

**FUEL TANK EXPLOSIONS  
THEIR CAUSE, COURSE AND PREVENTION**

**FOR**

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## **1. INTRODUCTION**

This presentation deals with explosions of flammable vapor/air mixtures in fuel tanks, with particular reference to aircraft fuel tanks. We will consider how and why such explosions occur, what damage these explosions can cause to the tank and surrounding structures and how these explosions might be prevented, or the explosion damage mitigated.

The occurrence of explosions in fuel tanks is not a problem peculiar to the aviation industry. Indeed, a large part of our knowledge of the subject comes from investigations into tank explosions in the process industry and marine industry.

Experience has shown that explosions of tanks containing flammable liquids can be devastating events. They can cause not only bursting of the tank itself but also extensive damage to surrounding structures and produce a blast wave that can cause damage to remote structures.

## **2. THE CAUSE OF THE EXPLOSIONS**

In order to get an explosion inside a tank containing a flammable liquid fuel, we need three things.

- 1) A combustible fuel in vapor form.

- 2) Oxygen.
- 3) A source of ignition.

These three requirements are often represented as the three sides of a triangle often called the fire or explosion triangle.

### **2.1 The Oxygen**

The oxygen that is required for the explosion is usually present in the form of air.

### **2.2 The Fuel**

The fuel is provided by the flammable liquid contained in the tank. The liquid vaporizes, or is agitated to produce a mist and so provides a flammable mixture with air in the ullage space or vapor space of the tank. The quantity of the vapor present in the vapor space is critical. If there is too little fuel vapor mixed with the air, the mixture will not burn and it is said to be too lean.

Similarly, too much fuel vapor mixed with the air will also not burn and the mixture is said to be over rich.

The range of fuel vapor in air mixtures that will burn is quite narrow.

The range depends on the exact nature of the fuel, but with aviation fuels, the range is about 1% to 10% vapor in air. The attached table shows the lower explosive limit and flash point for aviation fuels in air at sea level.