

FUEL TANK ENTRY



The Challenge

In order to carry out an entry into an aircraft fuel tank, engineers potentially expose themselves to a combination of hazards and threats that need to be adequately controlled before an entry is made.

Initially when the tank is first opened these threats are IDLH (immediately dangerous to life and health), however when the area has been adequately ventilated and tested, the threats like sources of ignition which may cause explosion and fire are much reduced. The concern becomes exposure to low concentrations of vapours that may have long term (latent) health threats. All operations must be carried out to ensure complete safety of the operators and must comply with all current legislation and standards.

Before the tank entry can take place, a full suite of equipment must be available to ensure that complete draining and ventilation of the space can be achieved in the most efficient and timely manner also that accurate atmospheric readings can be taken to confirm the condition of the space before entry and during occupation. Breathing apparatus and communications systems are used to further ensure the safety of all involved both on initial 'panel removal' and throughout the activity.

Entries may only be made into aircraft that are completely de-powered and earthed (grounded) and any electrical equipment taken into the tank must be intrinsically safe (ATEX) approved. All staff involved in the activity are to be fully trained and competent in the roles assigned to them.

Currently, with the equipment available, company procedures state that a period of 24 hours is required to fully drain and ventilate a tank prior to entry.

A gravity sump drain is used to remove the last of the fuel and this currently takes 4 to 5 hours. After sump draining the aircraft is de-powered and grounded and the tank panels removed. Ventilators are then installed and the tank space is ventilated for a minimum of 24 hours. After ventilation the atmosphere within the space is tested to prove adequate ventilation. (If this is not the case then further ventilation is carried out)

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Current ventilation times are so long because the system is inefficient. It is also very bulky and the ventilators and associated trunking require a large storage space and lots of manual handling and as a result they are not stored in the same location as other Tank Entry equipment. These electrical ventilators are susceptible to water and environmental conditions and have caused faults in the past, creating serious delays in work being carried out. The ventilation ducting used was found to be easily damaged and difficult to set up.

The current breathing apparatus in use consists of mobile trolley units that are cumbersome and awkward to use, these are now aged and there are issues with reliability, serviceability and cost of maintenance.

Solving the Problem

When designing a new unit to replace this aging equipment, financial implications were constantly in mind to reduce the time the task took and to avoid the costs associated with the upkeep of the old equipment. A new way of looking at the problem had to be employed along with innovative ways of approaching the concept.

The resultant design was a unique, mobile fuel tank entry system known as 'Tank Safe' incorporating a fuel drain and pump unit, tank ventilation and gas monitoring equipment, breathing protection, an emergency and communications system with back up air supply in the event of hangar air supply failings. This is contained in a single, towable unit.

In order to remove the need for an electrical system to power the ventilators, hangar supplied air (or a free standing compressor) is used to power Venturi ventilators that have no moving parts and therefore require little maintenance. Ventilation ducting is replaced with a combination of 'hard' suction ducting and 'soft', static-free exhaust trunking that requires less handling and had less potential for damage.

Larger air cylinders within the breathing apparatus system allow for the air to last for 30 minutes which was twice as long as before. This provides more time for emergency escape procedures to be enabled whether that be immediate egress, replacement of cylinders or normal air supply, as a result of the failing of air pressure or drop in air pressure, thus increasing the safety standard.

All equipment is stored inside a single compact trailer unit that may be housed in or outside ready to be towed to the required location for immediate use.

The Benefits

The new (Tank Safe) unit now allows the aircraft to be brought into the hangar at the start of the operation. A pneumatic powered vacuum sump pump is used to drain the remaining fuel from the

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tank. This is achieved in 15 – 20 minutes. During the sumping operation, breathing equipment is set up and tested and the ventilation equipment assembled. The Tank Entry team can now remove the required tank panels and install the ventilation system (suction or positive pressure as required) to ensure that no toxic or flammable vapours are allowed to contaminate the hangar/work area. The ventilation system is installed as soon as the tank panels are removed.

The introduction of hangar air or a compressor, so air rather than electrical power was used, meant that there would be no damage by the elements to ventilation equipment and cost savings from lack of technical delays. The avoidance of separate metal clamps and soft exhaust trunking meant the new hoses removed the likelihood of damage and the associated holdups. Air driven equipment also reduces the chances of damage to the delicate aircraft systems via static and mains discharge.

On average, the new equipment enabled the air within the tank to be **less than 10% of the LEL within just 3 hours (Industry standard safe Entry Level)** of starting the procedure as opposed to the anticipated 24 hours with the old, for which, even the worst recorded time was 19.5 hours. The new breathing equipment system made the task easier for the Tank Entry team who considered it a vast improvement to their working conditions and safety.

Where previously the equipment used was disjointed and bulky, the new self contained unit is designed to house all necessary equipment in a tidy and orderly fashion. Only one trailer containing all equipment is positioned adjacent to the aircraft and within 10 minutes the set up is complete and operations can start.

Not only did the compact design of the new complete system mean that the trailer contained **all** the relevant equipment required for a safe and efficient Tank Entry, it also requires far less storage space than the old equipment so can be stored where required for immediate use.

The compact design of the road going trailer and the lightweight units within also significantly reduces the potential for manual handling issues.

As the new system allows for tank Entry operations to be carried out much more efficiently and in a fraction of the time taken by the old system, **huge cost savings are available.**

Cost Savings

Current Fuel Tank Entry system	
Assembly and setup of equipment	2 hours
Fuel drain/sumping	4 Hours
Ventilation of tank space to 10% of LEL	24 hours
Total time BEFORE entry is made	30 hours

Tank Safe Tank Entry System	
Assembly and Setup of equipment	1/2 hours
Fuel drain / sumping	1/2 Hours
Ventilation of tank space to 10% of LEL	3 hours
Total time BEFORE entry is made	4 hours

Total saving in time **26 hours per task!**

As an example:

If for every minute one of the fleet is on the ground, the cost to the airline is £1.0k, this would equate to a cost of £1,800,000 for a 30 hour tank entry.

By using the **Tank Safe** equipment efficiently, this time frame may realistically be cut to 4 hours equating to a **SAVING** of £1,560,000 for **every** Tank Entry Task!