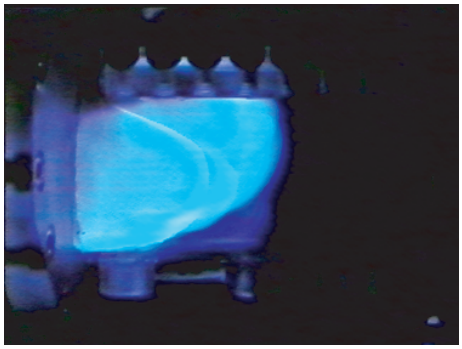
National Aeronautics and Space Administration

Glenn Research Center
Cleveland, Ohio

Water Mist Fire-Suppression Experiment (Mist) Studying Fire in the Sky

Misting Fires Isn't a Foggy Idea

Water is used to put out common fires, but it can also damage computers, paper, and other valuables. However, water mist—like that of a fine fog—has become an important subject of study as a fire suppressant because traditional chemical agents (e.g., halons) are harmful to the ozone layer and have been banned by international agreement. Water mist has many advantages: it's nontoxic, inexpensive, and more efficient than current sprinkler systems.



A flame propagating from left to right, through the flame tube during a normal gravity testing of the Mist experiment at NASA Glenn Research Center.

Because of these advantages, it is important to do research to more fully understand the exact methods by which water mist extinguishes a flame. In addition, it is important to study this phenomenon in microgravity, where gravity-induced effects (such as flame buoyancy and droplet settling) are virtually eliminated, making it easier to understand and model the mechanisms at work.

The Mist project was developed by the Center for Commercial Applications of Combustion in Space (CCACS) at the Colorado School of Mines, in collaboration with the NASA Glenn Combustion Module-2 (CM–2) team. The Mist experiment will be flown on the STS–107 mission of the Space Shuttle.

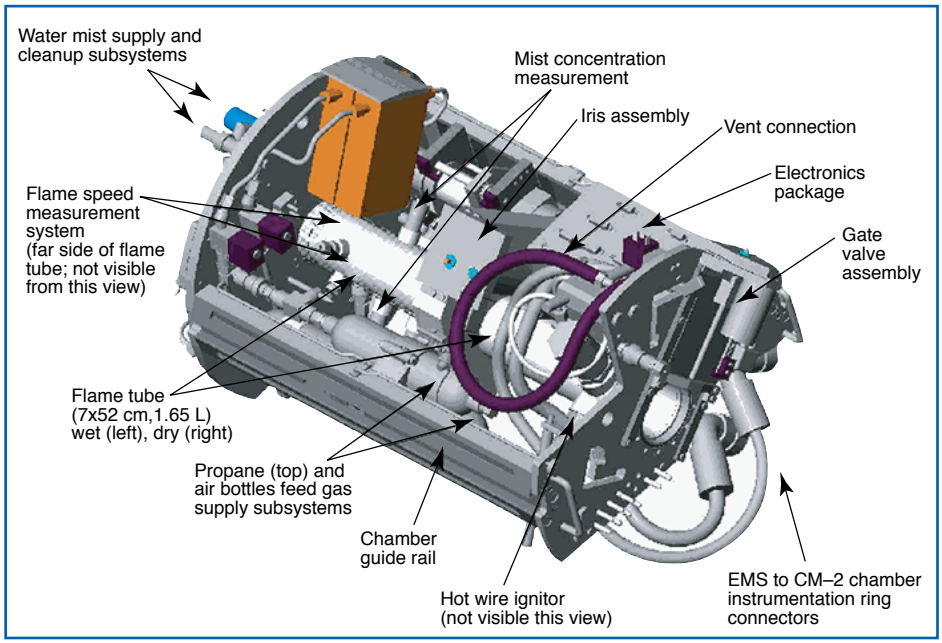
Science Objectives

The purpose of the Mist experiment is to study how water droplet diameter and water concentration affect the speed, strength, and shape of flames created in various fuel and oxygen mixtures. This will be accomplished by measuring the effect of water mist on a flame as it travels through a clear tube and passes from a dry section to a misted section.

Mist Hardware

The Mist Experiment Mounting Structure (EMS) comprises the following five main components:

- Water mist supply subsystem—A water-filled syringe driven by a pump which delivers water to an ultra-sonic atomizer.
- Gas supply subsystem—Air and fuel bottles (volumes of 0.5 and 0.3 liters, respectively), mass flow



A 3–D schematic of the Mist EMS with its elements identified.

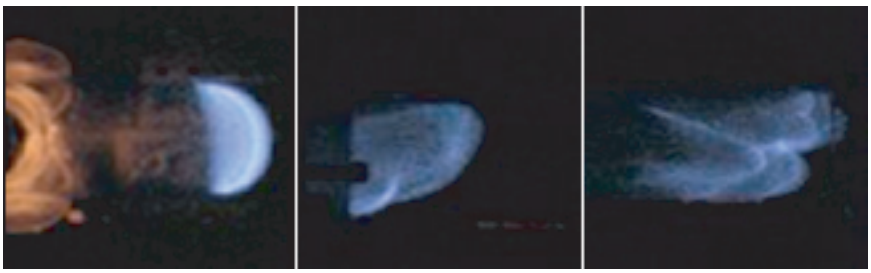
polycarbonate tube, 52 cm long and 7 cm in outside diameter, with a volume of about 1.6 liters.

- Vent/cleanup subsystem—The Mist EMS has a direct connection to the CM–2 chamber vent, which in turn leads to the overboard vent out of the SPACEHAB module and into space. Before venting all gases to space, water and combustion products are removed with a desiccant/catalyst

Mist Operations in Space

The Mist EMS operates while it is installed in the CM–2 chamber. The flame tube, which is divided into two equal sections separated by an iris mechanism, is first evacuated and then filled with a mixture of fuel and oxygen. After closing the iris, one section is filled with a fine water mist generated by an ultrasonic atomizer. Within a few seconds, the dry section of the tube is opened to the CM–2 chamber, the iris is then opened, and the fuel mixture is ignited by a hot wire. The flame moves through the dry section of the tube toward the misted section, taking less than one second or up to several seconds, depending on the ratio of fuel to oxygen. When the flame encounters the mist, it generally slows down, breaks up, or extinguishes before it reaches the end of the tube. The flame speed is measured by a photodiode array and the flame activity is recorded by four cameras.

At the completion of the experiment, post-combustion gases are removed by the Mist cleanup system. Finally, the tube is sealed off from the CM–2 chamber and evacuated in preparation for the next



This panel of images taken during a low-gravity test shows a flame after ignition in the left frame, encountering water mist after clearing the iris in the middle frame, and slowing down and breaking up in the right frame.

A NASA engineer inspecting the Mist EMS in CM–2.

Expected Results

The knowledge gained from the Mist experiment will be used to design and manufacture more effective commercial water mist fire-suppression systems that will help save lives and reduce property damage from fires.

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Benefits

- Determine optimum water concentration and water droplet size to suppress fires
- Improve models for designing the next generation of environmentally friendly and low-cost fire-fighting systems

Applications

- Ships (machinery spaces)
- Aircraft (passenger cabin and cargo)
- Spacecraft
- Libraries, museums
- Telecommunication racks
- Commercial cooking areas

For more information, please see the NASA Glenn Microgravity Combustion Web Site at
http://microgravity.grc.nasa.gov/combustion/

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