I would like to thank the committee members for the opportunity to speak here before you today. My name is Robert C. Krause, I am a Battalion Chief with the City of Toledo, Ohio, Fire Department. I am not here representing or speaking in an official capacity on behalf of the Toledo Fire Department. I’m here to provide testimony as a subject matter expert in the area of firefighting strategy and tactics, incident command and fire ground operations. I have undergraduate and graduate degrees in fire and safety engineering and homeland security management. I am a firefighting instructor and have trained numerous firefighters in the United States, including here in Connecticut at the State Fire Academy in Windsor Locks in 2007 as well as throughout Canada and the Middle East. I am a Hazardous Materials Technician as well as an Incident Safety Officer. I have more than 30 years experience in the area of emergency services. I have been the incident commander on a variety of fuel spills in my jurisdiction including the port within the City of Toledo.

I want to address preemptive booming as it is currently being used in the New Haven Harbor. I have personally been to the New Haven Harbor and toured the area by boat. I also surveyed the numerous businesses in the New Haven Harbor area, the infrastructure, and I have considered the proximity of ignition sources and potential for confined space accumulation of gasoline vapors. It is my opinion, which is supported by texts and articles that the booming process is a safe and effective safety measure used in the off-loading of gasoline from ships and reduces risk to public health.

In the United States and Canada first responders carry with them in their apparatus a manual entitled the Emergency Response Guide (ERG) produced by the U. S. Department of Transportation (DOT). This text is widely circulated and used by firefighters that respond to fires and hazardous materials incidents. Once the product being spilled is identified the responder uses the ERG to guide them in their initial actions in mitigating the hazard. Gasoline has been given the DOT identification number of 1203. Guide 127 contains in part the following instructions for firefighters when dealing with spills…

- ELIMINATE all ignition sources
- Stop the leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
• A vapor suppressing foam may be used to reduce vapors.

What must be remembered when dealing with gasoline vapors is that before a fire or explosion can occur, three conditions must be met simultaneously. The fuel (in this case gasoline vapor) and oxygen (air) must exist in certain proportions, along with an ignition source, such as a spark or flame. The ratio of fuel and oxygen that is required varies with each combustible gas or vapor.

Therefore minimum concentration of a particular combustible gas or vapor necessary to support its combustion in air is defined as the Lower Explosive Limit (LEL) for that gas. Below this level, the mixture is too “lean” to burn. The maximum concentration of a gas or vapor that will burn in air is defined as the Upper Explosive Limit (UEL). Above this level, the mixture is too “rich” to burn. The range between the LEL and UEL is known as the flammable range for that gas or vapor.

Gasoline vapor also has a vapor density of 3.0 - 4.0 meaning that it is heavier than air and will stay low and travel across the surface of the water or ground. The tendency of gasoline vapors to rapidly sink in air also explains why boats blow up at the gas dock…vapors sink down into the cabin, engine room or some other enclosed area where the concentration of gasoline vapors in air can build to above 1.4% , and if there’s a spark or open flame, it’s big trouble! This same phenomenon is why most building codes require hot water heaters in garages to be mounted on a box or platform, so the burner is about 2 feet above the garage floor where explosive gasoline vapors could be accumulating.

Do not be misled by the flash point of gasoline alone. The flashpoint of a flammable liquid is the temperature at which a liquid will give off sufficient flammable vapor for ignition to occur. This means that once the temperature goes above this point the liquid is giving off vapors which if an ignition source is found, will ignite. (gasoline flash point = -35)

Just reaching the flashpoint and having a source of ignition is not sufficient for the fire to occur. There has to be the correct ratio of fuel to oxygen to produce fire. The range of gas or vapor concentrations which will burn or explode if an ignition source is present is called the flammable limits. The two limits of the concentration are known as the lower explosive limit (LEL) and the upper explosive limit (UEL). Below the LEL the mixture is too lean to burn and above the UEL is too rich to burn. The ignition temperature of a flammable liquid, which is entirely different from the flashpoint, is the temperature at which the vapor will ignite without a spark or flame being present.
In an article published in Firehouse Magazine in March 2008 author Jonathan Riffe, of the Washington D.C. fire dept. wrote this following…

"Fires that involve gasoline will require foam since gas floats on water. Water will dilute the E85 and foam will smother the fire just as it does with gasoline fires. However, given the fact that ethanol is water soluble, foam will deteriorate more rapidly in E85 than with gasoline."

There are alcohol resistant foams (AR-AFFF) on the market. The International Association of Fire Fighters newsletter *Across the IAFF* says "Alcohol resistant foam must be used during any emergency involving gasoline that is blended with ethanol. The ethanol content prevents the formation of the film between the foam and the gasoline mixture and will break down the applied foam, rendering any non-alcohol resistant foam virtually useless".

If AR-AFFF is not available, use more conventional foam to compensate for the breakdown. In the words of one of the automotive engineers at GM we spoke to; "Firefighters should prepare for the worst." The more dangerous component of E85 (or any other ethanol blend) is the gasoline. Don't make it any more difficult than need be, it's a gasoline fire." Even the DOT Emergency Response Guide (ERG) for both liquids is essentially the same with the exception of the previously mentioned AR-AFFF. A simple solution to fighting fires that involve ethanol (or any other blend) is to use AR-AFFF; it will work on all gasoline fires regardless of the blend.

Written in June 2001, A joint publication of the: American Petroleum Institute, National Oceanic and Atmospheric Administration, U.S. Coast Guard, and U.S. Environmental Protection Agency entitled *Characteristics of Response Strategies: A Guide for Spill Response Planning in Marine Environments*, has addressed the use of booming and recommend it's use when public health is at risk and when safety procedures are used.

Reviewing the New Haven Fire Marshall’s Annual Report for 2005, a document which among other things lists the department’s responses to fires and emergencies from 2000 to 2005. That report did not identify a single response to a hazardous materials incident relating to a fuel spill at the port. On January 23, 2006, between 2000 and 4000 gallons of gasoline leaked from a barge into New Haven harbor and as reported in the *Yale Daily News*, “the barge had a containment boom in place when it started unloading, but the New Haven Fire Department deployed additional booms to further contain the spill.”
I believe the research is clear, booming of gasoline is an effective method of spill control when the public health is at risk. Even the New Haven Fire Department deployed additional booms at the Motiva Terminal, in 2006. The U.S. Coast Guard, the U.S. Environmental Protection agency, the American Petroleum Institute and the National Oceanic and Atmospheric Administration include booming in their 2001 publication, Characteristics of Response Strategies: A Guide for Spill Response Planning in Marine Environments.

While you can’t insulate yourselves from all risks, anything that can improve awareness and the management of risk is worth exploring. The question should be asked are you willing to risk the movement of gasoline throughout the harbor, gasoline that may find its way into ship hulls and intakes, under docks, near fishing piers and restaurants. And if you are willing to take that risk, are you willing to risk the accumulation of enough of the product in which it may reach its flammable range and find an ignition source at multiple locations throughout the harbor?

Localizing a potential spill near the ship where fire suppression equipment with vapor suppressing foam is readily available is by far the best preventative measure in spill control. Allowing gasoline to flow throughout the harbor sets the stage for multiple ignition points, multiple fires and potentially an untold numbers of casualties. The use of preemptive booming has been occurring for over twenty years. There have been no serious fires or explosions as a result of this booming process, and when faced with a spill in 2006 the New Haven Fire Department chose to deploy additional booms. The preemptive boom certainly helped mitigate a more significant spread of the gasoline. That historical perspective should illustrate the effectiveness of preemptive booming in providing a blanket of safety for the community and the surrounding environment.
References


Committee Hearing Transcript for March 21, 1994 for Raised House Bill 5122.


Reference Material

- Gasoline (LEL 1.4 to UEL 7.4) = 6 vapor density (3.0 – 4.0) the ignition temperature 853°F flashpoint -36°F

- Crude Oil (LEL 1.0 to UEL 8.0) = 7 Flash Point 20 - 90 degrees

- ethyl ether (1.9 – 36) = 34.1 vapor density (2.6) ignition temperature 320°F flashpoint -49°

- methane (5.0 – 15.0) = 10 vapor density (0.6) ignition temperature 1004°F

- ethyl alcohol (3.3 – 19) = 15.7 vapor density (1.6) ignition temperature 689°F flashpoint 55°F

E85 Versus Gasoline

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<tr>
<th>Properties</th>
<th>Ethyl Alcohol</th>
<th>Gasoline</th>
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<tr>
<td>Boiling Point</td>
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<td>Solubility</td>
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<tr>
<td>Visible Flame</td>
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<td>Yes</td>
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The New Haven Fire Department has a fire station located near the intersection of Forbes and Woodward, a short distance to the fuel transfer locations.