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A Rapidly Deployable Oil Containment Boom for Emergency Harbor Use

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A RAPIDLY DEPLOYABLE OIL CONTAINMENT BOOM FOR EMERGENCY HARBOR USE

by

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Project 15080 FVP

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ABSTRACT

This report attempts to describe performance criteria for an ideal oil spill containment boom for emergency harbor service. The type of boom recommended is that which an emergency service, such as a fire department or a plant team could transport promptly to a spill incident within a harbor and deploy quickly to contain the spilled oil. The experience acquired by the Marine Division of the NYFD over the course of one year, both at active spill control operations and in test exercises, serves as the principal source of information for this report. It is hoped that the information offered will lead to the development of the ideal boom as envisioned.

Among the boom criteria developed are: recommended size and performance capabilities; storage and handling problems; optimum design characteristics.

This report was submitted in partial fulfillment of Project Number 15080 FVP, under the partial sponsorship of the Water Quality Office, Environmental Protection Agency.

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FIGURES

SECTION I

CONCLUSIONS

The following criteria have been developed for an oil spill containment boom intended for emergency harbor use:

1. A draft of 12 in. and freeboard of 6 in. is adequate for harbor spills, as the increased capacity of a larger boom is slight, and the weight and the weight and deployment-time penalties large.

2. The weight should be kept under approximately 2 lb/ft.

3. Flotation, ballast, and stiffeners should be permanently attached, preferably inside the fabric to avoid snagging and simplify cleaning.

4. The fabric should carry the tension distributed over its height, with possible sewn or molded-in reinforcement top and bottom. In addition, the fabric must be tough, abrasion-resistant, stable in solar radiation, thermally stable, and resistant to petroleum oils and products. A bright yellow color is recommended.

5. The cost should be under $12.00/ft.

6. Grab handles should be provided on the top edge.

7. The boom should have an overall tensile strength near 6,000 lbs without external tension members.

8. Fire resistance is not recommended due only to high weight and cost penalties.

9. The ballast and float configuration should give stability in 15 knot winds, 0.5 - 1.0 knot currents and 2 ft waves.

The best storage mode appears to be in a closed box on board the boat. While reel storage is possible with detachable floats, the time penalty to attach floats is high. Adapting storage to available space would be simplified if boom were available in 50-ft as well as 100 ft and longer lengths.

Incompatible end connections, especially where booms from different manufacturers must be joined, are both a prime operational nuisance and a major cause of oil loss.

SECTION II

RECOMMENDATIONS

A most urgent need is for a standard end fitting for joining and terminating booms.

The end connection for the ideal boom would be an aluminum fitting designed to join standard boom ends. The boom ends (not the fitting) would terminate in a rounded bead of reinforced boom fabric similar to the rim bead on an automobile tire.

The short bead-bearing section would be about 3 in. long and the same height (in this case 18 in.) as the boom itself. The doubled section would be securely fastened or bonded to the boom so as to maintain its tension strength.

Since the beaded boom ends would be identical, an aluminum slip joint fitting is recommended. This fitting could be slid over the boom ends to form an oil-tight connection. (Figure 1)

To provide for towing or tying a boom, an aluminum fitting of the same dimensions as the 3 in. beaded section is recommended. It would have two holes to accommodate towing or securing lines. (Figure 2)

Not shown in Figures 1 or 2 is the arrangement of two short, light nylon lines run through a hole drilled through the top of the standard boom end fitting and tied through a small grommet in the top of the doublers of the joined boom ends or the aluminum tow fitting. These lines would prevent the beads from riding through the boom end fitting.

Should the boom sections be provided with external stress members, the stress members could be connected by shackles around the standard boom end fitting.

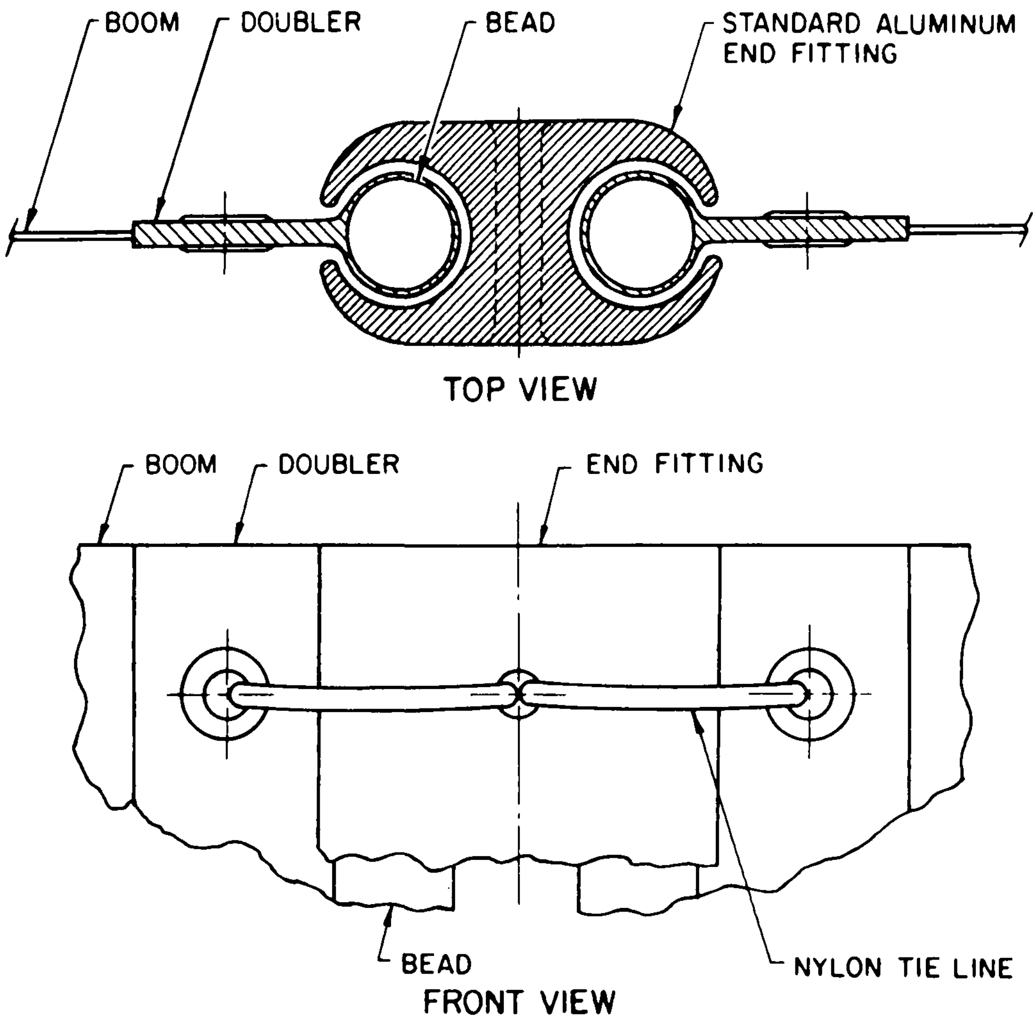

FIGURE 1

CONCEPT OF A STANDARD BOOM END FITTING

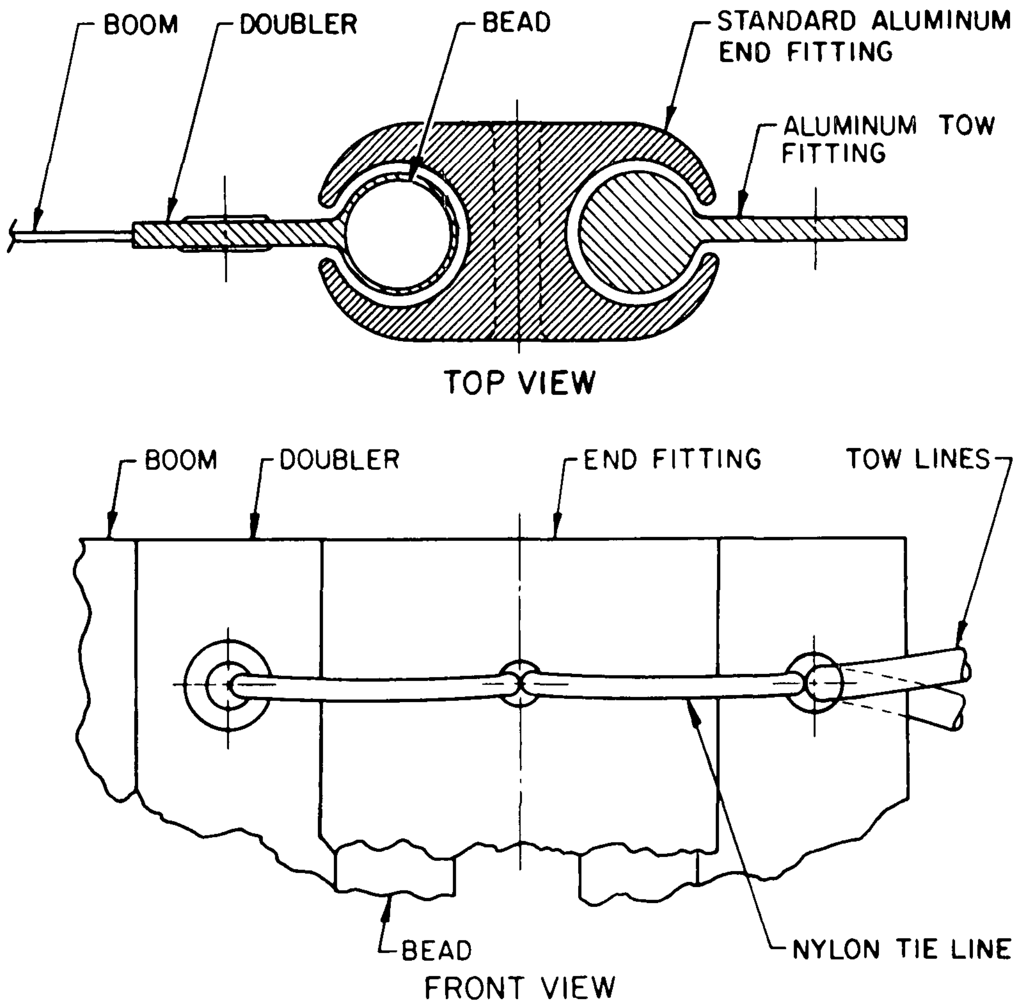

FIGURE 2
CONCEPT OF AN ALUMINUM SLIP JOINT TOW FITTING

SECTION III

INTRODUCTION

Not too long ago accidental petroleum spills in the nation's harbors went unreported for the most part, and nature was left to its own resources to absorb all such insults without much assistance from the human spoilers. But with today's widespread concern for the ecology, both the public and private sectors must take new initiatives to protect the marine environment against the degradation caused by accidental spills. Increased reporting of spills and demands for prompt containment and clean-up of spills must be met.

Next to stopping the flow at the source, the most urgent need at an oil spill accident is to restrict the spread of the oil to the smallest possible area. Due to the rapidity with which oil spreads on water, quick containment efforts are essential. These efforts must be harmless to the marine ecology and must not impede the removal of the oil. A quickly deployed, efficient containment barrier is the best known device at present to control the spread of a spill and assist in the recovery of the oil.

The prompt encirclement of a spill is usually achieved by the deployment of a manufactured containment boom brought to the afflicted area. Quiescent harbor waters can be expected to offer an acceptable surface for the containment of oil by a flotation barrier. At some waterfront locations where petroleum products are transferred or used regularly and in volume, a permanent flotation barrier is maintained around oil docks and vessels to limit the spread of accidental spills. In other situations where it is not feasible to keep containment boom in the water, some plant operators store a supply of boom ashore in accessible locations for deployment by plant personnel when the need arises. This report is concerned with that boom which would be deployed after a spill occurs.

During off-hours, the private sector is often restricted in its response capability by the insufficiency of personnel available on-scene to take corrective measures. It therefore becomes evident that a valuable emergency service can be supplied by equipping a local agency such as the fire department with a complement of containment boom, which would then be available for quick deployment on an around-the-clock basis. Such emergency response personnel would also be of assistance in deploying boom stored by plant operators or obtained from other sources.

This emergency containment service would be intended to fill the gap between the time of a spill occurrence and the effective initiation of a spill clean-up operation. The clean-up would, as a rule, be undertaken, or contracted for, by the person or organization responsible for the spill. It would be expected that any emergency service boom used in a spill would be released as soon as possible by those charged with the clean-up activity so that the boom could be restored to its original state of readiness.

To provide the Port of New York with this quick response capability, as well as for test purposes, four different types of containment boom were procured by NYFD's Marine Division.

Various basin and open water tests were conducted at which the four types of boom on hand were used. These booms were:

1. A heavy 36" boom having self-contained flotation, weighing about 4 lbs per foot.

2. A light 36" boom with attachable flotation, weighing about 2 lbs per foot.

3. Two types of light, 18" boom with self-contained flotation, one of which weighed 1.5 lbs per foot, the other 2.5 lbs per foot.

A definite feel for the type of boom equipment that would best serve a fire department, or other emergency response group, was acquired over the period of one year by way of -

Reviews of publications containing boom information,

Consulting with manufacturers' representatives,

Observations at spill operations,

Use of boom at spill operations.

As a result of the project's experiences with containment boom, certain performance criteria for an "ideal" boom for emergency harbor use, naturally evolved. It must be pointed out that this ideal boom, which will be described in this report, is not manufactured at the present time, but it is hoped that its description will assist those desiring to purchase harbor boom, in making a good choice from what is now marketed. It is also hoped that these boom criteria will assist manufacturers in their attempts to satisfy the needs of boom purchasers.

The offered boom criteria include:

1. Size and Oil Containment

2. Stability and Wave Conformance

3. End Connections

4. General Requirements
    (a) Tension Strength

(b) Fabric Characteristics
(c) Towability
(d) Fire Resistivity
(e) Weight
(f) Cost
(g) Color
(h) Cleaning

5. Storage and Handling

6. Personnel Acceptance

SECTION IV

BOOM SIZE AND OIL CONTAINMENT CRITERIA

As a result of one year's experience with the New York City Fire Department's demonstration grant Project 15080 FVP, a definite conclusion was reached as to the size of the containment boom best suited for use by an emergency service. This conclusion was based on the Fire Department's Emergency operations at fifteen spills, and on observations made at twenty-two other spills at which the Department's containment services were not required. This local experience was supplemented by research into available authoritative information on spills, and the performance characteristics of manufactured oil spill containment booms.

Originally it was felt that a deep draft boom might have to be specified for Project equipment. This early concept of a need for a deep draft boom was based on the possibilities of spill accidents occurring in the busy waterways of the Harbor where fast tidal currents flow, such as the North River, with currents up to 2.8 knots; the East River, with 5.2 knots; the Staten Island Kills, with 2.4 knots; and lastly, the Upper Bay, with 2.2 knots (1, 4).

It can be observed from these current conditions that during most of the tidal cycle, even a deep draft (24" skirt) boom cannot be expected to contain a spill effectively. From the recent US Coast Guard boom tests in the Gulf of Mexico, we learn that oil spill leakage by entrainment beneath a 27" submerged skirt seemed considerable at current speeds which reached only 1-1/2 knots, even though the captive pool of oil was only a few inches deep (3). Relating this reported oil spill loss beneath a deep draft boom, to the current conditions encountered in New York Harbor, we can readily conclude that right angle boom containment particularly, would be futile in midstream where the maximum velocities are achieved.

However, current meter readings taken during the course of the Project at piers, in slips, at bulkheads and in coves, indicate that even at peak flow periods, the high velocity currents in midstream were vastly greater than in the sheltered areas where most spills occur. Near the shoreline installations referred to, currents were usually less than 1/2 knot, and this velocity is within the capability range of a boom having a 12" skirt (5). At no spill incident during the course of the Project was oil observed washing over a boom having a 6" freeboard as a result of natural causes (wind and wave). Where surface losses were observed, the 6" sail was not inadequate. The leaks occurred at boom connection joints or through terminal gaps. The connector joints of the ideal boom would be oil tight and sufficient flotation at joints would prevent loss of buoyancy at the joints. Since terminal leaks cannot be attributed to boom deficiency, sealing of the terminal gap by hydraulic or mechanical means is suggested. As boom experience accumulated, it became apparent that a containment boom having a freeboard barrier of 6", and a submerged skirt of 12" would best suit the Fire Department's requirements. (A modest increase in these dimensions might be considered if the somewhat larger boom falls within the performance, weight, handling, cost and storage parameters established for the 18" boom).

Since the vast majority of the oil spills requiring boom containment occurred in waterfront areas where the current velocity is 1/2 knot or less, little oil droplet loss can be expected beneath the 12" skirt of an 18" containment boom used under such current conditions. Any loss rate reduction which might be sought by increasing the depth of the boom would be very small indeed. On the other hand, the weight penalty and the additional strength requirements associated with a deeper boom are quite high for the relatively small payoff, as the strength requirement increases at least linearly with depth; thus the quick deployment possible with light, flexible boom cannot be achieved with the heavier, more rigid deep draft boom.

Note: Since recovery of oil must be undertaken shortly after a spill is corralled (if the containment effort is to be successful), plans must be made to institute skimming as soon as possible.(4)

To further explain the preference of a light containment boom for harbor service, it is appropriate to describe the two spill incidents which did occur in fast moving currents during the course of the Project. These incidents, we believe, illustrate the problems related to the use of boom in fast currents:

1. The first incident happened in the East River. A towed oil barge carrying #6 fuel oil ran aground off Jackson Street, Manhattan, and opened a hull seam. The current running in the area was about 2 knots. The tow boat captain towed the leaking barge up river to a somewhat sheltered mooring site where containment operations were undertaken. The spill was contained at the mooring site by the use of a light boom supplied by a contractor while skimming operations were undertaken. The quantity of oil spill was estimated at 1,000 gallons.

Conclusion: Any attempt at encircling the barge with boom while underway or even moored in the fast current, would have been unsuccessful. Even though a considerable quantity of oil did escape before the barge was surrounded by boom, a large quantity was recovered from the combined containment and skimming effort in the sheltered location.

2. The second incident involved a gasoline barge which suffered a split hull seam as the result of a collision in the East River off the Port Authority Pier #3. The current running in the spill area was about 1.5 knots. Initially, some light Fire Department boom was used to contain a fire foam blanket until an improvised plug could be inserted in the hull fissure. An efficient contribution to minimizing the fire hazard to the nearby pier and dissipating the gasoline vapors was supplied by

the heavy calibre streams and propeller wash of two fireboats, which diverted the spill away from shore.

Conclusion: Boom containment in this instance served only to retain the fire foam blanket while an effort was being made to control the spill. A light, quickly deployable boom was used for this purpose. Wisely, the barge was removed to open water to allow for the harmelss dissipation of inflammable vapors and fire streams were used to assist the process until the gasoline in the damaged compartment could be transferred to secure storage.

In neither of these two incidents could the use of deep draft boom have been successful while the vessels were in the fast moving currents (5).

But it should not go without mentioning that boom has been reported as being used to contain or divert slicks in fast moving currents. One method is the encirclement of the slick by a boom and permitting the array to go downstream with the current until a quiescent area is reached. Then recovery is undertaken. Another method is to divert the spill by angularly held boom toward a pickup location.

SECTION V

BOOM STABILITY AND WAVE CONFORMANCE

Although intended for harbor area use, and for limited periods of exposure, the ideal boom must be sufficiently stable to withstand the effects of a 15 knot wind without failing, and without material loss of its stability. It is assumed that a 15 knot wind will create a chop condition and also generate a surface current slightly less than 1/2 knot. Also, the boom must be sufficiently flexible and possess a sufficiently high buoyancy-to-weight ratio and waterplane area to conform to waves up to 2 ft high, without loss of oil (4).

Boom stability is achieved by the nature of the boom design, including its flotation and ballast systems, and its tension members. Of the factors which might render a boom unstable, the accidental partial loss of its flotation seems to be the most likely. Flotation loss has been observed with booms having detachable floats, when these floats somehow come loose from their fastenings. Similarly, fabric tears can permit plastic flotation pellets to escape from a flotation capsule. This reduction in flotation means that the boom can lose buoyancy and become unstable, allowing oil to escape from the captive pool. The ideal boom's flotation should be protected by complete encapsulation within tough enclosure pods, and sections of closed cell foam should be used to avoid accidental loss of flotation through tears or punctures in the fabric.

Ballast weights should be preferably contained within the boom fabric to guarantee against loss or disturbance and to provide the design boom stability. Enclosure would also preclude loss of ballast and prevent snagging of the boom. Unfortunately, however, ballast is not very effective alone in providing stability although it is necessary for wave response. Consider a weightless flat plate suspended from a "hinge" at the water surface, with the flow against the flat face of the plate. For a plate one foot deep, in a one ft/sec current, a weight of 2 lb/ft will allow the plate to be deflected nearly 30° from the vertical. In the absence of a separate tension member - bridle scheme, stability in a current appears to be best obtained through the even distribution of tensile stress over the fabric (with integral re-inforcement such as sewn or bonded-in listing, if desired), and the curved configuration of the boom in use.

SECTION VI

BOOM END CONNECTIONS

The two most consistently observed causes of oil loss from booms in use have been the leaks at boom terminals and at connections between sections of boom. Leaks between the ends of dissimilar boom were particularly noticeable. All of these leaks can be avoided simply by proper design and standardization of end fittings.

Terminal leaks cannot be attributed to any particular boom deficiency, but rather to a lack of an efficient, readily available means for sealing the gaps between the boom terminals and the vessels or bulkheads to which the terminals are secured. In recognition of this deficiency in boom operations, a dynamic boom terminator was developed and employed during the course of the Project, whereby the propeller current of an outboard motor was utilized to generate a counter current to seal the terminal gap. Counter currents generated by fire hose streams or propeller streams from small boats were also found to be effective.

For the attachment of the ends of the ideal boom, a leakproof, quick connecting system, requiring no tools, is desirable. The use of the system must be obvious to even untrained personnel, and it should be workable from above water as from a small boat. The end connection should be capable of accommodating a tow line, anchoring equipment, a boom terminator device, or a universal connector for interfacing with booms of different sizes or designs. Leaks between similar and especially dissimilar boom systems must be considered. The inclusion of sufficient flotation at these joints is necessary to preclude sagging at the connection. Another important requirement for a boom connector system is its ability to distribute tension stresses to the fabric and tension members without chafing or tearing, and thus avoid damage to the boom itself at the connection point.

In response to the need for a universal boom connector to attach different types and different sizes of boom, during the course of the Project some experimental adaptor plates were fabricated from light aluminum stock. These light plates are merely narrow strips of aluminum, measuring 4" x 18" and 4" x 36" with two rows of bolt holes drilled at intervals to match grommet holes installed in the boom ends and accept tension lines. The use of these plates will allow one type of 18" boom to be joined to another type of 18" boom, or 18" boom can be connected to 36" boom. Further development and standardization of a universal end fitting is strongly urged.

SECTION VII

GENERAL REQUIREMENTS

The following general performance requirements would contribute toward the effectiveness of a lightweight, flexible boom intended for emergency harbor service:

Tension Strength

The boom's fabric should contain the flotation pods, ballast and vertical stiffeners, and should be strong enough to eliminate the need for outside chain or cable tension members. The tensile strength of the fabric and reinforcements should, therefore, be capable of withstanding total tension stresses up to 6,000#. It was noted that some boom fabrics which purportedly could withstand high stresses, failed at their seams. The tensile strength at overlaps or seams should be at least equal to the fabric itself.

Tension strength should be distributed equally throughout the 18" of the boom width, so that tears which have been observed to be the result of unequal stresses, when separate tension members are provided, would be avoided.

Another fault that the suggested integral tensile strength would correct is that caused by human oversight, which neglects to connect chain to chain or cable to cable at boom ends. Furthermore, the snagging problems created by cable or chain appendages would be eliminated.

Fabric Characteristics

Besides providing for the boom's tensile strength, the fabric must be made of a tough, abrasion resistant material impervious to the sun's heat and ultraviolet radiation, the coldest anticipated temperatures, the effects of salt water, and all types of petroleum products for reasonably long periods of time. It can be expected that the boom's fabric will be subjected to the scuffing and abrasion on rough concrete surfaces, to the sharp wood splinters of pier stringpieces, and even to the impact of nails and spikes. The fabric must resist any tendency to tear after it has been cut or punctured, requiring a high notch strength. Some boom fabrics observed cannot withstand this type of torture treatment and even tend to crack in cold weather.

But the ideal boom fabric must, if it is to serve its purpose, be exceptionally durable. The emergency service boom will be launched and retrieved frequently, but would not be expected to be in the water for very long periods of time, as would the boom used at a bulk storage plant or by a clean-up contractor. It is in the handling of boom that most damage and wear to its outer fabric can be anticipated. Therefore, there is a need for a tough, resilient boom fabric.

Towability

At times it may be necessary for a fireboat to tow several hundred feet of boom to a spill location, possibly against the current. This is the most severe type of towing to which a boom could be subjected in a harbor. For a boom to give satisfactory harbor service, it should be towable from one end, up to 5 knots without physical damage. Dynamometer tests indicated a total stress of 230 lbs for 300 ft of 18" boom which was towed in a tailed-out attitude at about 5 knots behind a fireboat. The smooth design and limited bulk of the ideal boom should keep tow stresses well within this limit, and the equal distribution of tow tension throughout the boom should insure against fabric failure.

The boom's flexibility and smooth design must provide sufficient water mobility to permit easy deployment and oil herding even by a small boat with an outboard motor. Towing of 200 ft or 300 ft of boom tailed-out in a straight line could be handled with relative ease by an outboard-equipped small boat in a sheltered area. For oil herding purposes, two 6-1/2 horsepower outboards could tow a "U" configuration of the boom in a quiescent area.

Fire Resistivity

An oil containment boom must serve its prime function in controlling the spread of accidentally spilled oil. If the fire resistive feature does not restrict the performance of this function, fire resistivity may be accepted as a desirable and added bonus. However, at the present time the following characteristics of the "fire resistive" booms are inconsistent with the criteria for an ideal boom for harbor service:

To begin with, the weight and physical dimensions of this type boom, as well as assembly requirements such as float attachment or connection of boom sections, preclude fast launching and easy retrieval. Those fire-resistive booms investigated are not adaptable to the storage facilities and launching facilities commonly used. Fire resistive booms now marketed might be suitable for use as constant barriers in areas where the spill frequency is high, but their use by an emergency service would not be feasible.

It would not be possible to prescribe the use of such a boom for use as a fire control implement. There is no available record of the use of such a boom at actual fire operations and it would be unlikely that a fire department would adopt this technique in favor of present fire extinguishing methods. Present fire control systems in a harbor can be activated quickly and certainly have greater flexibility than a system for surrounding a spill fire prior to commencement of extinguishment operations.

The cost of "fire resistive" boom is considerably higher than the proposed ideal boom would be, and higher than most comparably sized containment booms.

Weight

Being a lightweight boom, the optimum weight recommended is somewhat less than 2 lbs per foot. This prescribed weight will allow for the necessary structural components, insure the boom's performance in the water and yet be easy for a small work crew to handle.

Cost

The ideal boom must be attractively priced so that purchasing agents with limited funds can consider procurement of the boom in meaningful quantities. Although cost estimating for a manufactured product is rather risky, the ideal boom should be marketable at less than $12.00 per foot. The useful life expectancy of the ideal boom, with reasonable maintenance care, should be a minimum of five years.

Color

A bright yellow would provide for ready identification of the boom as an area to be avoided by unconcerned vessels, thereby contributing to the reduction of boom damage caused by boats.

SECTION VIII

BOOM STORAGE AND HANDLING

Provisions for the storage and use of oil spill containment boom were never dreamed of when existing harbor vessels, docks and waterfront storage buildings were designed. Therefore, in establishing the performance criteria for an ideal boom, adaptability to existing or easily created storage facilities is a matter of concern. Criteria for maximum storability in space available and for easy handling by limited personnel were an outgrowth of Project experience. Operational tests of several modes of storage were undertaken with four types of boom. The booms were: (a) a heavy 36" boom having self-contained flotation, weighing about 4 lbs per foot; (b) a light 36" boom with attachable flotation, weighing about 2 lbs per foot, and (c) two types of light, 18" boom with self-contained flotation, one of which weighed 1.5 lbs per foot, the other about 2.5 lbs.

Dockside Storage

Before storage and deployment facilities could be prepared aboard a fireboat, boom was stored at dockside for quick loading in case of a spill emergency. Boom was hand-carried from the dock, then flaked out along the length of the boat's deck for easy launching at spills or test exercises. It soon became apparent that light weight and considerable flexibility would be necessary if the standard crew of four men were to work rapidly and with ease. The type (a) boom which weighed more than 4 lbs per foot proved to be too heavy and cumbersome to be considered as an emergency service boom.

Other handling and storage problems related to delays caused by affixing floats and/or storage problems associated with the type (b) boom and the handling of one of the type (c) booms because of rigid longitudinal members. These made handling difficult when changing direction, stacking for storage, flaking on deck and retrieving over the boat's rail. The need for on-boat storage became apparent. Loading of 200 feet of a type (c) boom with 6 foot articulations from the dock to a deployment array on a boat deck took six minutes, compared to a "typical" overall response time (call to on-scene) of ten minutes, when stored on the boat.

The possibility of storing boom on pallets or in nets and then lifting it aboard the fireboat with the boat's power davit had to be rejected. It was found that at low tide the boat's davit was too low to lift the boom over the dock edge. However, this obstacle can be overcome when planning a shoreside boom storage depot by providing loading equipment ashore or utilizing a mooring facility having a sufficiently low profile. Also, if dock storage must be resorted to, those comments which follow relating to pallet, reel or box storage aboard a boat, apply.

Boat Storage

Three modes of boat storage were tested for booms up to 300 feet in length, namely storage on a large hose reel; in a sheltered deck area on wood pallets and lastly, in a storage box. Due to limited deck space, and to avoid interference with the fireboat's primary function, it was not possible to carry boom already flaked out along the length of the boat's deck. This restriction would also apply to any harbor craft for which oil spill control is a secondary job. The objective was to determine the best storage mode and the boom design criteria dictated by storage.

Reel Storage

The possibility of storing a boom on a large reel was given consideration. To test the concept, a fire hose reel measuring 5 feet overall in diameter, 5 feet wide and containing a spool 5 feet long (width of the reel) and 9 inches in diameter was made available. The reel was situated on the main deck at the stern of the fireboat. Three hundred feet of 36" boom with attachable floats were used in this experiment. With the flotation removed, the boom was wound around the spool of the reel. When used the reel was turned to unwind the boom and the floats were attached. The services of two men were required to affix the floats, one man on each side of the boom. Unreeling also required the commitment of two men. In a timed test, four men launched 300 feet of this boom in approximately 18 minutes, compared with 3 minutes for a light boom with integral flotation.

It was determined that application of the reel storage concept was incompatible with the self-contained flotation concept of the ideal boom. Flat storage is preferable for the ideal boom, not only because of the usual availability of such storage, but because of the build-up problem which would occur if it were reel-stored. Build-up on a reel would mitigate against compact storage. However, a recently developed 15" boom, designed for harbor service having self-contained flotation, is reported as being adaptable to reel storage.

Some of the disadvantages associated with reel storing boom with detachable floats proved to be: the large storage space requirement of floats; the tedious jobs of attaching and detaching the floats; the launching delay caused by float attachment; the tendency of floats to become detached.

Deck Storage on Pallets

This mode of storage is comparable to box storage insofar as the boom's readiness for use is concerned. The ideal boom could be stored on standard wood pallets, since it would be sufficiently flexible to conform to pallet dimensions, and the boom's limited bulk would allow for quantity storage. It must be expected that pallet storage is not as orderly as box storage and spillage of the boom over the pallet sides can be expected. Although the ideal boom should be impervious to the elements, storage in a protective box would keep it dry and free of ice in winter, and therefore insure easier handling. Box storage is also more orderly than piling the boom on deck. Launching of 300 feet of 18" boom with self-contained flotation can be expected to take approximately four minutes or less, as opposed to eighteen minutes for boom to which flotation members must be attached.

Box Storage

An 18" lightweight, flexible boom described herein as an ideal boom for emergency harbor service is very adaptable to storage in boxes of varied dimensions. The dimensions of a storage box would be dictated in most cases by the amount of deck space available for this use, and the dimensions of the flotation units. Some available 18" booms with contained flotation would require boxes between 6' - 7' long due to the length of their rigid structural members. Space limitations may preclude or severely limit the storage or use of these booms.

The bulk requirements of the ideal boom should be kept within limits which would not only assure satisfactory performance while in the water, but would also assure that meaningful quantities of boom could be stored aboard the emergency response vessel. Excessive flotation bulk should be avoided and maximum flexibility provided by articulations every 2 feet or less.

To insure that adequate quantities of boom could be carried aboard a fireboat or similar harbor craft, the ideal boom would occupy about 25 cu ft per 100 ft of boom. A box measuring 6 ft long by 4 ft wide by 3 ft 6 in. high would be more than ample for 300 ft of such boom. A box measuring about 4' x 4' x 3' 6" could hold 200', and one measuring about 8' x 3' x 3' could contain 250 ft of the ideal boom. It might be noted that a box higher than 4 ft above a deck becomes inconvenient for easy removal and replacement of even the light boom recommended. This box should be placed in a vessel's stern section so that boom can be launched and retrieved over the stern.

Project experience indicates that such a box should have one end and its cover easily removable, with its floor raised slightly above the deck, and should contain provisions for drainage. A convenient construction material for the suggested storage box is 3/4" marine plywood.

General Recommendations

1. Because of its excessive weight and bulk, heavy 36" boom is not adaptable to the needs of a quick emergency response service for a harbor.

2. A recommended optimum boom weight would be two pounds or less per foot. The lighter booms tested approximated this weight limitation and posed no handling or exertion problems for personnel.

3. Flexibility is a necessary boom requirement for handling and storage as well as oil containment. A boom array must be susceptible to easy change in direction when being launched, retrieved, deployed in the water, flaked on deck and stored. Longitudinal rigidity and infrequent articulations are objectionable features in a boom. Frequent articulations (possibly every foot or two) are desirable.

4. To facilitate handling, the upper portion of a boom should be provided with hand grips at least at 5-ft intervals. Having to grab a smooth, possibly slippery surface is inefficient and frustrating. Such grips could also be used for line attachment when retrieving and hauling boom aboard a boat by the vessel's power capstan.

5. The ideal boom should be offered in lengths of 2 sizes, 100 ft and 50 ft. The shorter length would be intended to fill out a boom complement and squeeze as much boom as possible aboard a boat. Operationally, the 100 ft lengths would be preferable since end connections would be kept to a minimum.

6. The exterior surface of the ideal boom should be smooth enough to run over a boat's cap rail or a pier's stringpiece without snagging. A smooth surface will, of course, also facilitate towing. Hardware protrusions are unacceptable for an emergency service boom because of snagging and personal injury possibilities.

SECTION IX

PERSONNEL ACCEPTANCE

In the belief that if a tool works well and is easy to use it will be accepted by those using it, the suggestions and gripes of firemen handling various types of boom were collected and evaluated.

Feed-back from the men related to their observations concerning some boom failures at spills; to the durability and weaknesses of boom construction material; to the handling characteristics of boom in regard to launching, retrieval and storing; and lastly, to boom cleaning problems.

These personnel suggestions, although offered in an informal manner, were given thoughtful consideration, and where appropriate, were included in the criteria for the ideal boom for harbor service.

SECTION X

ACKNOWLEDGMENTS

The practical use of various types of containment boom at actual spills and at numerous test exercises provided the basic information for this report. The Officers and Members of the Marine Division of the NYFD and the personnel of Alpine Geophysical Associates were the principal project participants.

The guidance of Mr. Howard Lamp'l, EPA Project Officer, and the cooperation of the City of New York and the US Navy in providing the test basin at Wallabout Creek, Brooklyn, New York, is gratefully acknowledged.

SECTION XI

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16. Abstract

This report attempts to describe performance criteria for an ideal oil spill containment boom for emergency harbor service. The type of boom recommended is that which an emergency service, such as a fire department or a plant team could transport promptly to a spill incident within a harbor and deploy quickly to contain the spilled oil. The experience acquired by the Marine Division of the NYFD over the course of one year, both at active spill control operations and in test exercises, serves as the principal source of information for this report. It is hoped that the information offered will lead to the development of the ideal boom as envisioned.

Among the boom criteria developed are: recommended size and performance capabilities; storage and handling problems; optimum design characteristics.

This report was submitted in partial fulfillment of Project Number 15080 FVP, under the partial sponsorship of the Water Quality Office, Environmental Protection Agency.

17a. Descriptors *Oil Spills, *Harbors, *Water Pollution Control

17b. Identifiers *Concept, *Oil Spill Containment Boom, *Fire Department, *Emergency Service, Performance Criteria, Quiescent Water

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