

DEVELOPMENT OF LIGHTWEIGHT, FIRE-RETARDANT, LOW SMOKE,  
HIGH STRENGTH, THERMALLY STABLE AIRCRAFT FLOOR PANELING

Roy A. Anderson and Richard J. Karch  
Boeing Commercial Airplane Company  
Seattle, Washington 98124

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AIRCRAFT FLOOR PANELING

By

Roy A. Anderson and Richard J. Karch

BOEING COMMERCIAL AIRPLANE COMPANY

P.O. Box 3707

Seattle, Washington 98124

## ABSTRACT

This presentation describes Boeing's participation in a NASA-funded program (FIRMEN) to develop materials for use as floor panels possessing flammability, smoke and toxicity (FS&T) characteristics superior to current materials. The objectives of the program are to develop an aircraft floor paneling suitable for high traffic areas, e.g., aisle or galley and to install and certify the panel in a commercial aircraft for service evaluation.

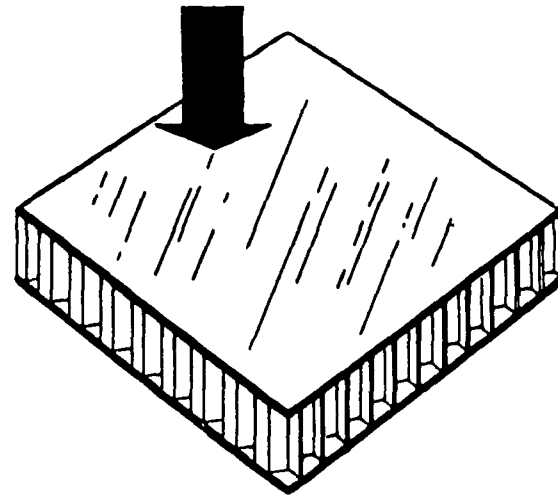
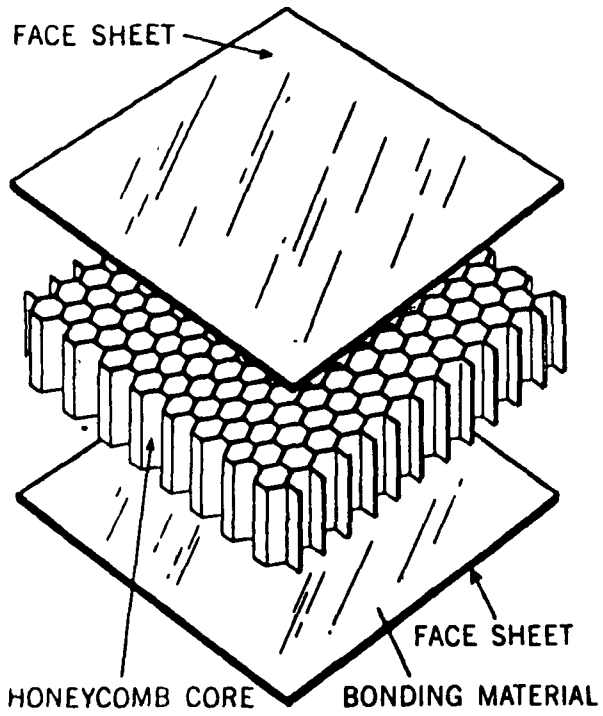
The development of a light weight, fire-retardent, low smoke, high strength, thermally stable aircraft floor panel has been completed. The service evaluation of a panel in a commercial aircraft is in progress and scheduled to be completed in March 1978.

DEVELOPMENT OF LIGHTWEIGHT,  
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AIRCRAFT FLOOR PANELING

NAS 9-15062

# INTRODUCTION

## ○ PRESENT AIRCRAFT FLOORING



## INTRODUCTION

### ○ PRESENT AIRCRAFT FLOORING

- FACE SHEETS - Epoxy impregnated unidirectional fiberglass
- ADHESIVE - Epoxy resin
- CORE - Phenolic/nomex honeycomb core

## INTRODUCTION

- CONTRACT NAS 9-14753 - PRIMARY OBJECTIVES
  - INCREASE FIRE RESISTANCE
  - LESS SMOKE AND TOXICANTS
  - INCREASE BURN THROUGH RESISTANCE
  
- CONTRACT NAS 9-15062 IS A FOLLOW ON TO NAS 9-14753

## INTRODUCTION

### ○ FLOOR PANEL EVALUATION

- FLAMMABILITY, SMOKE AND TOXICITY TESTS (F, S&T)
- MECHANICAL STRENGTH TESTS
- HUMIDITY RESISTANCE TESTS



## INTRODUCTION

- NAS 9-15062 PRIMARY OBJECTIVES
  - DEVELOP A HIGH-TRAFFIC PANEL
  - IMPROVE BURN THROUGH RESISTANCE
  - SERVICE TEST (Five year flight test)

## INTRODUCTION

### ○ NAS 9-15062 - STATUS

- SERVICE EVALUATION PANEL HAS BEEN PROVIDED TO UNITED AIRLINES
- PANELS HAVE BEEN PROVIDED FOR LARGE SCALE TESTING IN SUPPORT OF CONTRACT NAS 9-15168
- LABORATORY TEST SPECIMENS HAVE BEEN PROVIDED IN SUPPORT OF CONTRACT NAS 9-15168

## INTRODUCTION

### ○ PRESENTATION OBJECTIVES

- APPROACH USED TO DEVELOP THE SERVICE EVALUATION PANEL
- SELECTED TEST RESULTS
- CONCLUSIONS

## INTRODUCTION

### ○ APPROACH

- SCREENING TESTS (14 candidates)
- VERIFICATION TESTS (3 candidates)
- END ITEM FABRICATION (1 system)

## APPROACH

- SCREENING TESTS - FLAMMABILITY
  - VERTICAL BURN (12 & 60 second FAR 25-32)
  - BURN THROUGH (10 minute exposure)
  - SMOKE DENSITY ( $D_s$  at 1.5, 4 minutes and maximum)
  - TOXIC GAS EMISSION ( HCN, HCL, HF, CO, SO<sub>2</sub>, & NO<sub>x</sub>)
  - OXYGEN INDEX TESTS (LOI)
  - CHEMICAL PROPERTIES (TGA)

## APPROACH

### ○ SCREENING TESTS - MECHANICAL STRENGTH/DURABILITY

- IMPACT (flat point dart test)
- FATIGUE (food roller cart)
- WEIGHT
- FLEXURE (long beam and short beam)

## RESULTS

○ SCREENING TEST RESULTS (3 MOST SATISFACTORY CANDIDATES)

● NORDAM CONSTRUCTED

● AIR LOGISTICS CONSTRUCTED

● BOEING CONSTRUCTED

## APPROACH

- VERIFICATION TESTS - FLAMMABILITY
  - SCREENING TESTS
  - HORIZONTAL BURN
  - FLAMMABILITY PROPERTIES (Lennox oil burner)



## INTRODUCTION

- NAS 9-14753 - CONCLUSIONS AND RECOMMENDATIONS
  - EXPERIMENTAL FACE SHEETS, ADHESIVES, AND CORE SYSTEMS CAN BE DEVELOPED INTO A SATISFACTORY FLOOR PANEL
  - ADDITIONAL FLAMMABILITY AND MECHANICAL TESTING IS REQUIRED
  - SERVICE EVALUATION IS REQUIRED

## APPROACH

- VERIFICATION TESTS - MECHANICAL STRENGTH/DURABILITY
  - SCREENING TESTS
  - WARPAGE
  - PEEL (rolling drum)
  - INSERT PULL OUT
  - PANEL IN-PLANE SHEAR

## APPROACH

### ○ VERIFICATION TESTS - HUMIDITY EXPOSURE

- WEIGHT GAIN
- PEEL (rolling drum)
- FLEXURE (long beam and short beam)

## RESULTS

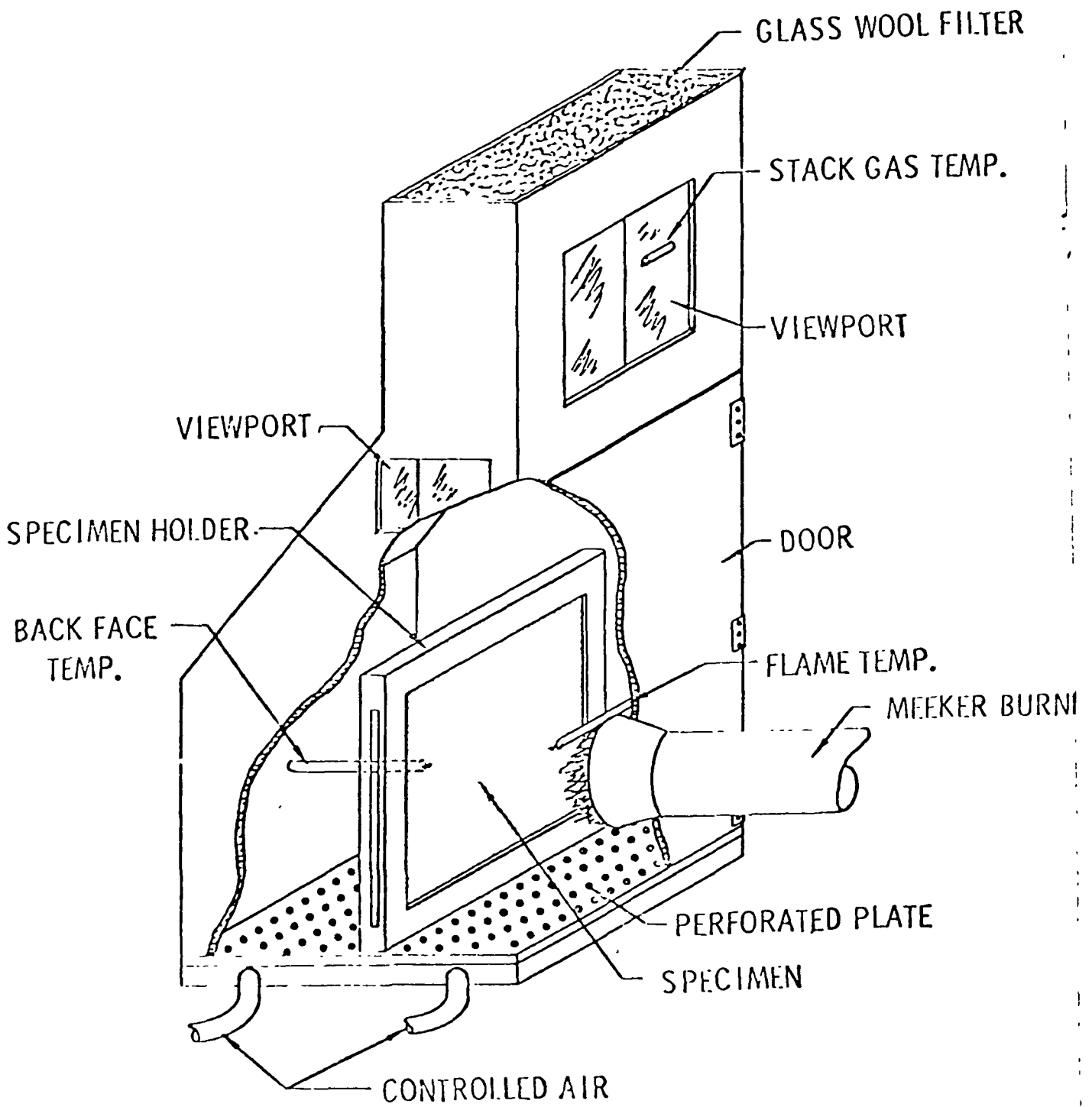
### ○ VERIFICATION TEST RESULTS (ONE PANEL FOR END ITEM FABRICATION)

#### ● BOEING CONSTRUCTED

FACE SHEETS - Modified phenolic impregnated unidirectional  
S-glass (Deco XMP-100)

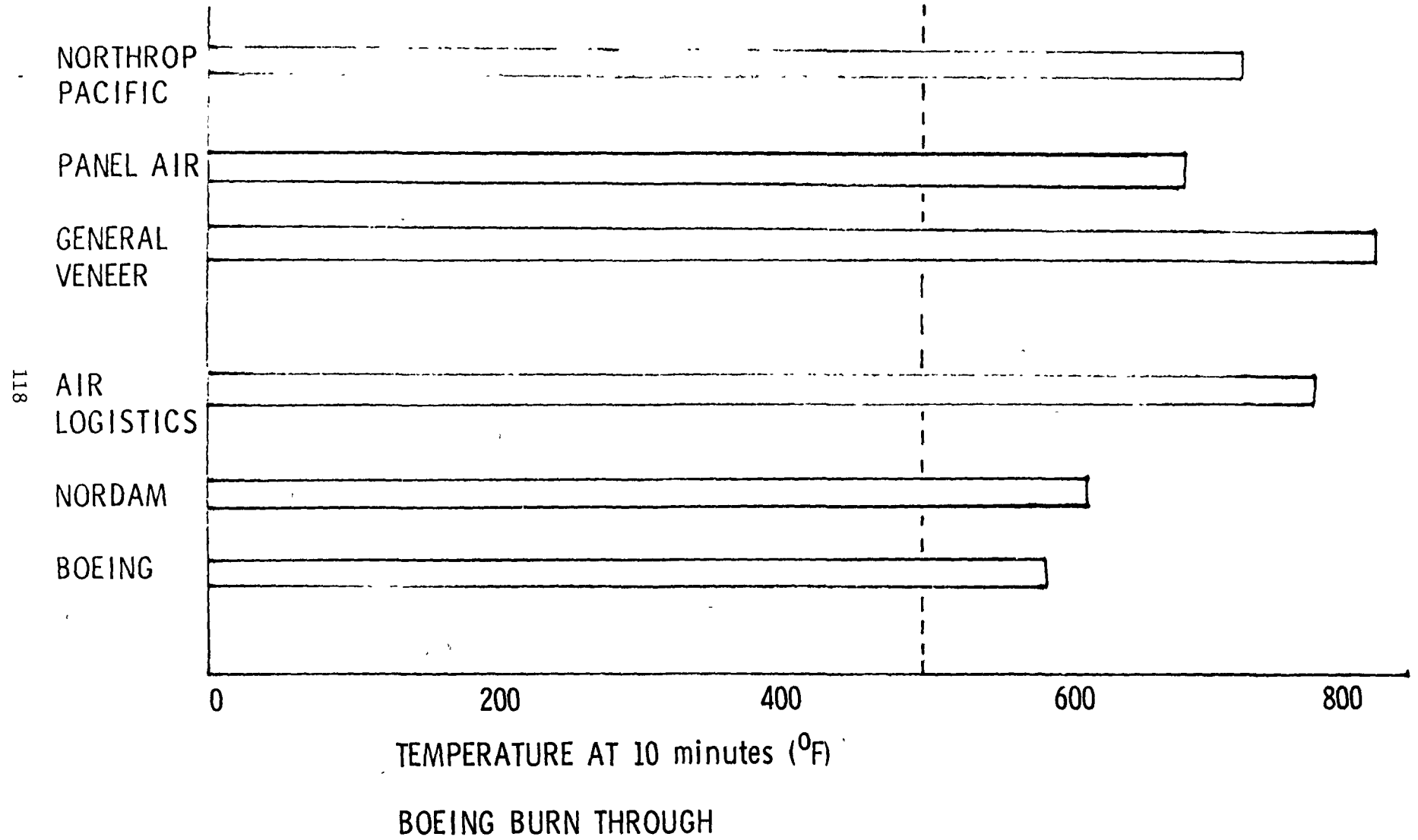
ADHESIVE - Modified phenolic film (Narmco 9252)

CORE - Phenolic/nomex honeycomb (Orbitex) filled with  
polyimide foam (Solar)

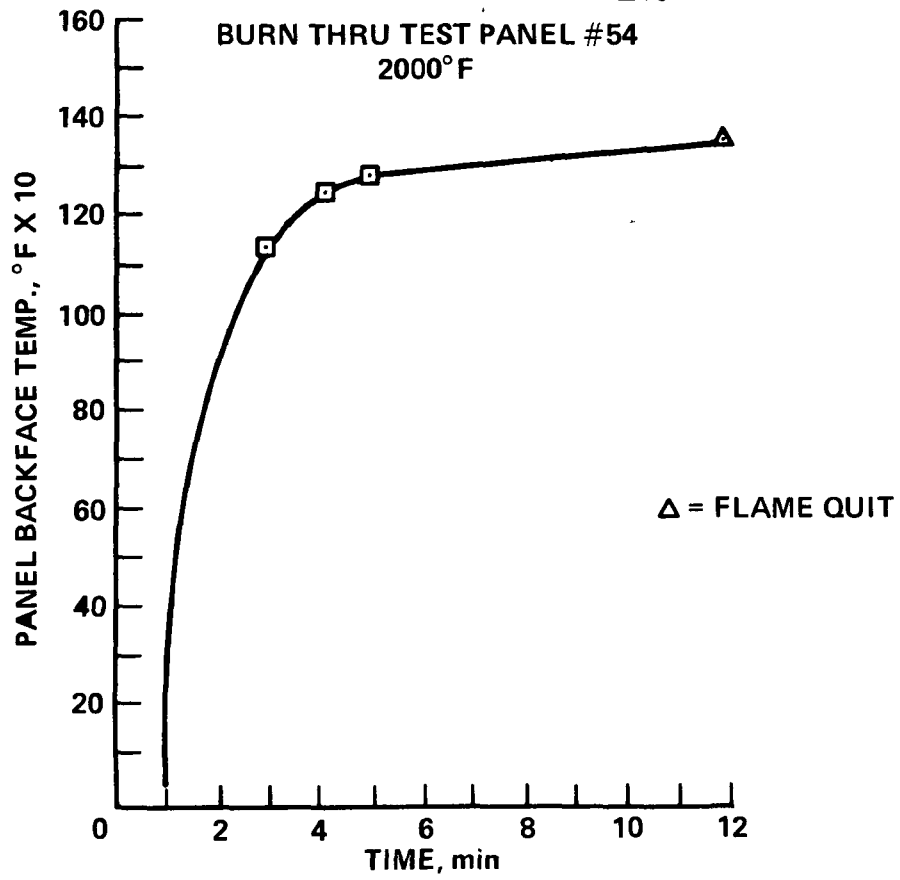


Boeing Burnthrough Apparatus

# RESULTS

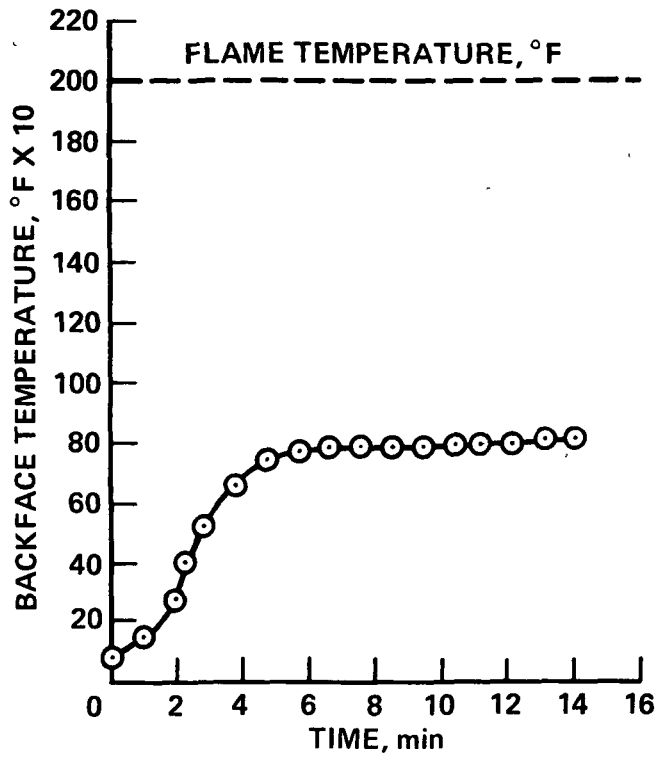


**LENNOX OIL BURNER**  
BURN THRU TEST PANEL #54  
2000°F



# LENNOX OIL BURNER

BURN THRU TEST PANEL #76  
2000°F OIL BURNER BLOWER

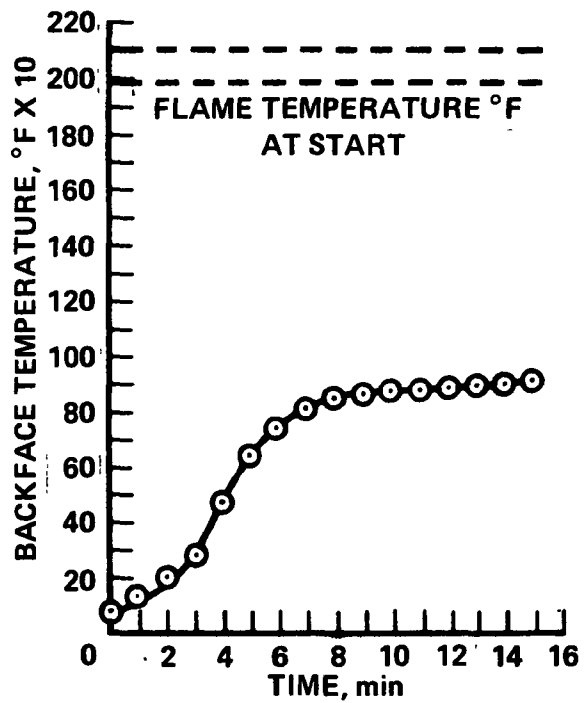




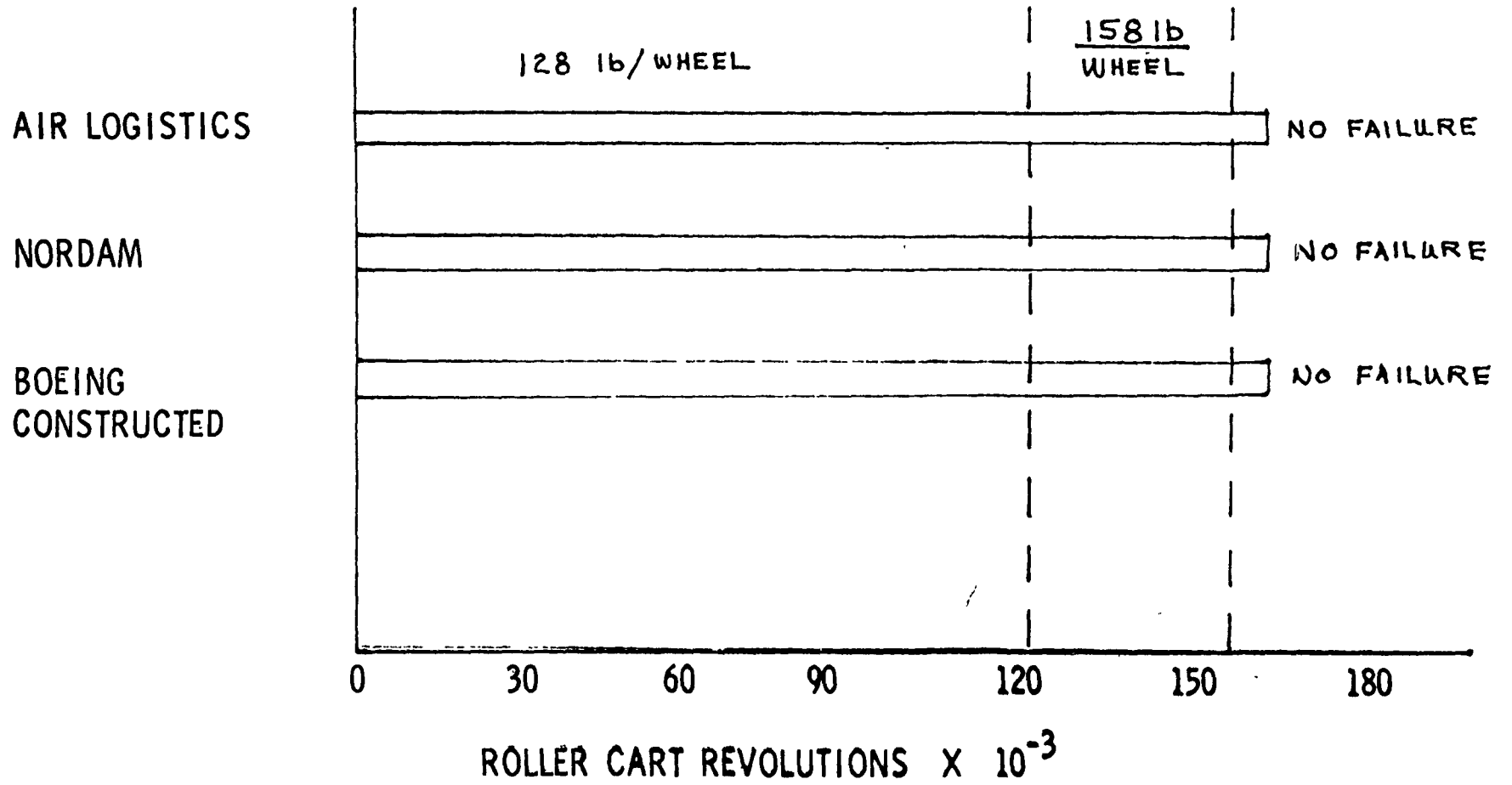
# LENNOX OIL BURNER

BURN THRU TEST PANEL #68

2000° F OIL BURNER BLOWER AT 3.5 INCHES FROM FACE



# RESULTS

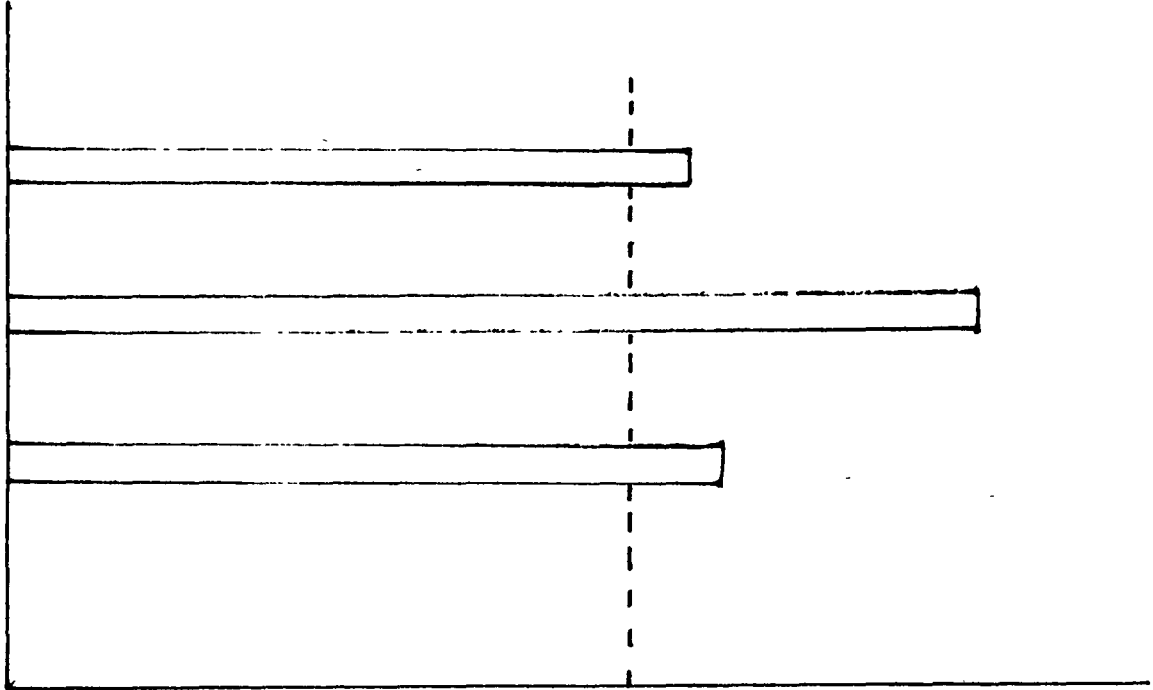


RESULTS

AIR  
LOGISTICS

NORDAM

BOEING



0 .20 .40 .60 .80 1.00  
WEIGHT lb/ft<sup>2</sup>

## SUMMARY

### ○ CONCLUSION

- A LIGHTWEIGHT, FIRE-RETARDANT, LOW SMOKE, HIGH STRENGTH, THERMALLY STABLE AIRCRAFT FLOOR PANEL CAN BE CONSTRUCTED FOR UNDERSEAT AND HIGH TRAFFIC AREAS.