ICOMIA

INTERNATIONAL COUNCIL OF MARINE INDUSTRY ASSOCIATIONS

GUIDELINES TO MINIMISE OIL SPILL AND EMISSIONS FROM FUEL EVAPORATION

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I. Introduction:

As stated in the ICOMIA Sustainable Boating Strategy document, a main objective of the organisation is to establish 'environmental care' as a core value of the recreational boating industry. This implies the industry is committed to minimize possible harm to the environment.

Businesses as well as individuals are responsible for complying with environmental regulations and for preventing pollution of air, land and water. To avoid being driven by legislation, it is important for the industry to be proactive by self-regulating.

Although the consequences of spill of oil and fuel, and emissions from fuel evaporation from recreational craft may be minimal in comparison with similar spills caused by for instance ships and ship wrecks leaking e.g. large amounts of crude oil, it is important the boat industry is demonstrating a high level of environment responsibility.

II. Legislation, standards and regulations:

Australia:

In March 2003 the Transport SA, Marine Group, issued the "Refuelling Guidelines" as part of their "Protecting Our Coastal Waters" campaign "Doing it better". In Australia diffusion through hoses and containers is regarded as being minute compared with careless handling and spillage from for instance worn hoses. Thus the said document is concentrating on the process of refuelling, stating for example that "Only when refuelling on shore is not possible should over-water refuelling be considered an option." The document gives recommendations to be followed before refuelling, during refuelling and after refuelling while focussing as much on safety as on environmental issues specifying

- best practice: "Sealed coupling used for refuelling from wharf dispenser or road tanker",
- better practise: "Refuelling by hand dispenser - absorbent cloth ready at hand", and
- least preferred: "Decanting of fuel by hand increases the chance of spillage".

USA:

In 1972 The Clean Water Act (CWA) was signed into law (subsequently amended in 1987) regulating discharges of bilge water for all vessels in navigable U.S. waters, prohibiting all *discharge of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone.*

On April 3 2007 the Environment Protection Agency (EPA) published their proposed rules for "Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less than 30 litres per Cylinder". On April 17 2007 the Agency published their proposal for "Control of Emissions from Nonroad Spark-Ignition Engines and Equipment" focussing on new engines with the intention of substantially reducing emissions. While the former is concentrating on exhaust emissions, the latter 280 pages document includes proposals for "Evaporative Emissions Standards". The document proposes limits on *Fuel Line Permeation*, on *Fuel Tank Permeation* (fuel tank permeation may occur through the panels of fuel tanks fabricated from other materials than metal e.g. polymers), on *Diurnal Emissions*, on *Diffusion*, as well as an outline of *Requirements Related to Refuelling.* The proposal includes for instance requirements for fuel hoses having a permeation rate of maximum 15 g/m^2.
EPA proposes the new standards be implemented during the period 2009 - 2013.
For full document see <http://www.epa.gov/otaq/regs/nonroad/marinesi-equipld/nprmpreamble.pdf>.

Europe:

To minimize spill and evaporation of fuel and oil, clause 5.8 of the EU Recreational Craft Directive (RCD) requires that *Craft shall be constructed so as to prevent accidental discharge of pollutants (oil, fuel, etc.) overboard.*

This requirement is further elaborated by two of the harmonized standards supporting the RCD:

ISO 10088:2006 on permanently installed fuel systems, Clause 5.1.5:
The fuel filling system shall be designed so that accidental fuel spill does not enter the craft or the environment when it is in its static position"
and
ISO 7840 on Fire-resistant fuel hoses, Clause 5.7:
A permeation rate shall be tested ... and be classified in the following way:
Type 1 shall be hoses with a permeation rate of 100 g/m^2 or less per 24 h.
Type 2 shall be hoses with a permeation rate of 300 g/m^2 or less per 24 h.

While the harmonized standards supporting the EU Recreational Craft Directives specify ways to fulfil the Directive's minimum requirements, the *international* (ISO) standards from which they originate do not have the same power outside the EU. Nevertheless they are giving relevant and important information.

III. How can industry contribute to minimise fuel evaporation?

Fuel evaporation is far greater for petrol than for diesel oil (in the USA neither EPA nor California have plans to regulate evaporate emissions from *diesel* fuel systems). According to a recent study carried out by TNO (Netherlands Organisation for Applied Scientific Research), as far as recreational craft are concerned *evaporation* is equivalent to between 12% and 20% of the average exhaust emission of hydro carbons (HC). This ratio will increase dramatically as a result of on-going development programs which will bring average HC exhaust emissions down from 24.6 kgs per annum per boat to 3.0 kgs per annum, while average figures related to evaporation remains at a level of between 3 and 5 kgs per annum.

Some sources of evaporative emissions are related to engines and fuel systems, some of them refer to the design of the engines and their breathing system, some are related to the fuel systems fitted by the boat manufacturer, and a few of them are in the hands of the boats' operators such as maintenance routines and

keeping the fuel lines tight. The following engine and fuel system related causes are important contributors to evaporative emissions:

a. Crankcase losses
b. Fuel hose permeation
c. Tank permeation losses
d. Diurnal breathing losses from the fuel tank
e. Refuelling losses.

a. *Crankcase losses (re. engine design):*
This category of losses origins from the "blow-by" of combustion gases past the piston into the crankcase. To prevent pressure build-up, the crankcase is ventilated to the outside. When the engine is operating, the atmosphere inside the crankcase is saturated with hydro carbons (HC). Because of ventilation this HC mist is emitted to the atmosphere. To minimize emission, the crankcase ventilation is rerouted into the inlet system to take part in the combustion process. Thus the crankcase losses are almost non-existent and are no longer regarded an issue.

b. *Fuel hose permeation (re. installation of fuel lines):*
Because of differences in molecular structure petrol will permeate with slightly less resistance than diesel. However, the difference is small and normally not recognised. Hose permeation is dependent on the fuel hose material. At present permeation levels are normally between 100 grams and 200 grams per square metre per 24 hours at 23 degrees C. The relevant clause of ISO 7840 is quoted in Section II. However, hose materials are available that would reduce permeation rate to 15 g/m^2 per 24 hours without making the hoses too stiff and resistant to bending to be practical. In the USA many boat builders are already using such low permeation hoses. The inside of the hose may have a permeation resistant barrier based on for instance polyamide or fluor modified polymers. However, in case of engine room fire the toxicity of emissions is badly influenced by the presence of fluor. The increase in cost compared with "standard" hoses varies with the materials used and the hose construction. With reference to the situation in USA, price difference may be small. However, a price increase of between 40% and 50% is indicated by a major European manufacturer.
Whenever possible the industry should specify fuel hoses with the lowest possible permeation rate.

c. *Tank permeation losses (re. tank manufacture):*
Fuel tanks made of plastics are being fitted into an increasing number of craft. Rotation moulded polyethylene seems a preferred material. However, early versions of tanks made of thermoplastics proved to be permeable to HCs and the resulting evaporative losses were rather high. The automotive industry has carried out comprehensive research to minimize the problem, and treatment with special coatings provides the necessary barrier.
Boat manufacturers fitting fuel tanks made of plastics materials should ascertain that the tank construction and the material used do prevent permeation.

d. *Diurnal breathing losses from the tank (re. fuel system):*
Variation of temperature (for instance by day and night) causes the air inside the fuel tank to expand and contract. This brings about an outward flow of air/fuel vapour mixture during warming-up and an induction of ambient air during cooling down. This natural "breathing" causes emission of hydrocarbons. One way to avoid this emission is to let the tank breath over a vapour recovery system such as a "carbon canister", i.e. a canister filled with active carbon which in turn is purged during engine operation by returning the flow direction from the ambient atmosphere through the canister into the engine intake system to combust the hydrocarbons in the engine's combustion chamber. The EPA (USA) claims that a system as outlined may result in a reduction in evaporative losses in the order of 60%. According to EPA carbon canisters are one technology that manufacturers may use to meet the strict diurnal emission standards in California.

However, before general acceptance the USCG will need to work through all installation issues related to canisters. This includes developing clear instructions that will ensure that the evaporative emissions controls are installed properly and will not compromise the safety of the vessel. These efforts will take time and an implementation date beyond 2010 is necessary.
The USCG also recognizes that the recreational marine industry will require a great deal of training to ensure proper and safe installation of canisters.

e_1. *Refuelling losses (re. fuel system):*
When the fuel tank is refilled, air mixed with fuel is driven out of the tank through the vent pipe and/or the fuel fill pipe while it is replaced by the liquid of the fuel. Various types of vapour recovery systems have been looked into, but practical difficulties are hard to overcome.
The introduction of canisters as mentioned above (d) may be a feasible way to minimize refuelling losses.
The industry should be aware of the negative impact of refuelling losses and of the possibility of fitting canisters to recover these losses (see above).

e_2. *Avoiding spill when refuelling (re. boat design):*
Fuel fill lines, deck plates and tank breather vents must be designed and arranged to avoid spill when refuelling and when the vessel is entering rough water immediately after the tanks have been topped up.
Decks should be designed to ensure fuel spill from overfilling can be properly collected and taken care of.

IV. How can industry contribute to minimise oil and fuel spill from the bilges?

Contaminated water should never be discharged into any watercourse. Consequently recreational craft must be designed and laid out to make sure such discharge is avoided.

Particular attention must be paid to checking that bilge water which might contain for instance lubricants, oil spill, cooling water and leak water from propeller shafts etc. is collected to be delivered to dedicated treatment facilities on shore. Detergents or emulsifiers must not be used in bilge water.

When automatic bilge pumps are fitted where the water may be contaminated, it is important the water be pumped into a special holding tank or container and *not* over board. Oil absorbent pads may be provided.

The industry must provide relevant information to the boat owners and boat users to make sure contaminated bilge water is properly taken care of.

V. What can marinas and pump stations do to minimise oil spill and fuel evaporation?

Marinas and pump stations must be aware of the following main reasons for fuel and oil being spilt and take all possible measures to avoid such spill:

- Fuel and oil-based products may be spilt during delivery or when store tanks are filled;
- Fuel and oils may be spilt because of storage tank leaks, because they are not properly maintained, because they are not correctly bunded, or because they are vandalised;
- Fuel and oils may be spilt because of being kept in poorly designed tanks;
- Oil separators may not be properly used and/or maintained;
- Used oil may simply be poured into drains.

Any marina and pump station should always keep stock of absorbent material (e.g. sand, earth or commercial material) near to facilities where oil is used to contain and remove any spillage that might occur.

VI. What guidance may the industry provide to the boat users?

The industry may include in the Owner's Manual, or in another document delivered with the boat, relevant information to the boat owner and the boat users such as:

- *The risk of pollution from the craft is increased during refuelling, servicing or bilge pumping;*
- *When refuelling, take care not to overfill the tank;*
- *Carefully measure the proper amounts of petrol or diesel when refuelling;*
- *Leave some space in the tank to avoid spillage during normal motion of the vessel;*
- *When refuelling at a pump station check the line has an automatic stop device;*
- *Ensure that no fuel is discharged over the side or into any part of the vessel;*
- *Regularly check that boat fuel line connectors are tight;*
- *Keep the drip tray under the engine clean;*
- *If oil is spilt in the bilge, remove it instantly using an absorbent sheet or pad;*
- *Ensure that bilge water is clean before pumping out;*
- *Pay particular attention when automatic water level sensor bilge pumps are fitted;*
- *Keep a small quantity of oil absorbent material on the craft at all times for instant use if needed;*
- *Oil absorbent pads can be placed in the bilge to absorb any oil or fuel that may be present;*
- *Used oil absorbents should be disposed of properly at approved facilities (hazardous waste);*
- *Use caution when pumping fuel into a portable fuel tank at the gas station;*
- *When filling a portable tank, stay away from the water's edge;*
- *Only use a portable fuel tank you can handle easily and hold securely;*
- *When pouring from a portable tank, use a proper funnel or spout with matching capacity;*
- *Close the vent of portable petrol tanks when the engine is not in use or when the tank is stored;*
- *Transport and store petrol out of direct sunlight in a cool, dry place;*
- *Eliminate unnecessary idling;*
- *Limit engine operation at full throttle;*
- *Follow the engine manufacturer's recommended maintenance schedule;*
- *Prepare engines properly for winter stowage;*
- *When servicing the engine ensure that used oil is collected and taken to an oil recycling bank;*
- *Do not mix used oil with other materials (e.g. paints/solvents) which makes recycling difficult;*
- *Never use detergents or emulsifiers to deal with oil or fuel spills;*

(Note: Filters with material which bonds with oil are available for being fitted into the bilge pumping system.)

VII. Conclusion:

For the time being no legislation is in force to prevent or minimise emissions from fuel evaporation. Nevertheless, in 2003 Australian Transport SA issued their refuelling guidelines as mentioned in section II. In Europe the EU RCD is giving directions for the design of fuel systems and requirements for fuel hoses, and in the USA specific standards are being worked out to be implemented during the period 2009-2013.

However, independent of rules and regulations the boat industry and the boat users should always demonstrate environment awareness paying due attention to these guidelines.

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