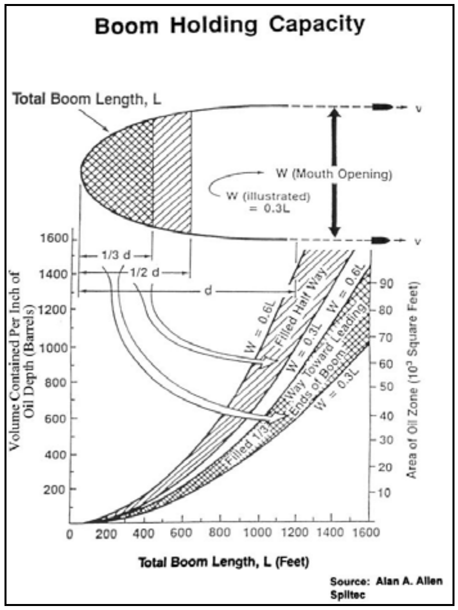
The inflatable boom system SEAPRO owns is designed for off-shore applications as either containment or deflection/exclusion. The boom is kept on reels or on ORB 9. Constructed by Ro-Clean-Desmi it is the model Ro-Boom 1000 and is 1 meter in height un-inflated.



Foam Filled Boom

Boom Holding Capacity

All containment booms have a limiting factor when it comes to capacity for holding product. Usually this limited to 1/3 the length of the boom or 1/3 the size of the pocket created for towing the boom in a "U" configuration. The limiting factor defines when a containment boom has reached its peak performance capabilities for holding product and at which time the operators of the vessels towing the boom need to find an area to drop off the contained product. The easiest method of emptying the product is by either speeding up the towing speed of the boom and causing entrainment or by releasing one end of the tow. The diagram below shows the limits in which containment boom can hold oil.



Current Consideration

Current speed or speed of tow through the water can affect the performance of the boom. Two situations can cause boom to become affected by current,

- Speed of tow with regard to towing configuration.
- Angle of boom positioned against current flow of water.

Speed of Tow

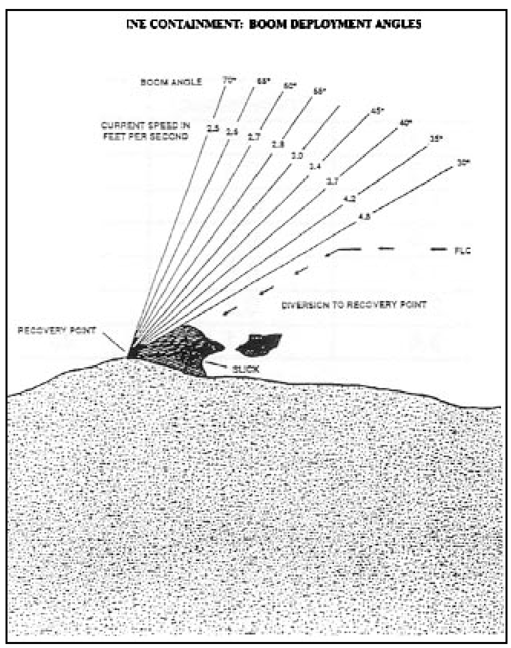
The speed of tow by a vessel will determine how well boom will handle the containment of oil. Commonly vessels tow boom in the "U" configuration to collect spilled product, most boom in this configuration can handle speed of around ½ knot headway and still retain the spilled oil in the pocket. Anything greater than ½ knot headway and the boom will fail and entrainment or washing over the floatation of the boom. To avoid sharp stresses on towed boom, towlines of sufficient length should be used. Generally, the more boom being towed, the longer the towline should be. Towlines of two hundred feet would be appropriate for 1500 feet of boom, and should not be shorter than 50 feet for any length of boom. When feasible, an odd number of sections of boom should be used to avoid having a connector at the apex from which oil may leak. Boom performance can be judged at the apex of the U or J by eye. Oil lost under the boom will appear as globules or droplets rising from behind the boom. Eddies behind the boom are also indicators that the boom is being towed too fast, or that the current washing past the boom is too strong.

Angle of Boom

In order to affectively perform protective booming of shoreline areas, boom must be placed at a particular angle. This angle will allow the boom to hold position without boom failure. The following table will provide guidance when setting boom in current. The speed of the current will affect the boom's ability to redirect oil because of entrainment. By changing the boom angle, response personnel can collect the maximum amount of oil possible.

Maximum Current Speed (knots)	Maximum Current Speed (ft/second)	Maximum Current Speed (meter/sec)	Maximum Effective Boom Angle
<0.5	<1.0	<0.4	90°
0.8	1.3	0.4	70°
0.83	1.4	0.43	60°
0.93	1.6	0.5	50°
1.12	1.9	0.6	40°
1.6	2.4	0.7	30°
2.1	3.5	1.1	20°

The following diagram shows the position boom relative to the current speed-

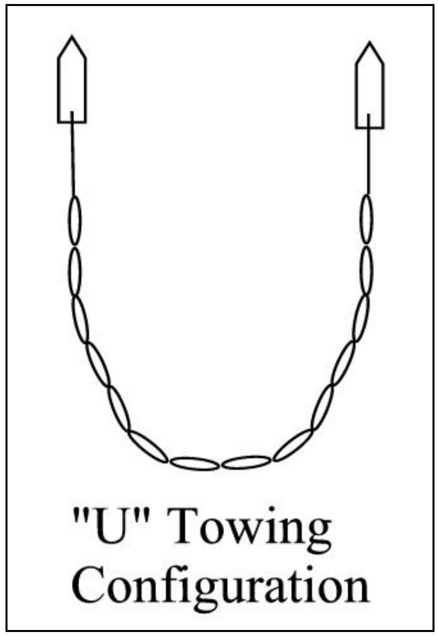


Off Shore & Near Shore Boom Configurations

Offshore recovery is an operation where the oil is encountered, contained and recovered from the water, and away from land. This type of response requires vessels, fairly short lengths of boom, skimmers and storage devices specifically designed for floating when filled with oil/water, debris, etc. The following configurations are used to contain oil spill on water.

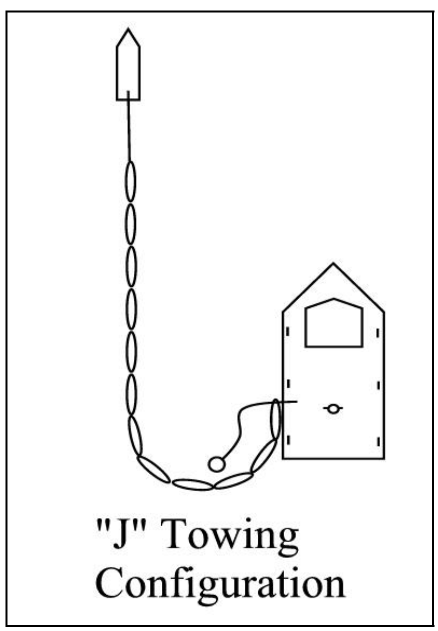
"U" Configuration

As seen in below, several hundred feet of boom is towed by two vessels in a U. The vessels towing the boom work into the wind and current and trap the oil as it moves in the opposite direction. This configuration requires very slow towing speeds and close coordination between several vessels. The configuration is excellent for consolidation of oil for later recovery by a skimming platform.



"J" Configuration

This configuration is similar to that of the U. except that only two vessels are required. The trailing vessel in the "J" deploys the skimmer and storage device, as well as tows one end of the boom. This configuration can be accomplished with only a couple of hundred feet of boom. The disadvantage of the J compared to the U is that generally the swath width is smaller, so less oil is encountered. Again, slow towing speeds and close coordination between vessels is required.



Shoreline Booming Configurations

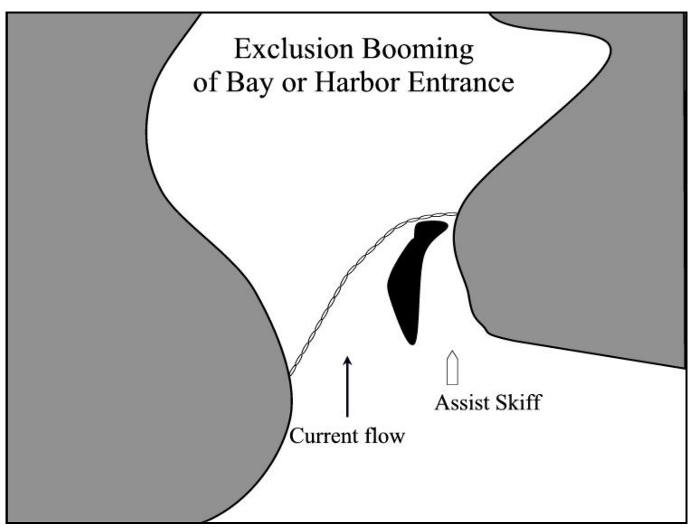
Oil will reach the shoreline if on-water and near-shore strategies do not completely contain the spilled product or if the spill takes place too close to shore to allow effective implementation of on-water or near shore strategies. Booming, commonly used to contain and recover floating oil on lakes, rivers, streams, and oceans, can also be used to divert (diversion booming) or exclude (exclusion booming) oil from sensitive areas. The following details describe both techniques-

Exclusion Booming

Exclusion booming should be used across small bays, harbor entrances, Inlets, and river or creek mouths where currents are less than 1 knot and breaking waves are less than 0.5 feet in height.

Harbor & Inlets

Exclusion booming involves deploying the boom in a static mode, i.e., placing or anchoring the boom between two or more stationary points. This method is used primarily to prevent or exclude oil from entering harbors, marinas, breakwater entrances, lagoons, and inlets. Many of these entrances or channels have tidal currents exceeding 1 knot or surf breaking in the opening. Under these conditions, booms are placed landward from the entrance in quiescent areas of the channel, harbor or inlet. Exclusion booms are also deployed at an angle to a shoreline when possible (preferably in the direction of the wind) to guide oil to an area where pumps or skimming equipment can recover the oil. In many cases, the deployment of a secondary boom behind the primary boom is desirable in order to contain oil that may spill under the primary boom. Exclusion booming of harbors or inlets will require that a small skiff be stationed at the upstream end of the boom to open the boom for boat traffic entering or leaving the harbor. See Diagram for a detail of boom harbors and inlets.

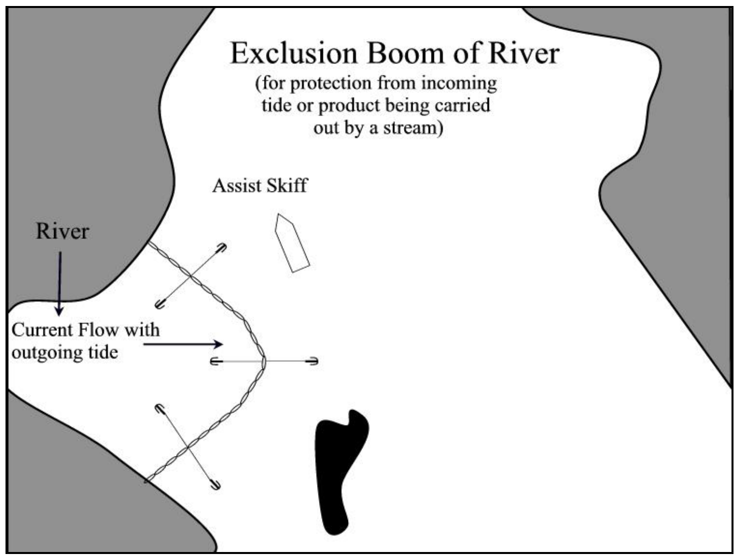


Estuaries

Exclusion booming of estuaries or rivers where sand bars are present can pose problems in boom placement. Because high currents can be expected in entrance channels, boom placement should be attempted on the landward side of the entrance where current velocities drop. This point is generally discernible by ripples and boils. Sand bars commonly form in this area and should be avoided in booming.

Stream Deltas

Many streams which empty into bays, harbors, or rivers are characterized by a delta at the stream mouth, which can provide spawning grounds for some fish. At certain times of the year, these deltas may require protection, particularly if they are exposed by tidal fluctuations. If water currents across a delta are less than 1 knot, an exclusion boom should be deployed. Because the stream deltas normally extend beyond the mainland at low tide, boom deployed around the perimeter of the delta will have to be anchored at several locations In the water, as well as on the shoreline. A typical exclusion boom deployment to protect a delta is shown In **Diagram 1**. If possible, the boom should be placed seaward from the low tide line so that it will float throughout the full tide cycle. If the area requiring protection is too large, the boom should be deployed so that the delta above the mid-tide line is protected.



Considerations

Exclusion booming can be effective If the water currents are less than 1 knot, breaking waves are less than 1 ft, and water depth is at least twice the boom depth in other than Intertidal areas. Exclusion booming in most areas will require two booms to be deployed across an Intertidal zone to an attachment above the high-tide mark; therefore a flexible curtain-type boom should be used. This type of boom will react more favorably to tidal level fluctuation than a rigid fence-type boom. Boom configurations will have to be changed during every tide cycle to effectively handle to exclusion actions.

Equipment Requirements

Specific manpower and equipment requirements will depend on the length and type of boom used and the nature of the area in which it is deployed.

Diversionary Boom

Diversion booming is used where the water current in an area is greater than 1 knot or if the area to be protected is so large that the available boom would not be sufficient to contain oil or protect the shoreline. In addition, diversion booming is useful for diverting oil from sensitive areas to other shoreline locations that are less sensitive and/or more easily cleaned up.

Description

Diversion booms are deployed at an angle from the shoreline closest to the leading edge of the approaching oil stick to deflect oil toward shore, where pickup of pooled oil is more effective. When the boom is at right angles to the current, surface flow of water and oil is stopped. At current speeds greater than about I knot, vortices (whirlpools) and entrainment (oil droplets shearing off from the underside of the oil layer) will drag the oil down beneath the skirt, rendering the boom Ineffective. If the boom is placed at an angle to the current, surface flow is reduced and diverted permitting the oil and water to move downstream along the boom into the collection area and/or against the shore. The reduction in current speed perpendicular to the boom is related to the decrease in the angle of the boom relative to the direction of current flow.

The first of two possible methods of diversion booming involves two or more lengths of boom ranging from 30 meters (100 feet) to 152 meters (500 feet) placed in a cascading formation in the water. The lead boom intercepts the oncoming oil slick and diverts it toward the shore. Subsequent booms placed downstream of the lead boom continue the diversion process until the slick is directed to the recovery area. **See Diagram 1.**

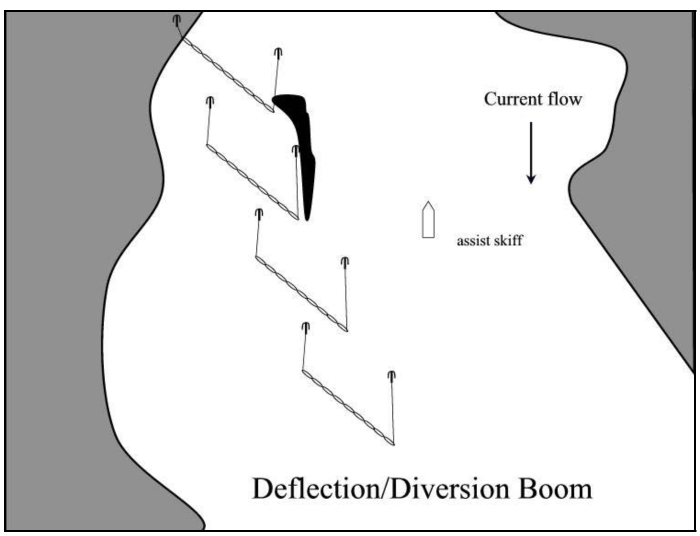


Diagram 1

The second method of diversion booming is similar to the first except that the diverting boom is used to direct the oil onto the shoreline or away from shore. One of the diverting booms is anchored to the shoreline and the free end is angled by the vessel. The advantage of this method is that it can be set up in less time and with less equipment than the cascading booms method **(See Diagram 2).** Both are most effective on shorelines with limited wave action. The primary disadvantage is that the shoreline around the recovery area must be cleaned. **(See Diagram 3).**

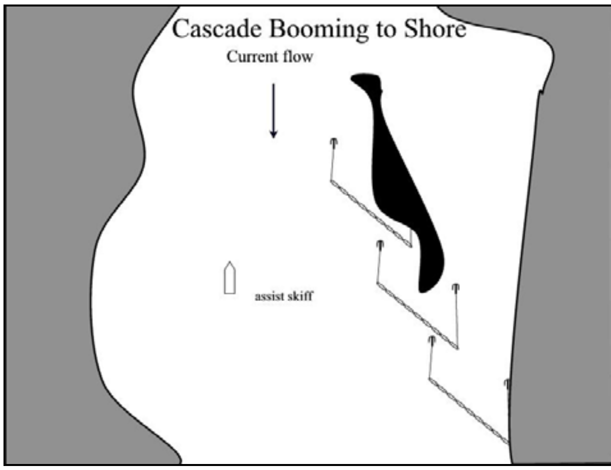


Diagram 2

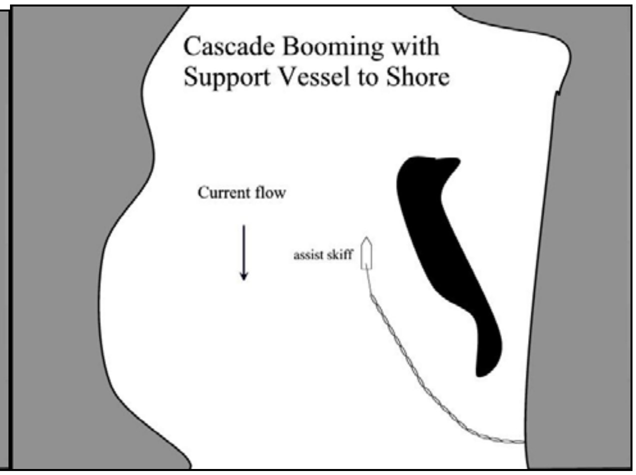


Diagram 3

Considerations

The optimum angle of boom deployment is dependent on the current speed and the length and type of boom used. To avoid boom failure in strong currents, the angle must be smaller than in weak currents. The same relation is true with regard to boom length. The optimum deployment, angle decreases as boom length increases.

The various types of booms available have varying degrees of stability under increasing current conditions. The more stable the boom, the larger the optimum deployment angle for a given current speed. In general, booms with a high ratio of buoyancy to weight, with tension members located at the top and bottom edges and booms with horizontally oriented floatation collars resist pivoting and have good stability under most conditions.

Since diversion booms cause a significant reduction in surface current successive booms can be deployed at increasingly larger angles as the current decreases.

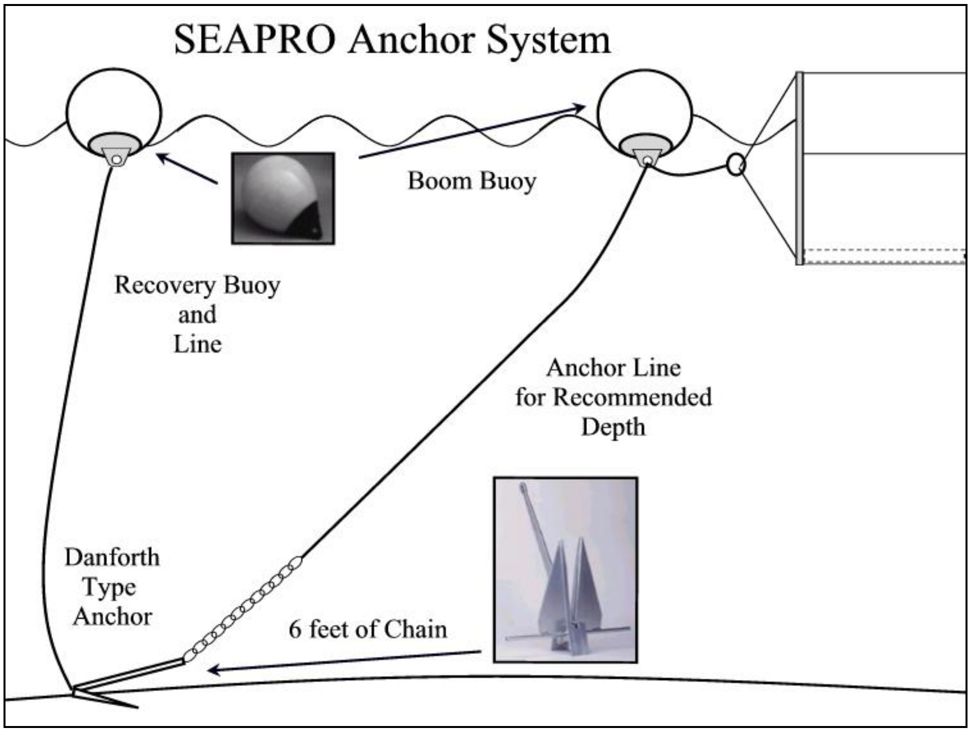
Boom configurations will have to be changed during every tide cycle to effectively handle to diversionary/deflection actions.

Equipment Requirements

Specific manpower and equipment requirements depend primarily on the width of the approaching slick and the current speed. The type of boom and angle to which it is deployed also affect the requirements. Booms deployed at small angles in high current areas require greater boom lengths to cover the same width as those deployed at greater angles.

Anchoring Systems

In order to effectively handle booming operations, anchor systems will be necessary to effectively hold boom in a determined configuration. The below diagram shows the necessary equipment for anchoring SEAPRO boom for containment, exclusionary booming, diversionary booming, deflection booming, or cascade booming.



Mooring the Boom with SEAPRO Boom Anchoring Systems

Danforth anchors are used to moor the SEAPRO boom as follows:

- Assemble the anchors, chain, anchor line, trip line, and buoys as shown in diagram above.
- Set the anchor, and then attach the anchor line to the anchor point on the bottom of the boom.
- The length of the anchor line should be three times the water depth. (If possible).
- Each anchor bucket has 200 feet of anchor line (in 50' sections) and 200' of buoy line. (100' sections).
- The buoy line must be connected to the heel of the anchor to allow the anchor to be easily pulled from water.