

Cabin Water Mist – 25 years on

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The Accident to the Boeing 737 at Manchester Airport in August 1985

Manchester B 737 Accident 1985



Manchester B 737 Accident 1985

“4.27 A research program should be undertaken to establish the effect of water mist-spray extinguishing systems on the toxic/irritant constituents of fire atmospheres.”

**UK AIR ACCIDENT INVESTIGATION
REPORT 8/88 – RECOMMENDATION 4/27**

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AIRWORTHINESS AUTHORITY RESEARCH FOLLOWING THE MANCHESTER ACCIDENT

Airworthiness Authority Research Following The Manchester Accident

Research was carried out by the FAA, the UK CAA and Transport Canada to assess the feasibility of using Cabin Water Mist systems to provide protection for occupants from Ground Pool fires resulting from the release of kerosene from ruptured fuel tanks.

Airworthiness Authority Research Following The Manchester Accident

Tests carried out by the US FAA and UK CAA showed that in a post-crash cabin fire event, water mist is effective in cooling the cabin, wetting the materials, and slowing the progress of fire. The system was considered capable of significantly delaying the onset of cabin flashover, providing a more survivable cabin atmosphere and giving occupants greater time to escape the fire.

Airworthiness Authority Research Following The Manchester Accident

The US FAA, Transport Canada and the UK CAA concluded that the system was likely to be effective and presented no insurmountable problem areas.

Airworthiness Authority Research Following The Manchester Accident

However, it was estimated that Cabin Water Mist systems would save an average of 14 lives per year world-wide, or 6 lives in the US, Canada and European countries of the JAA (at the time) and the cost per life saved was assessed to be prohibitively high at US\$m 22 to US\$m 32.

Airworthiness Authority Research Following The Manchester Accident

Furthermore, concerns were raised, at the time, regarding the possible adverse effects of Cabin Water Mist on:

- aircraft systems**
- occupants and**
- emergency evacuations.**

Due to this adverse assessment of benefit, no further regulatory work or research was undertaken by the Authorities.

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SO WHAT HAS CHANGED?

Current Status of Disbenefits of Cabin Water Mist Systems

Transport Canada, supported by the US FAA and UK CAA, has been funding a research project to investigate the feasibility of the installation of a Cabin Water Mist system in the light of recent research and development.

As part of this research the disbenefits of Cabin Water Mist systems have been reconsidered.

Current Status of Disbenefits of Cabin Water Mist Systems

1. The adverse effects of inadvertent operation on electrical and electronic systems

A study carried out by the State Key Laboratory of Fire Science, University of Science and Technology of China into Water Mist Systems suggests that their effects on electrical and electronic systems are benign.

Current Status of Disbenefits of Cabin Water Mist Systems

“Recently, extensive full-scale fire tests have been conducted to evaluate the feasibility of using water mist systems for the protection of electrical and electronic equipment. ...fine water mist was effective in extinguishing in-cabinet electronic fires, as well as fires in a computer room, without causing short circuits or other damages to electrical and electronic components. Water mist has also demonstrated some advantages in suppressing fires in electrical and electronic equipment, in comparison to gaseous agents.”

LIU Jianghong, LIAO Guangxuan, LI Peide, FAN Weicheng & LU Qiang (2003), Progress in research and application of water mist fire suppression technology, Chinese Science Bulletin 2003 Vol. 48 No.8 718 725 China: University of Science and Technology of China, Hefei 230026, China.

Current Status of Disbenefits of Cabin Water Mist Systems

2. Noise and Reduced Visibility

Cranfield University Evacuation trials suggested that the use of “cabin water spray” systems would not be likely to cause any significant adverse consequences for emergency evacuation of the aircraft.

The test programme however, did not address the effect on evacuation of wetting of the cabin interior and escape slides or the effect of water on floor proximity lighting which may require further research.

Bottomley, D. M., Muir, H. C., Lower, M. C. (1993) Aircraft Evacuations: The Effect of a Cabin Water Spray System upon Evacuation Rates and Behaviour, CAA Paper 93008

Current Status of Disbenefits of Cabin Water Mist Systems

3. Inhalation of Particulate and Water Droplets

“The use of water spray was found to decrease greatly the amount of solid particles and liquid droplets capable of penetrating into the lungs, and also the irritants attached to them, thereby reducing the risk of lung damage.”

Civil Aviation Authority (1993) International Cabin Water Spray Research Management Group – Conclusions of Research Programme, CAA Paper 93012. United Kingdom: Civil Aviation Authority

Current Status of Disbenefits of Cabin Water Mist Systems

4. Other Effects on Human Safety

A Medical Health Panel evaluated water mist under the Significant New Alternatives Policy (SNAP) and the results were published in August 1995 .The overall conclusion was that water mist using potable water is benign to nature and does not present a toxicological or physiological hazard to human beings and is thus safe for use in occupied areas.

Protection of Stratospheric Ozone; Acceptable Substitutes for the Significant New Alternatives Policy (SNAP) Program - [Federal Register: July 28, 1995 (Volume 60, Number 145)] [Rules and Regulations]

Current Status of Disbenefits of Cabin Water Mist Systems

5. Overall Conclusions - Disbenefits

Whilst there are issues requiring resolution and further research, the disbenefits perceived for Cabin Water Mist systems do not appear to present an insurmountable obstacle to their feasibility as a protection means to occupants from ground pool fires.

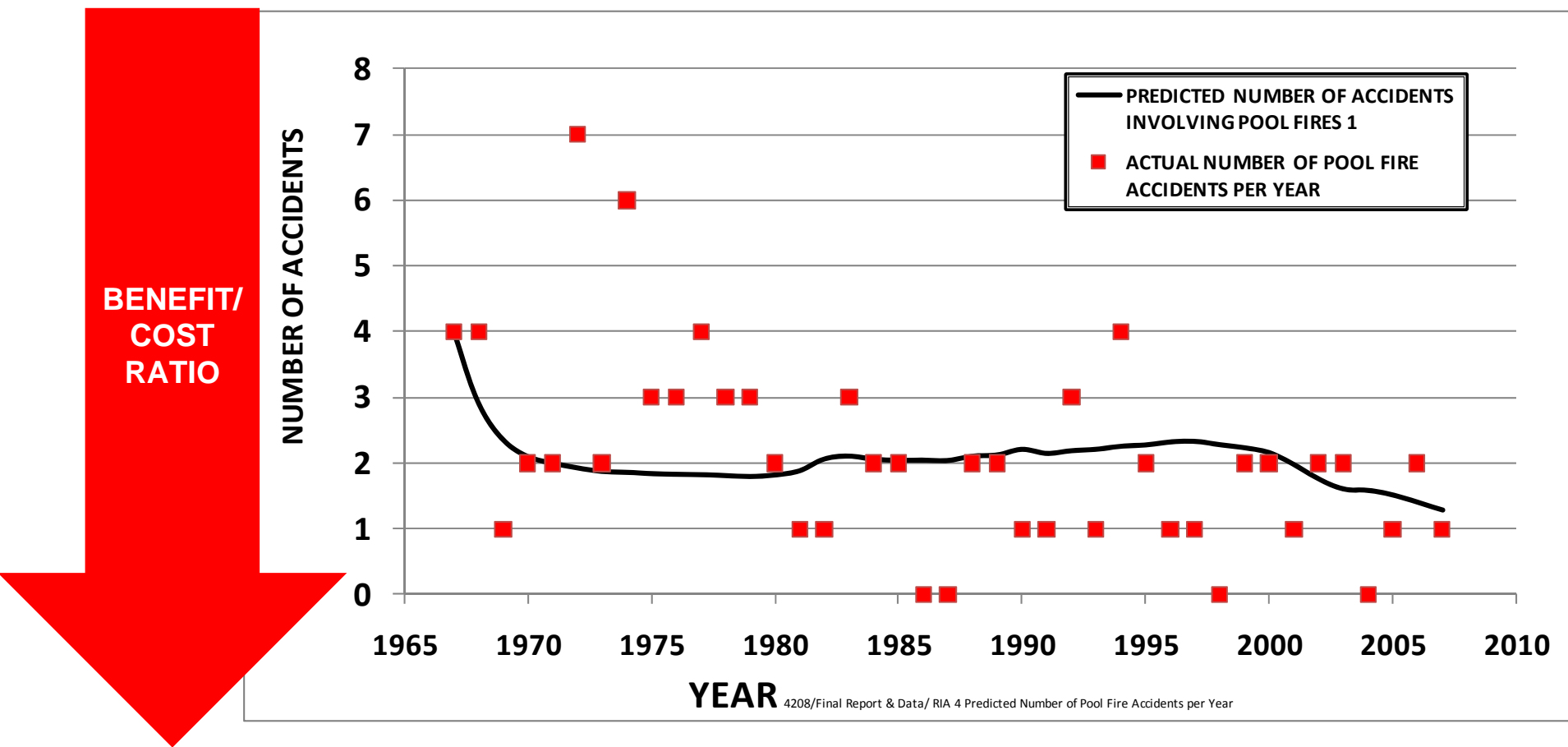
However, the primary issue to be addressed is whether CWM can be shown to be cost beneficial.

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SO WHAT HAS CHANGED – REGARDING COST BENEFIT?

Current Status of Cost Benefit of Cabin Water Mist Systems

Changes in the Number of Pool Fire Accidents per Year



Current Status of Cost Benefit of Cabin Water Mist Systems

Changes in the FAA Value of Life



BENEFIT/
COST
RATIO

The FAA Value of Life has increased markedly since the time of the first Cost Benefit Analysis and now stands at US\$ 5.8 million.

Current Status of Cost Benefit of Cabin Water Mist Systems

Extending the application to accommodate In-flight fires

Tests have been carried out by the US Navy on a Boeing 737-200 at Greenwood, Mississippi. These tests suggest that a Cabin Water Mist system might be both feasible and effective in combating in-flight cabin fires.

Current Status of Cost Benefit of Cabin Water Mist Systems

Extending the application to accommodate
In-flight fires

The in-flight use of a Cabin Water Mist System might prove to be beneficial in combating intentional fires resulting from terrorist actions.

In May 2002 an intentional in-flight fire on-board a China Northern Airlines MD-82 aeroplane resulted in 112 fatalities

BENEFIT/
COST
RATIO

Current Status of Cost Benefit of Cabin Water Mist Systems

However, further cost savings are needed to improve the benefit cost ratio.

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POSSIBLE STRATEGIES FOR IMPROVING THE BENEFIT/COST RATIO OF WATER MIST SYSTEMS?

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?

In order to investigate cost beneficial Water Mist system applications Transport Canada requested that a mathematical cost benefit model be developed, as part of their Integrated Fire Protection program. The model has been developed and may be used to assess the benefit cost ratio for varying water mist system applications on aeroplanes of varying size.

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?

WATER MIST



CARGO
COMPARTMENTS



CABIN

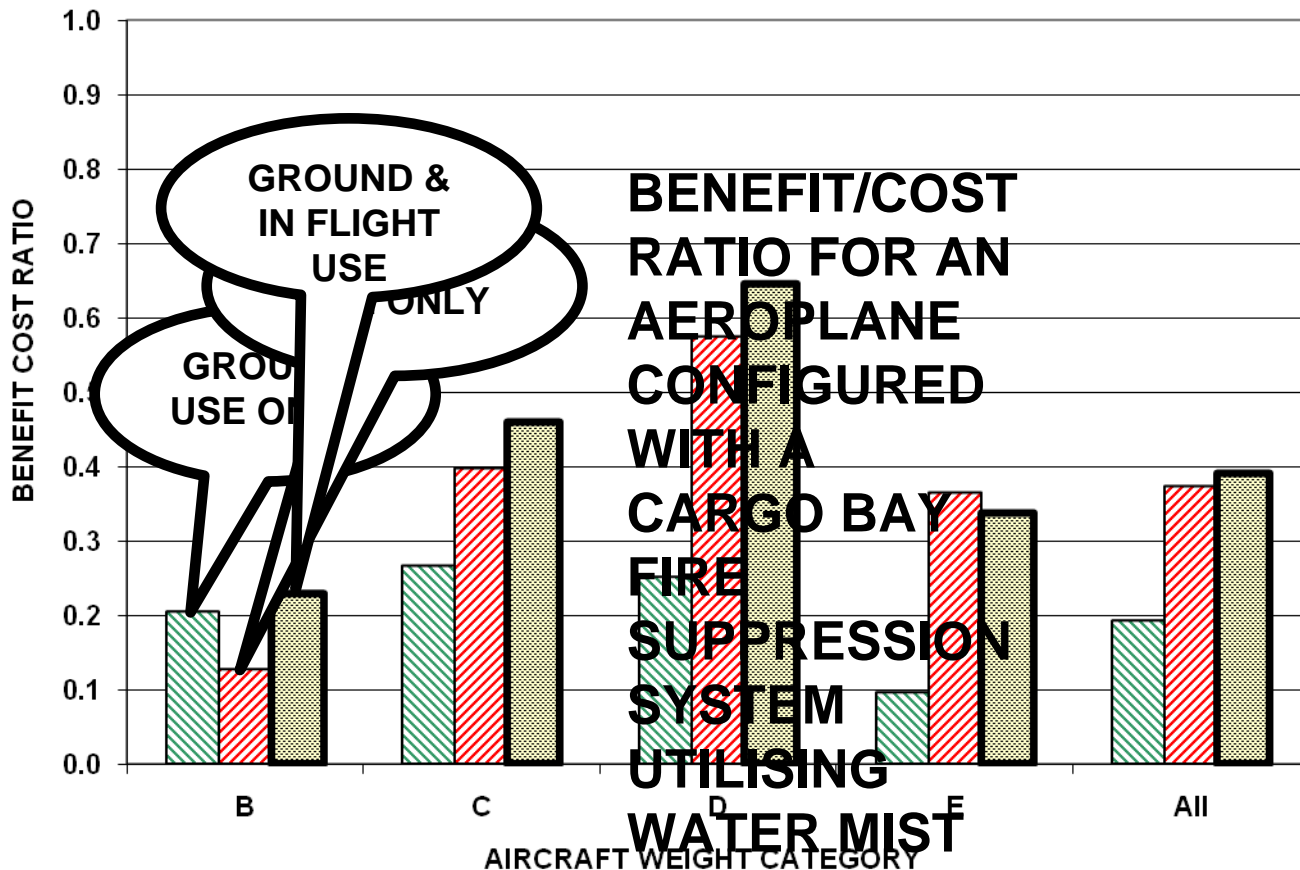


OBIGGS



INTEGRATED FIRE PROTECTION

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?



WEIGHT CATEGORY	AIRPLANE MAXIMUM TAKE-OFF WEIGHT
B	12,500 lb to 100,000 lb
C	100,000 lb to 250,000 lb
D	250,000 lb to 400,000 lb
E	Greater than 400,000 lb

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?

The primary elements of the cost of Cabin Water Mist systems are:

- **The increased fuel burn due to the weight of the system and**
- **The cost of installing the system**

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?

✓ Reassessment of Costs and Weights

The weight and cost assessments were based on technologies that are now 25 years old.

- Could Cabin Water Mist systems be made lighter and cheaper with modern equipment and components?

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?

✓ Re-evaluation of Occupant Protection from Ground Pool Fires

Current regulations require that any Thermal Acoustic Insulation fitted to the lower half of the fuselage is resistant to fire penetration from ground pool fires. This results in both a cost and weight penalty

– Could Cabin Water Mist provide a more cost beneficial alternative?

Possible Strategies for Improving the Benefit/Cost Ratio of Water Mist Systems?

Since it is estimated that the number of fire fatalities worldwide, that are caused by ground pool fires, is in excess of 40 per annum then these questions are worthy of answers.