

## **FLUIDS EXPERIMENT APPARATUS (FEA)**

by

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### **ABSTRACT**

The FEA is a modular zero gravity chemistry/physics laboratory to support fundamental space processing research. It can be used to conduct basic and applied process or product experiments in general liquid chemistry, crystal growth, fluid mechanics, thermodynamics, and cell culturing. The various FEA subsystems can be readily configured to perform this wide range of investigations. Designed to be operated by a crew member in the orbiter middeck, the FEA can be accommodated on most Space Shuttle missions.



# FEA CONCEPT

FUNDAMENTAL SPACE PROCESSING RESEARCH

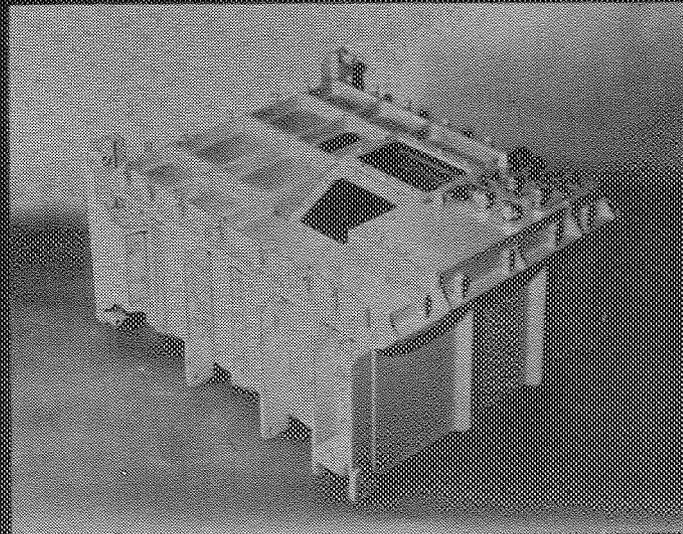
MODULAR ZERO GRAVITY CHEMISTRY/PHYSICS LABORATORY

## PURPOSES

- BASIC PROCESS/PRODUCT RESEARCH
- GENERAL LIQUID CHEMISTRY
- CRYSTAL GROWTH
- FLUID MECHANICS
- THERMODYNAMICS
- CELL CULTURING

## OPERATIONAL CHARACTERISTICS

- HEAT/COOL SAMPLES
- MIX GASSES, LIQUIDS, & SOLIDS
- STIR SAMPLES
- CONTAINED SAMPLES
- FLOAT ZONE SAMPLES
- VACUUM AVAILABLE
- MEASURE TEMPERATURE/VISCOSITY
- PHOTOGRAPH (MOVIE) SAMPLE
- RECORD DATA
- ASTRONAUT OPERATED
- SHUTTLE MID DECK



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## FEA FLOAT ZONE CONFIGURATION

HEATER TRANSPORT  
 BIDIRECTIONAL  
 0.5 - 10 IN./HR  
 0.5 IN./MIN SLEW

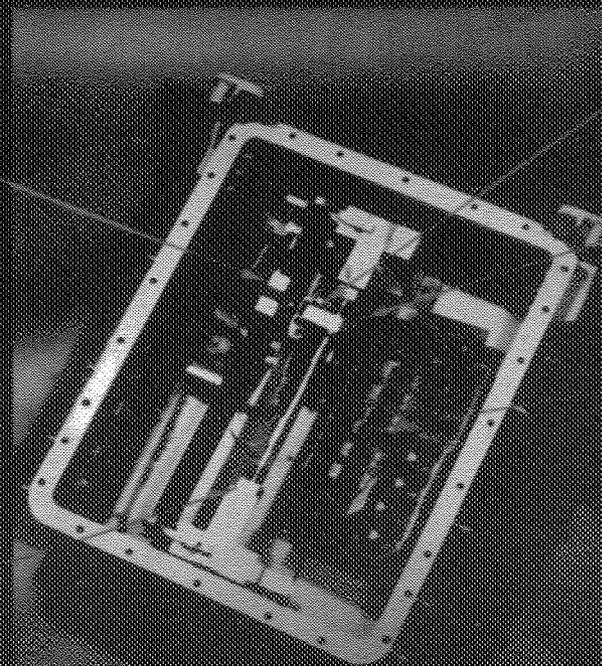
HEATER  
 100W

GAS RESERVOIR  
 ARGON - 2 PSI

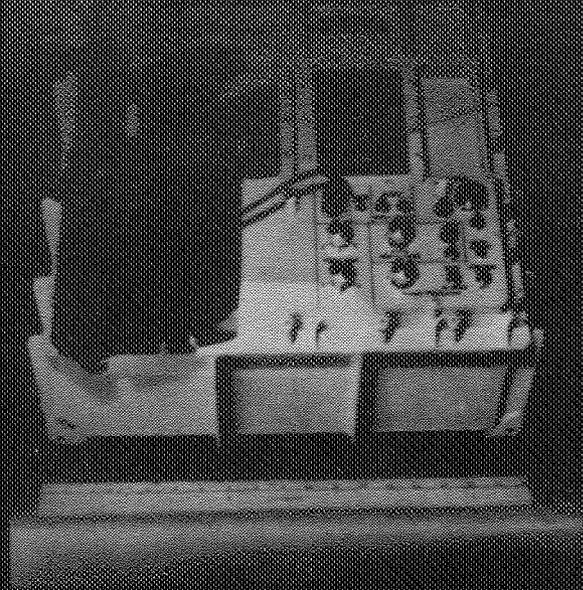
DATA DISPLAY MODULE  
 TIME SEC  
 HEATER POWER W  
 HEATER POSITION IN  
 HEATER RATE IN/HR  
 TEMPERATURES IN

SAMPLE CONTAINER  
 8.5 IN LONG  
 0.65 IN DIA

SAMPLE  
 0.4 IN DIA



CAMERA  
SCALE  
DATA DISPLAY  
VARIATION FRAME RATE  
1000 FPS 16:9



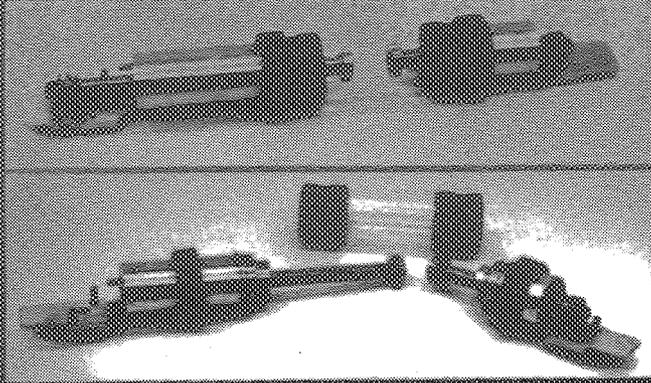
OPERATIONAL DATA

CONTROL PANEL

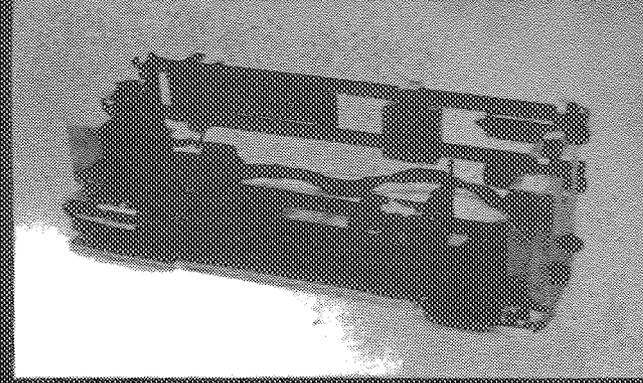


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## FEA OPTIONAL SUBSYSTEMS



FLUIDS MANIPULATION  
EXPERIMENT CONTAINER



EXPERIMENT MANIPULATION  
ASSEMBLY

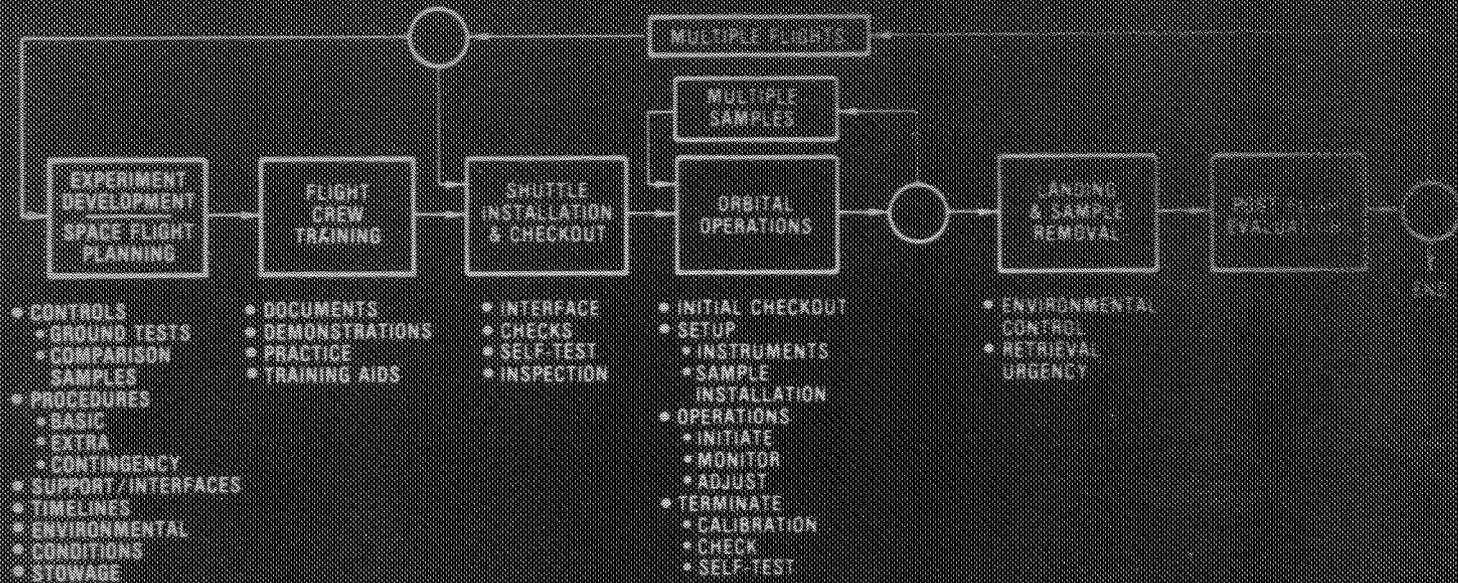


FLUIDS STORAGE &  
PUMPING ASSEMBLY

### OTHERS

- BULK FLUID CHEMISTRY CHAMBER
- LIVING CELL INCUBATOR
- MULTISAMPLE COLUMN
- CUSTOM HEATER DESIGNS
- SAMPLE CHILL BLOCKS
- SPECIAL INSTRUMENTATION

# TYPICAL EXPERIMENT PROJECT FLOW



## GUIDELINES

- USE CREW CAPABILITIES
- ALLOW TIMELINE FLEXIBILITIES
- MINIMIZE SPECIFIC SHUTTLE REQUIREMENTS



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## FEA-1 MISSION

"THE PURIFICATION AND GROWTH OF SINGLE CRYSTAL INDIUM  
BY THE FLOAT ZONE TECHNIQUE IN A ZERO GRAVITY ENVIRONMENT"

### OBJECTIVES

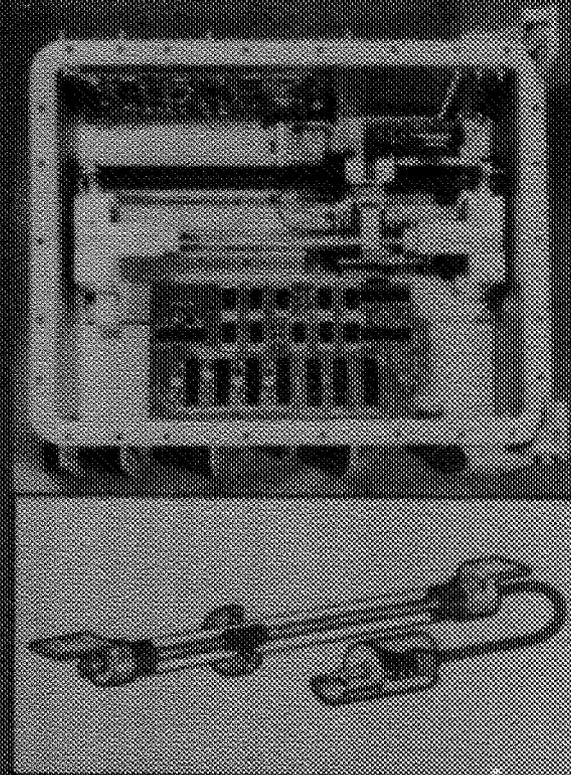
- FLIGHT TEST THE FEA
- DEMONSTRATE THE PROCESSING TECHNIQUE
- STUDY THE MATERIAL PROPERTIES
- INVESTIGATE PROCESS BENEFITS & LIMITATIONS

### ANTICIPATED RESULTS

- IMPROVED CRYSTAL QUALITY & DOPING UNIFORMITY
- PROCESS LESS DEPENDENT ON MATERIAL PROPERTIES
- KNOWLEDGE ABOUT
  - FLOAT ZONE LENGTH EFFECTS
  - SURFACE TENSION (MARANGONI) EFFECTS
  - MICRODYNAMIC/THERMAL ENVIRONMENT SENSITIVITY
  - THERMAL GRADIENT/GROWTH RATE (G/R) EFFECTS
  - MANUAL EXPERIMENT CONTROL SUSTAINABILITY

### IMPROVED SEMICONDUCTORS -- SIMPLER SYSTEMS

- VERY LARGE HIGH YIELD INTEGRATED CIRCUITS
- HIGH PERFORMANCE DETECTORS
- ADVANCED MICROWAVE DEVICES



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