

# The Flammability Hazards Associated with the Handling, Storage and Carriage of Residual Fuel Oils

## Oil Companies International Marine Forum - December 1989

This bulletin has been prepared by a working group representing member companies of the Oil Companies International Marine Forum (OCIMF) in order to advise the industry and users of residual fuel oils of the hazards associated with the presence of light hydrocarbons in the vapour spaces of storage tanks. Recent information has shown that a potential flammability hazard can arise from this phenomenon and that additional precautions should therefore be taken when handling residual fuel oils as cargo or fuel.

This document refers only to **residual fuel oils** and **not** distillate fuels and applies to both marine and inland applications. The following points serve to summarise the problem :-

- Residual Fuel Oils must be considered to be potentially hazardous and capable of producing light hydrocarbons which could result in the head space atmosphere being near to, or entering, the flammable range. Proper precautions should be taken to ensure the safety of personnel and property.
- Investigations have shown that there is no direct relationship between the flash point of residual fuel oil and head space flammability. A residual fuel oil, even when stored at temperatures below its flash point, can produce a flammable atmosphere in the tank head space.
- Conventional gas detectors (explosimeters) can be used to give an indication of the flammability of the head space, although they are not primarily designed for this purpose and, therefore, do not necessarily give an accurate measurement.

Residual Fuel Oils are capable of producing light hydrocarbons in the tank head space such that the vapour composition may be near to or within the flammable range. This can occur even when the storage temperature is well below the measured flash point. This is not normally a function of the origin or manufacturing process of the fuel, although fuels containing cracked residues may show a greater tendency to generate light hydrocarbons.

Although light hydrocarbons may be present in the head spaces of residual fuel oil tanks, the risk associated with them is small unless the atmosphere is within the flammable range and close to an ignition source. In such a case an incident could result. It is therefore recommended that residual fuel oil head spaces are regarded as being potentially flammable.

### a. Flash point

Fuel Oils are classified for their safety in storage, handling and transportation by reference to their closed cup flash point. However, recent information on the relationship between the calculated flammability of head space composition and the measured flash point of the residual fuel oil has shown that there is no fixed correlation. A flammable atmosphere can therefore be produced in a tank head space even when a residual fuel oil is stored at a temperature below its flash point.

## b. Gas Detectors

Traditionally, gas detectors such as explosimeters have been used to check that enclosed spaces are 'gas free'. They have also been used to measure the 'flammability' of head spaces in terms of percentage of the lower flammable limit (LFL).

Such detectors rely on a calibration carried out normally on a single hydrocarbon (e.g. methane) which may have LFL characteristics that are far removed from the hydrocarbons actually present in the head space. When using an explosimeter to assess the degree of hazard in residual fuel oil tank head spaces, it is recommended that the instrument is calibrated with a pentane / air or hexane / air mixture. This will result in a more conservative estimate of the flammability but the readings should not be regarded as providing a precise measurement of the vapour space condition.

When taking measurements, the manufacturers operating instructions should be closely followed and the calibration of the instrument should be checked frequently as oxidation catalyst detectors (pellisters) are likely to be susceptible to poisoning when exposed to residual fuel oil vapours.

In view of the problems associated with obtaining accurate measurements of the flammability of residual fuel tank head spaces using readily available portable equipment, the measured % LFL only broadly ranks fuels in terms of relative hazard. Care should therefore be exercised in interpretation of the figures generated by such gas detectors.

Measured levels in excess of 50% LFL are generally considered to indicate that precautionary measures are required.

## Storage and Handling Temperatures

Temperatures in the fuel system should conform to recognised Codes of Practice at all times and excessive local temperatures should be avoided.

## Filling and Venting

When tanks are being filled, tank head space gas will be displaced through vent pipes. Particular care should be taken to ensure that any flame screens / traps are in good condition and that there are no ignition sources in the area immediately surrounding the venting system.

When filling empty or near empty tanks, it should be ensured that the heating coils are shut down and cool. Fuel Oil contacting hot, exposed heating coils could possibly lead to a flammable atmosphere being rapidly generated.

## Head space Classification

All residual fuel oil tank head spaces should be classified as 'hazardous' and suitable precautions taken. Electrical equipment within the space must meet the appropriate safety standards.

## Hazard Reduction

The flammability of the head space of residual fuel oil tanks should be monitored regularly. Should a measured value in excess of the recommended level be detected, e.g. IMO Resolution A.565 (14) states 50% LFL, action should be taken to reduce the vapour concentration by purging the head space with low pressure air. Gases should be vented to a safe area with no ignition sources in the vicinity

of the outlet. On completion of venting, gas concentrations within the tank should continue to be monitored and further venting undertaken if necessary. Once the tank has been purged with air, consideration may be given to inerting the head space should it be practical to do so.

### **Ullaging and Sampling**

All operations should be conducted such as to take due care to avoid the hazards associated with static electrical charges. These precautions would, for example, include ensuring that metallic sampling and ullaging equipment is properly earthed or bonded to the tank structure.

When tanks have to be opened, it is important not to stand downwind of the tank and to ensure that there are no sources of ignition within the vicinity of the tank hatch.

### **Further Guidance**

The following publications give further guidance on safe handling and storage :-

- International Safety Guide for Oil Tankers and Terminals (ICS/OCIMF/IAPH)
- IP Marketing Safety Code (IP)
- BSI Static Code (BSI)
- European Model Code of Safe practice in the Storage and Handling of Petroleum Products (European Petroleum Organisations (European Technical Co-operation- 1980)

Reference should also be made to IMO Resolution A.565 (14) 'Recommended Procedures to Prevent the Illegal or Accidental Use of Low Flash Cargo Oil as fuel'. The above list is not exhaustive and reference should be made to any relevant National Codes of Practice or guidance.