EPS (ELECTRIC PARTICULATE SUSPENSION) MICROGRAVITY TECHNOLOGY PROVIDES NASA WITH NEW TOOLS

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EPS (Electric Particulate Suspension) microgravity technology provides NASA with new tools:

- A portable diagnostic tool for **fire safety**
- Small scale utility for **combustion testing** of powders on International Space Station and (Mars) Rovers.
- Device for **burning/testing magnesium in CO_2** atmosphere of Mars
- Control of **heat transfer** in vacuum and gas enclosures in space environments

The Electric Particulate Suspension is a fire safety ignition test system being developed at **Iowa State University** with **NASA support** for evaluating combustion properties of powders, powder-gas mixtures, and pure gases in microgravity and gravitational atmospheres (quenching distance, ignition energy, flammability limits). A separate application is the use of EPS technology to control heat transfer in vacuum and space environment enclosures. In combustion testing, ignitable powders (aluminum, magnesium) are introduced in the EPS test cell and ignited by spark, while the addition of inert particles act as quenching media.

As a combustion research tool, the EPS method has potential as a benchmark design for quenching powder flames that would provide NASA with a new fire safety standard for powder ignition testing. The EPS method also supports combustion modeling by providing accurate measurement of flame-quenching distance as an important parameter in laminar flame theory since it is closely related to characteristic flame thickness and flame structure.

In heat transfer applications, inert powder suspensions (copper, steel) driven by electric fields regulate heat flow between adjacent surfaces enclosures both in vacuum (or gas) and microgravity. This simple E-field control can be particularly useful in space environments where physical separation is a requirement between heat exchange surfaces.

EPS (Electric Particulate Suspension) microgravity technology provides NASA with new combustion tool:

Iowa State University research supported by NASA Office of Biological and Physical Research; NASA Glenn Research Center National Center for Microgravity Research on Fluids and Combustion

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Strategic Research to Enable NASA's Exploration Missions

EPS (powders/gases) Combustion Cell APPLICATIONS:

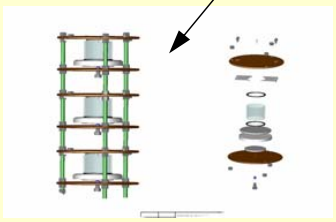
WHAT IS AN EPS (Electric Particulate Suspension):

- Particulate clouds formed electrostatically using high voltage ~10-30kV between parallel plates
- E-field controls particle dynamics produces more uniform clouds of particles in **microgravity**
- Ignition by sparking

ISU's EPS method is fundamentally simple. It utilizes a cylindrical test section enclosure comprised of two parallel plate electrodes (15 to 20 cm diameter) and Pyrex glass tubing for the insulated sides (Teflon and quartz are also used).

Features of EPS:
- Uniform Cloud Density and Simple Parallel Plate Test Section (no gas dispersion injection)
- Small powder sample few ~ mg
- Ignition testing of both gases and gas-powder mixtures
- Particle concentration easily measured by weight or laser attenuation
- Testing in virtually any space environment-microgravity to standard 1g+ (electric field overcomes gravity)

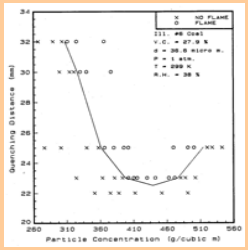
3,4,5 Tiered EPS Configuration For KC-135/DropTower Tests



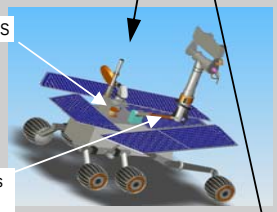
Portable Fire Safety Measurements

- Flammability limits – fuel curves
- Quenching distance
- Ignition energy

Laboratory or Hostile Space



Small scale utility for combustion testing in space environments

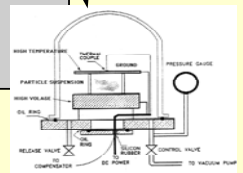


MARS ROVER
Burning/testing magnesium in CO2

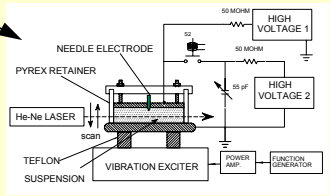
Combustion Integrated Rack (CIR)

ISS US Lab Module

EPS Suspension → Ignition → Burn



Fundamental research tool for Powder Flames Research in Microgravity:



RESEARCH OBJECTIVES:

- To compare quenching distance/flame velocity for combustible powders using ISU's EPS method and McGill's flow dispersion technique
- To evaluate inert particle concentration (copper) on combustible gas flame quenching using EPS method
- To quantify the effect particle-gas slip velocity on flame quenching of gas/powder flames using EPS method
- To characterize particle velocity distribution (PVD) using the EPS method

EPS Heat transfer control in space environments