HOST LINER CYCLIC FACILITIES

FACILITY DESCRIPTION

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The HOST Liner Cyclic Program is utilizing two types of test apparatus, rectangular box rigs and a full annular rig. To date two quartz lamp cyclic box rigs have been tested and a third is to begin testing in late October 1983. The box rigs are used to evaluate 5x8 inch rectangular linear samples. A 21 inch diameter outer liner simulator is also being built up for testing beginning in April 1984. This annular test rig is being procured through a cooperative agreement with P&W-E, Hartford. Under this agreement they supply the test rig and two test liners while we supply the test facility. The data are shared by both. All rigs are atmospheric rigs.

The first box rig, a three 6-kVA lamp installation, was operated under adverse conditions to determine feasibility of using quartz lamps for cyclic testing. This work was done in December 1981 and looked promising.

The second box rig, again using three 6-kVA lamps, was operated to obtain instrumentation durability information and initial data input to a Finite Element Model. This limited test program was conducted in August 1983. Five test plates were run. Instrumentation consisted of strain gages, thermocouples and thermal paint. The strain gages were found to fail at 1200° F as expected though plates were heated to 1700° F.

The third box rig, containing four 6-kVA lamps, is in build-up for testing to beging in late October 1983. In addition to 33 percent greater power input, this rig has provision for 400° F backside line cooling air and a viewing port suitable for IR camera viewing. The casing is also water cooled for extended durability.

The 21 inch diameter outer liner simulator uses 112 6-kVA lamps to cyclicly heat the test liner. Power levels will be adjusted to simulate typical linear heat loadings. Air will be supplied to provide typical liner film and backside cooling. In addition to the test liners being supplied by P&W, which are production configurations, several simple liners will be tested to obtain confidence in the Finite Element Model.

This apparatus in addition to 672 kVA of 480 volt power, requires 7.5 lb/sec of 500° F air at 35 psia, 3.5 lb/sec of ambient temperature air at 5 psig, 1.5 lb/sec of ambient temperature air at 1 psig and 70 gal/min of cooling water. This apparatus is scheduled to go under testing in April 1984.

Special Test Instrumentation

Liner cold side temperatures will be measured using an IR-TV camera system with thermocouple measurements for varification. The IR-TV camera system will permit several hundred temperature measurements to be made in a relatively

small area. Linear hot side temperatures will be measured with thin film thermocouples. New technology high temperature strain gauges will be used to obtain local strain measurements.

Facility Preheater Test

The proposed natural gas fired vitiated preheater for the annular test rig was tested in February 1983. As part of this test, quartz tubing was placed in the preheater exhaust stream to determine if exhaust smoke would deposit on the quartz. The tubing remained soot free but an iron oxide deposit did appear. The rust is thought to have originated in the carbon steel laboratory air supply system. As a result a filter and stainless steel pipe will be used in the final rig installation. Additional preheater testing in the actual installation is scheduled for December 1983.

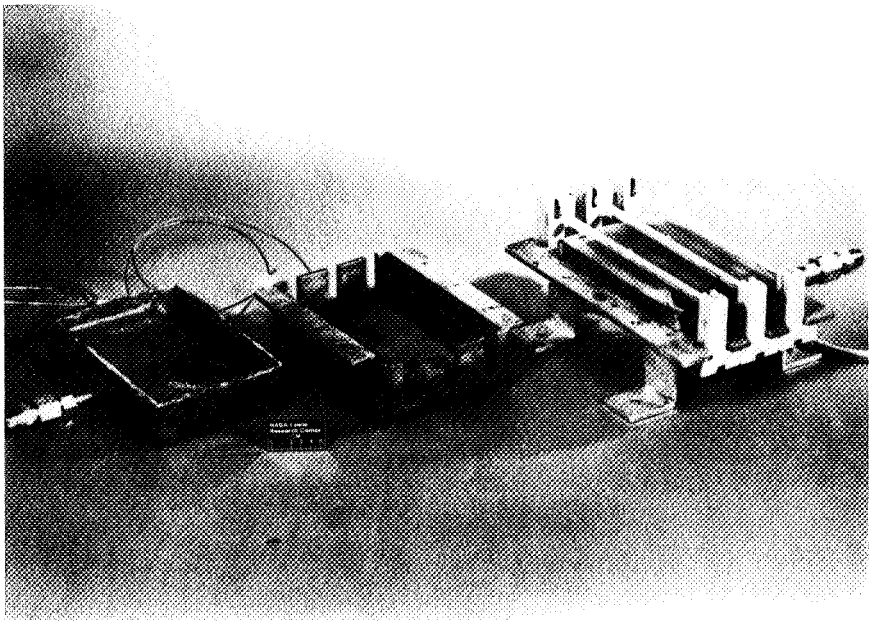
HOST LINER CYCLIC FACILITIES

I. QUARTZ LAMP BOX RIGS

- A. FIRST
- B. SECOND
- C. THIRD

II. QUARTZ LAMP ANNULAR RIG

FIRST QUARTZ LAMP BOX RIG



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FIRST QUARTZ LAMP BOX RIG

- OBTAINED 2000° F TEST PLATE TEMPERATURE
- LIMITED LAMP LIFE

SECOND QUARTZ LAMP BOX RIG

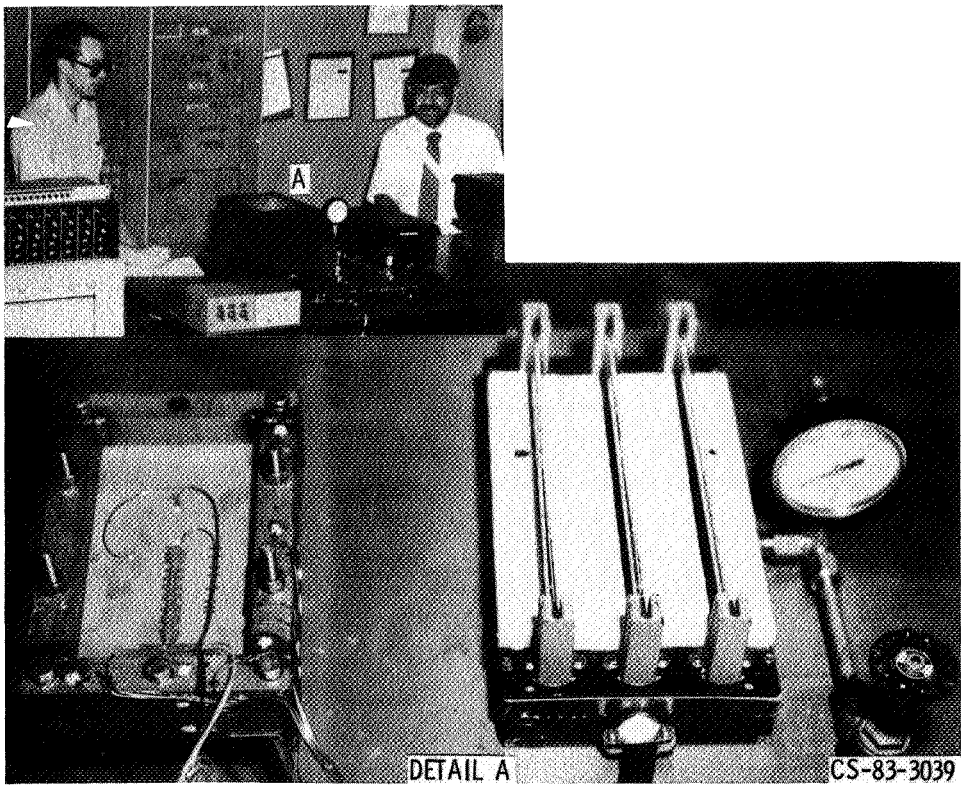
OBJECTIVE:

- VERIFY PERFORMANCE AND DURABILITY OF INSTRUMENTATION
- PROVIDE INITIAL DATA IMPUT TO FINITE ELEMENT MODEL

TEST HARDWARE

- 5x8 in. FLAT HASTELLOY-X PLATES
  - TWO UNINSTRUMENTED
  - ONE INSTRUMENTED WITH THERMAL PAINT
  - ONE WITH THERMAL PAINT, NINE C/A-t/c's AND ONE STRAIN GAGE
  - ONE WITH THERMAL PAINT, NINE C/A-t/c's AND EIGHT STRAIN GAGES
- TEST PLATE SUPPORT FRAME WITH TWENTY-TWO C/A-t/c's

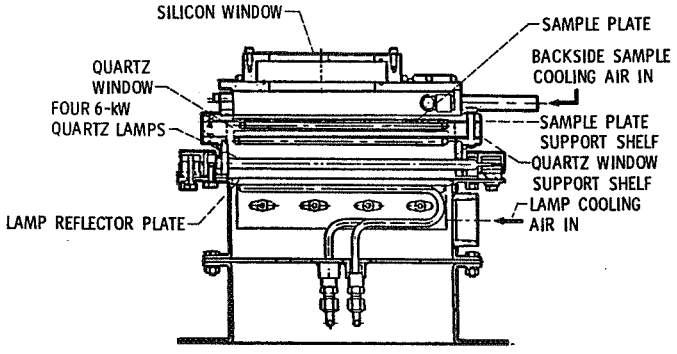
TEST RIG AND HARDWARE USED ON INITIAL FLAT PLATE TESTS



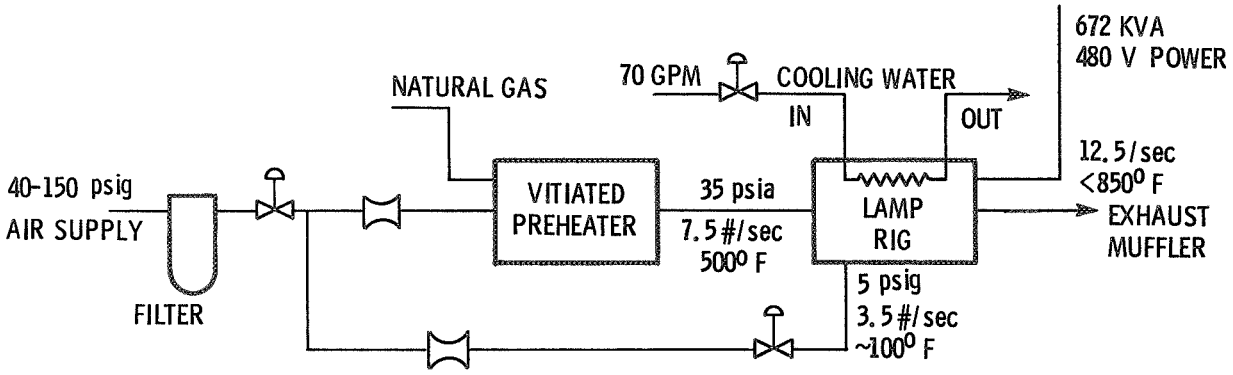
TEST RESULTS

- SUPPORT FRAME HEATED TO 1500° F
- SAMPLE PLATE TO 1700° F
- STRAIN GAGES FAILED AS EXPECTED AT 1200° F
- STRAINS WERE CONTROLLABLE BY VARYING LAMP POWER AND COOLING AIR FLOW RATE

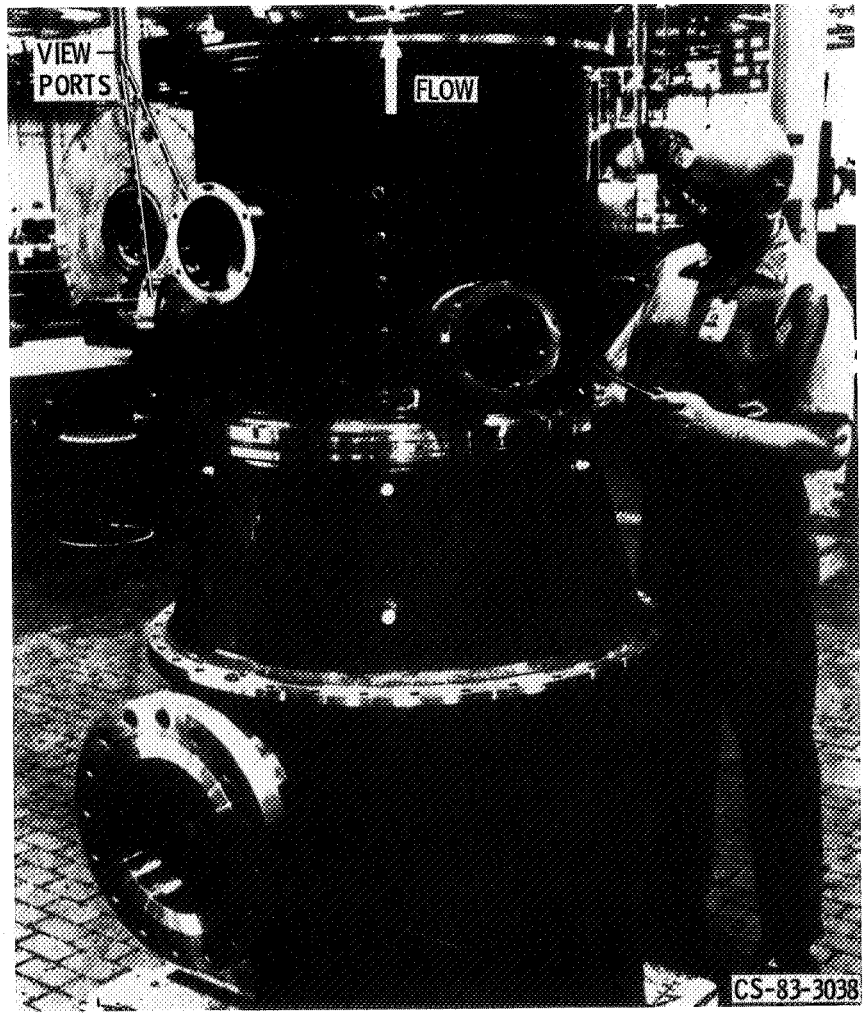
QUARTZ LAMP BOX RIG



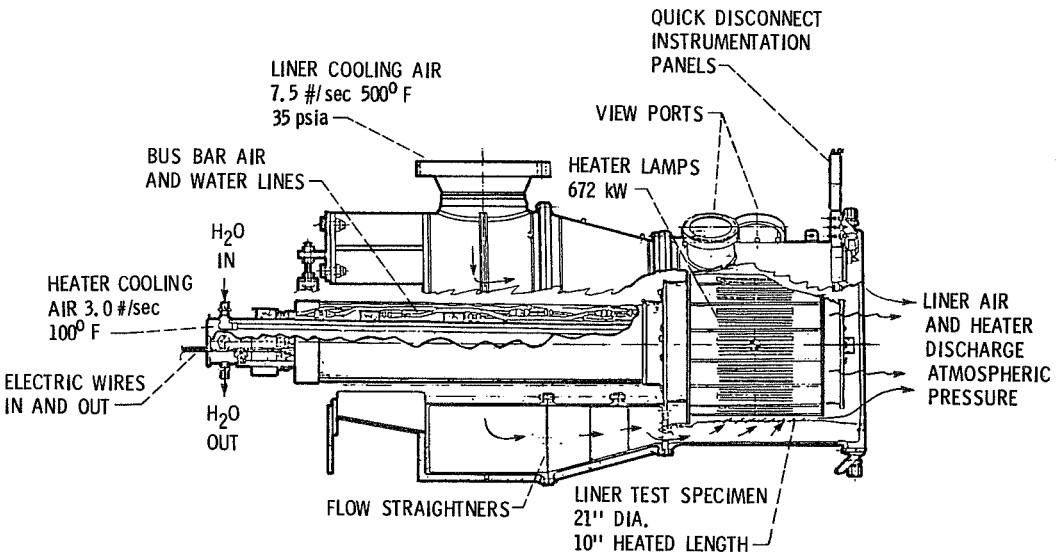
HOST QUARTZ LAMP ANNULAR RIG SCHEMATIC-ECRL-1



QUARTZ LAMP ANNULAR RIG HOUSING



QUARTZ LAMP CYCLIC COMBUSTOR TEST RIG



SPECIAL INSTRUMENTATION

I. IR - TV MONITORING OF LINER TEMPERATURES

II. THIN-FILM THERMOCOUPLES

III. LASER STRAIN GAUGE

IV. HIGH TEMPERATURE STRAIN GAUGES

FACILITY PREHEATER TEST

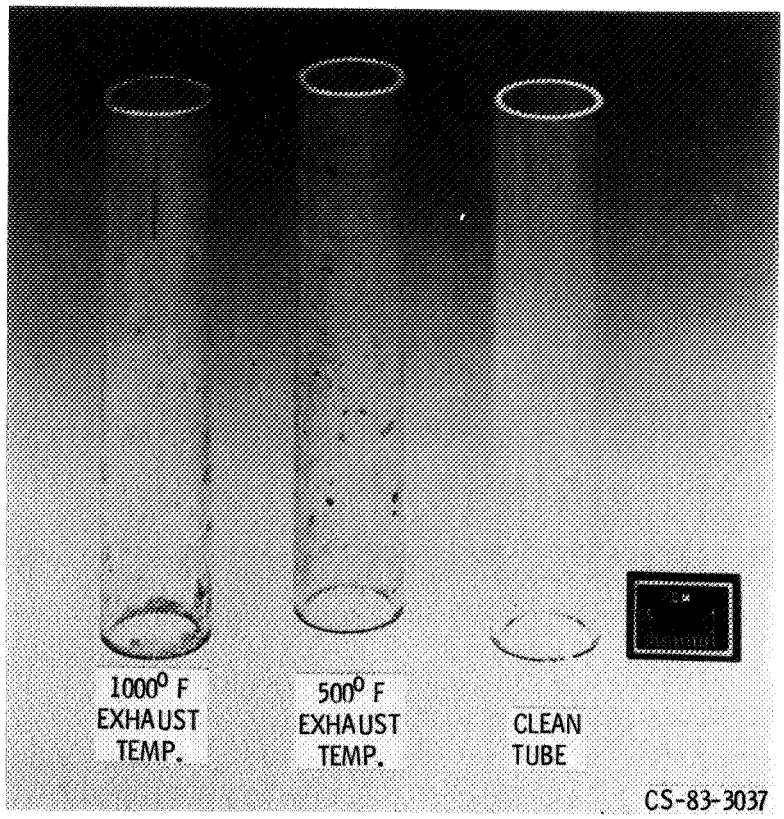
OBJECTIVE:

1. DETERMINE IF A NATURAL GAS FIRED VITIATED PREHEATER IS CLEAN ENOUGH FOR USE WITH THE ANNULAR LAMP RIG
2. EVALUATE PERFORMANCE OF LOW PRESSURE LINER CYCLIC CAN RIG VITIATED PREHEATER

TEST RESULTS

1. RUST FROM AIR SYSTEM PIPING DEPOSITED ON QUARTZ TUBES AT 500^{0} F
2. NO SMOKE
3. COMBUSTION EFFICIENCY OVER 95 PERCENT

DEPOSITS ON QUARTZ TUBING AFTER FACILITY PREHEATER TEST



HOST CYCLIC LINER PROGRAM