



Capillary Flow Experiments-2 (CFE-2)

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Glenn Research Center



PI: Prof. Mark Weislogel, Portland State University

PS: Robert Green, NASA GRC

PM: Robert Hawersaat, NASA GRC

Engineering Team: ZIN Technologies, Inc.

Objective:

- The objective of CFE-2 is to investigate the role of capillary forces in the transport and storage of fluid systems in space. Capillary forces can be exploited to control fluid orientation to enable predictable performance for large mission critical systems involving fluids. CFE-2 builds on the very successful CFE experiments that operated on ISS Increment 9-15 (8/2004 -12/2007).

Relevance/Impact:

- Technologies in space use capillary forces to position and transport fluid. CFE-2 provides improved design knowledge in the storage and transport of liquids in space thereby increasing system reliability, decreasing system mass, and reducing overall system complexity.

Development Approach:

- CFE-2 consists of eleven (~2.0kg) test vessels designed to probe capillary flow in complex containers, critical wetting in discontinuous structures and surfaces, and passive gas-liquid phase separations.
- Four of the eleven vessels require simple, quick adaptations to existing flight hardware. The remaining seven units are new designs based on the CFE Interior Corner Flow (ICF) test results. Stepped (ICF3&4), porosity gradient (ICF5&8), and internal vane tapers (ICF6,7,9) will measure the test vessel geometries effect on time dependent flows as well as their passive phase separation characteristics.
- Highly quantitative video images of the crew performed procedures provide immediate confirmation of the usefulness of current analytical design tools, as well as provide guidance to the development of new ones.
- CFE-2 vessels (VG1, VG2, ICF1, ICF2) were launched on Shuttle flight 19A in April 2010. The next set of vessels (ICF4, ICF9) will be launched on SpaceX-1.
- All of the experiments contain small volumes of zero hazard fluids, require no electrical interface, and use the same general set-up, camera alignment, focus, lighting fluid fill, expected experiment fluid response and operation timeframes. Operations are performed on the MWA in the Destiny or Kibo Modules on ISS.

Project Life Cycle Schedule

Milestones	SCR/ RDR	RDR/ PDR	Phase III Safety Review 1 / Phase III Safety Review 2	SAR	FHA	Launch	Ops	Return	Final Report
Actual/ Baseline	06/2008	04/2009	07/2009 / 10/2009	03/2012	01/2010	04/2010, 19A	Inc. 24/25	N/A	2012
					03/2012	08/2012, SpaceX-1	Inc. 33/34	N/A	2013
Documentation									



Interior Corner Flow 1



Interior Corner Flow 2



Mike Fossum operates the CFE-2 Vane Gap 1 vessel during Increment 29



Vane Gap 1&2

ISS Resource Requirements

Accommodation (carrier)	Maintenance Work Area (MWA)
Upmass (kg) (w/o packing factor)	14
Volume (m³) (w/o packing factor)	0.036
Power (kw) (peak)	N/A
Crew Time (hrs) (installation/operations)	35
Autonomous Ops (hrs)	N/A
Launch/Increment	19A/Inc 23 and SpaceX-1/Inc 32