

FUEL VAPORIZATION EFFECTS

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Many studies on premixed-prevaporized combustion have been made in an attempt to understand better this type of process and its potential for applications to future aircraft gas turbines. The lean premixing-prevaporizing technique has exhibited low emissions in flame-tube studies. For this reason, design information and specific studies of various aspects of lean, premixed, prevaporized combustion are being conducted in a flame-tube experiment to evaluate their applicability to aircraft engines.

The test objective is composed of two parts. The first part involves the study of the effects of fuel-air preparation characteristics on combustor performance and emissions at temperature and pressure ranges representative of actual gas turbine combustors. The second part will investigate the effect of flameholding devices on the vaporization process and NO_x formation. Flameholder blockage and geometry are some of the elements that affect the recirculation zone characteristics and subsequently alter combustion stability, emissions and performance.

A water cooled combustor is used as the test rig. Preheated air and Jet A fuel are mixed at the entrance of the apparatus. The fuel is injected in two zones. A fully vaporized fuel injector is positioned on the centerline of the test section and a second non-vaporized injector is placed 10 inches from the first one. A vaporization probe is used to determine percentage of vaporization and a gas sample probe to determine concentration of emissions in the exhaust gases. The experimental design will be presented and experimental expected results will be discussed.

NASA LEWIS FUEL VAPORIZATION STUDY

OBJECTIVES

STUDY THE EFFECTS OF FUEL-AIR PREPARATION CHARACTERISTICS ON COMBUSTOR PERFORMANCE AND EMISSIONS AT HIGH PRESSURES.

- DEGREE OF VAPORIZATION
- DROP SIZE DISTRIBUTION
- PREMIX QUALITY (FUEL-AIR DISTRIBUTION)

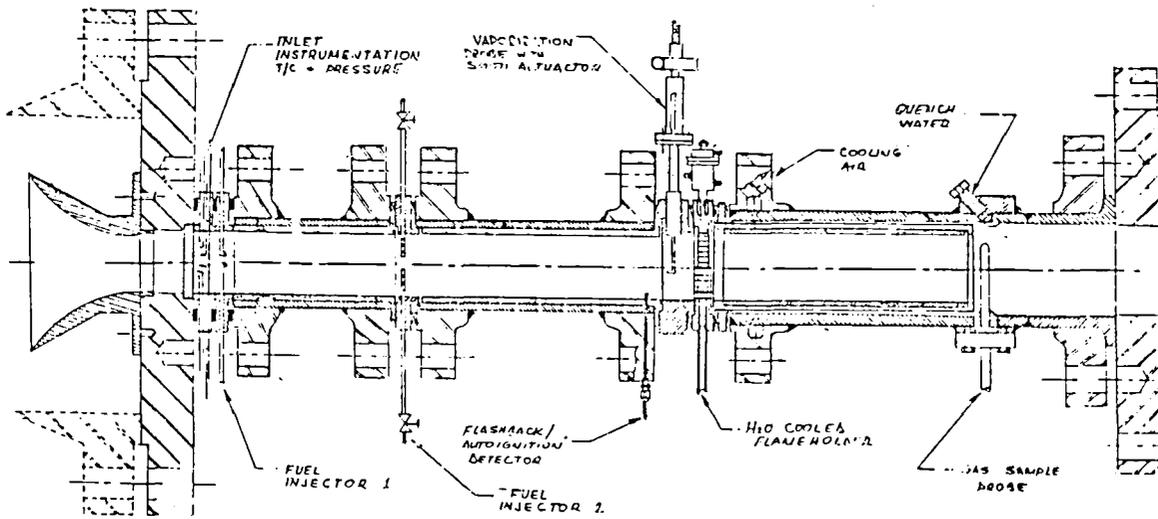
INVESTIGATE THE EFFECT OF FLAMEHOLDING DEVICES ON THE VAPORIZATION PROCESS AND ON NO FORMATION.

- CHARACTERISTICS OF BLOCKAGE
- LIQUID COLLECTION
- REATOMIZATION EFFICIENCY

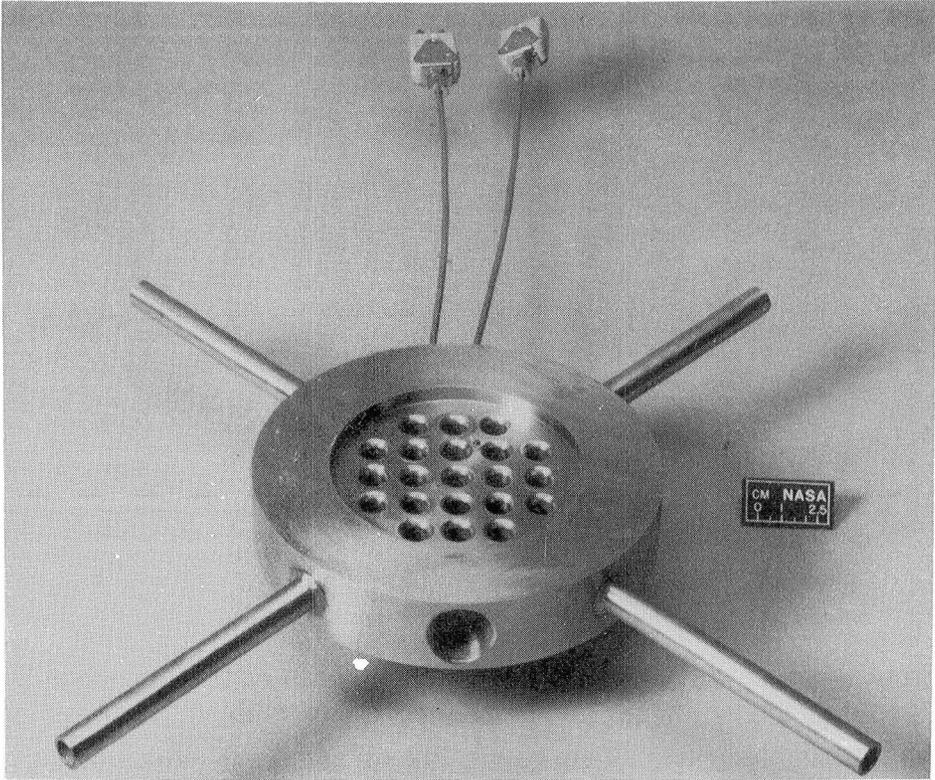
EXPECTED RESULTS

- THE OBTAINED DATA WILL PROVIDE A BETTER UNDERSTANDING OF THE FOLLOWING SUBJECTS.
 - THE IMPACT OF THE DEGREE OF FUEL VAPORIZATION UPON EMISSIONS AT HIGH PRESSURE AND TEMPERATURE.
 - COLLECTION AND REATOMIZATION CHARACTERISTICS OF FLAMEHOLDER DEVICES.
- MEASUREMENTS WILL BE USED FOR COMPARISON AND DEVELOPMENT OF THEORIES FOR THE PURPOSE OF MODELLING THE COMBUSTOR PHENOMENA.

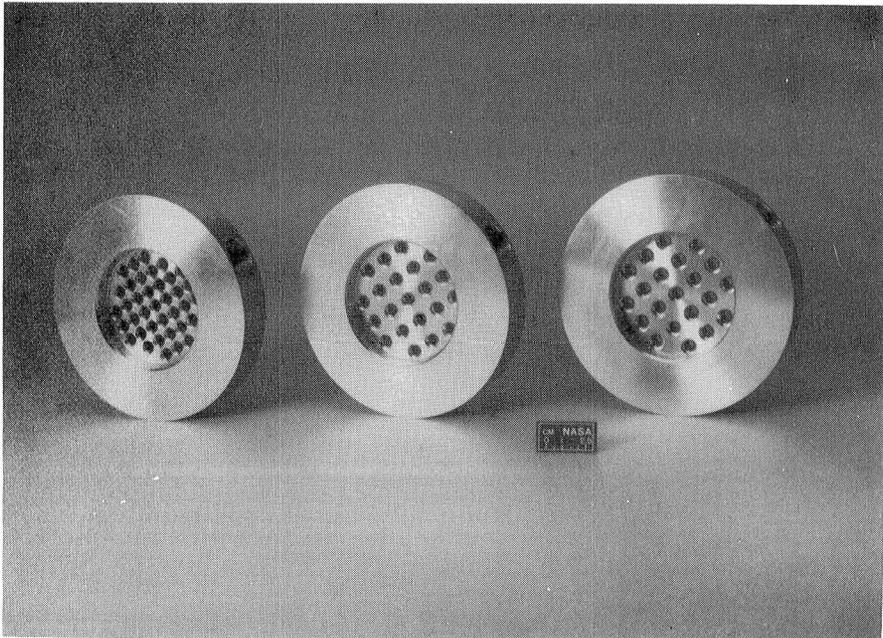
FUEL VAPORIZATION RIG (CE5-B)



TEST CONDITIONS	
Temperature	600-900 °F
Pressure	5-25 atm.
Velocity	20-40 m/sec.
Ø	.6-.8
Fuel	Jet A

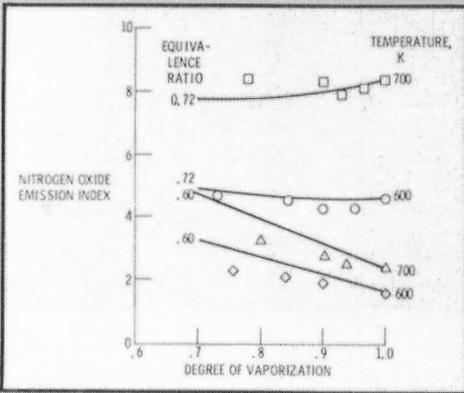
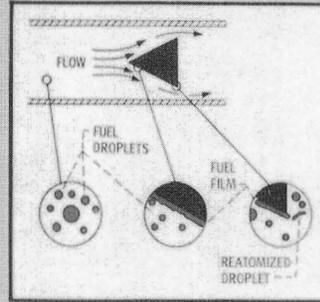
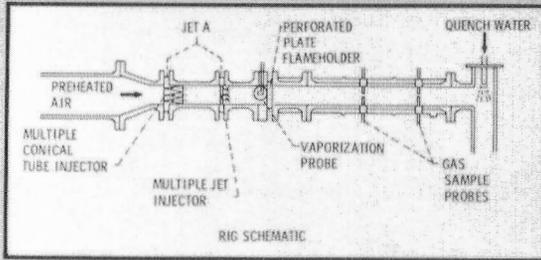


WATER COOLED PERFORATED PLATE FLAMEHOLDER



**PERFORATED PLATE FLAMEHOLDERS
WITH DIFFERENT PERCENTAGES OF BLOCKAGE**

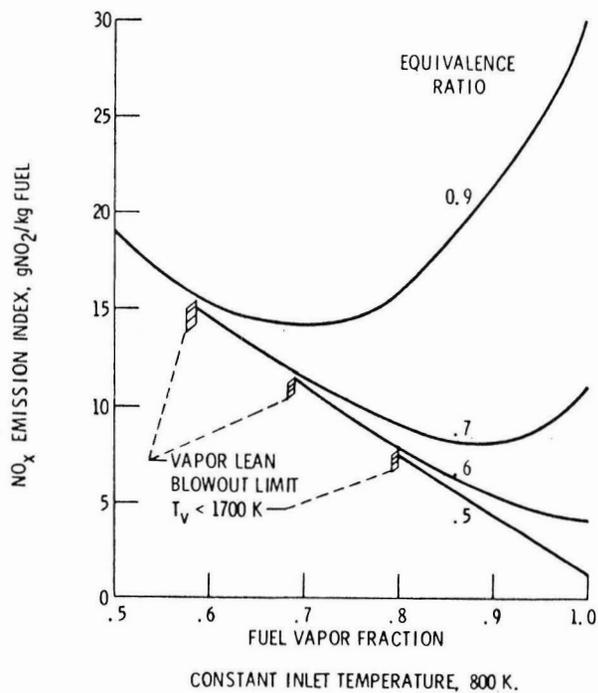
EFFECT OF FUEL VAPORIZATION



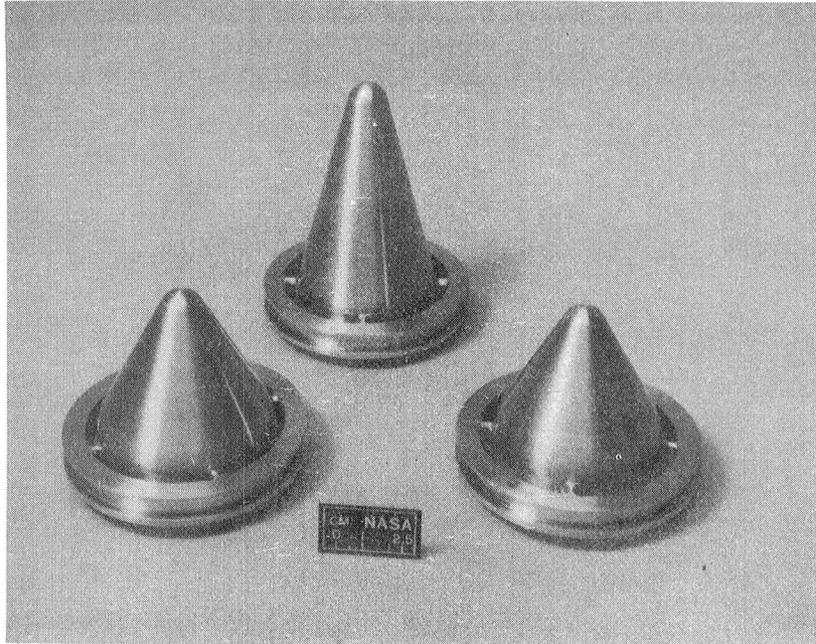
- TO STUDY THE EFFECT OF FUEL VAPORIZATION ON COMBUSTOR PERFORMANCE AND EMISSIONS AT HIGH PRESSURE (TO 25 ATM.)

OBJECTIVES:

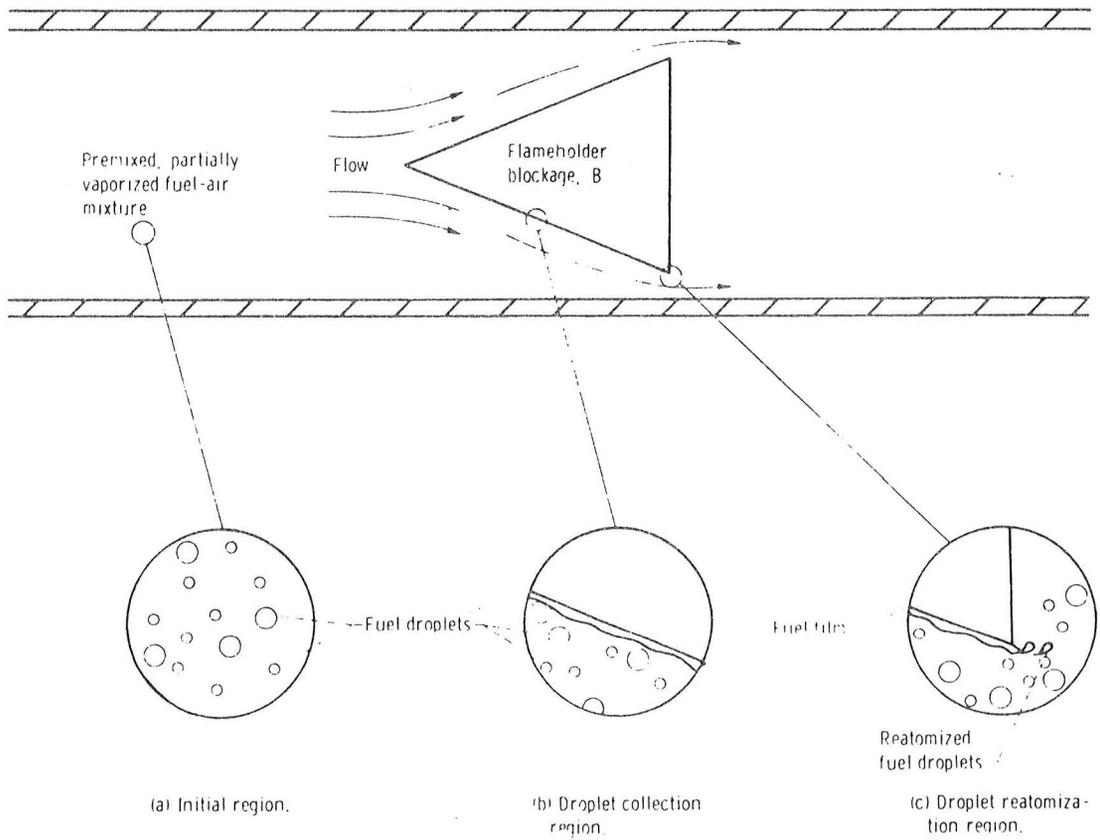
- TO STUDY THE EFFECT OF FLAME HOLDERS ON THE VAPORIZATION PROCESS (RE-ATOMIZATION)



EFFECT OF FUEL VAPOR FRACTION UPON NO_x EMISSIONS (P=1ATM)



CONICAL FLAMEHOLDERS



Flameholding Devices in Premixed Partially Vaporized Flows