

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

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By

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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.

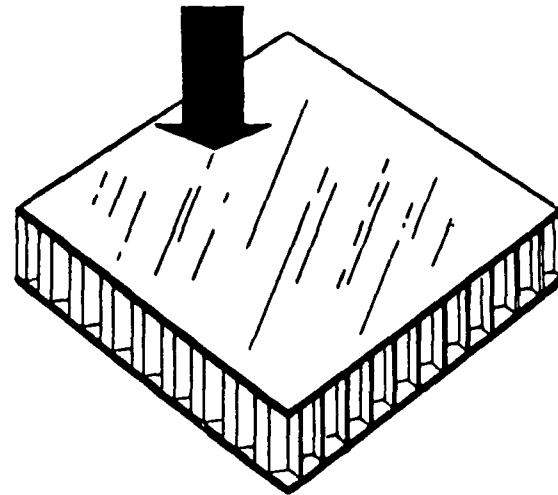
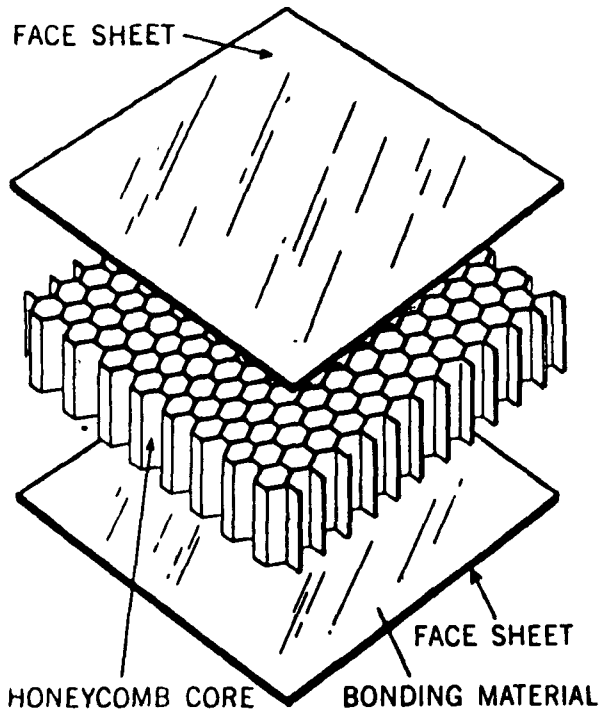
The development of a light weight, fire-retardent, low smoke, high strength, thermally stable aircraft floor panel has been completed. The service evaluation of a panel in a commercial aircraft is in progress and scheduled to be completed in March 1978.

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

NAS 9-15062

INTRODUCTION

○ PRESENT AIRCRAFT FLOORING



COMPLETED SANDWICH STRUCTURE

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, SO₂, & NO_x)
 - 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

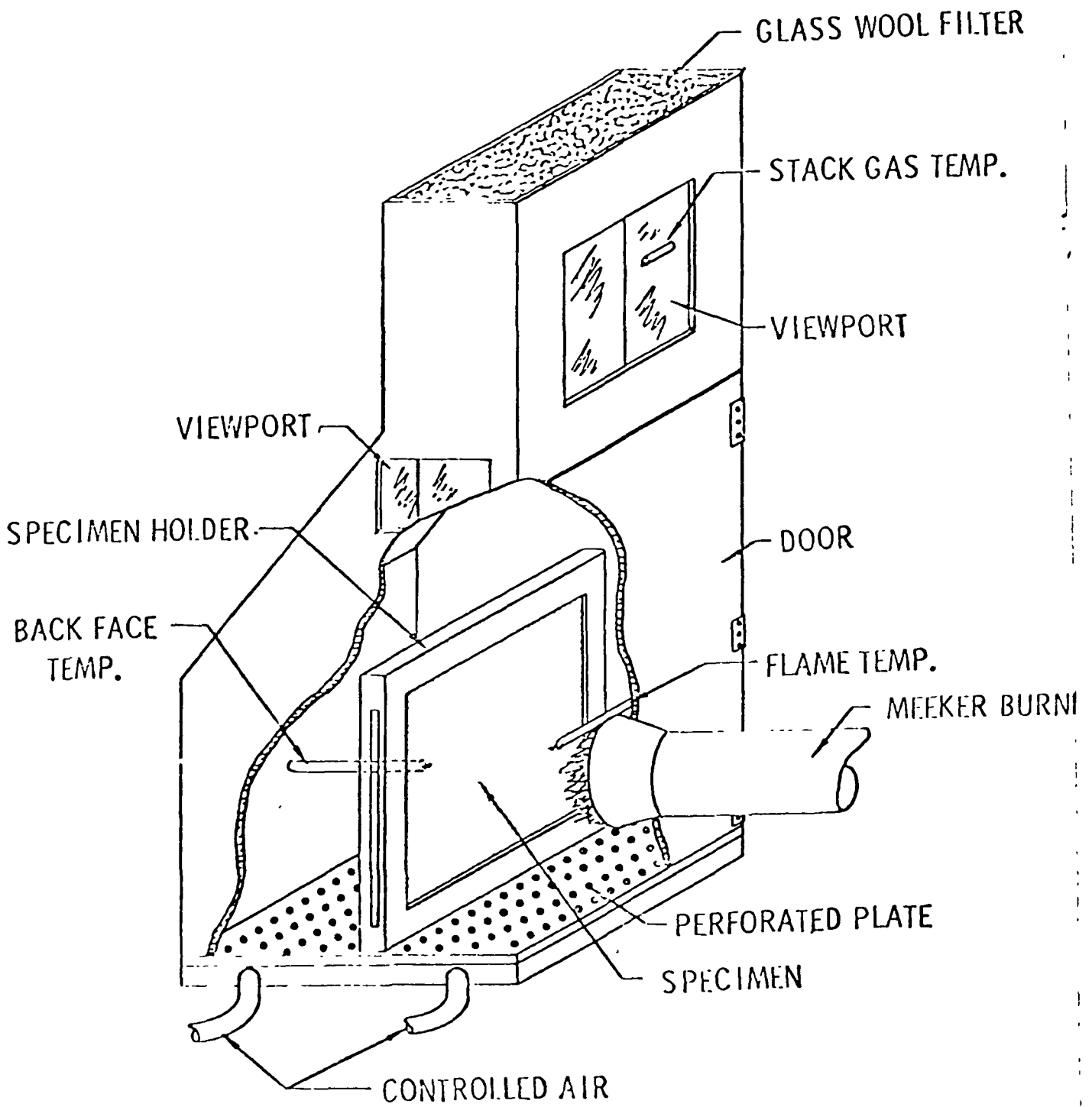
○ VERIFICATION TEST RESULTS (ONE PANEL FOR END ITEM FABRICATION)

● BOEING CONSTRUCTED

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

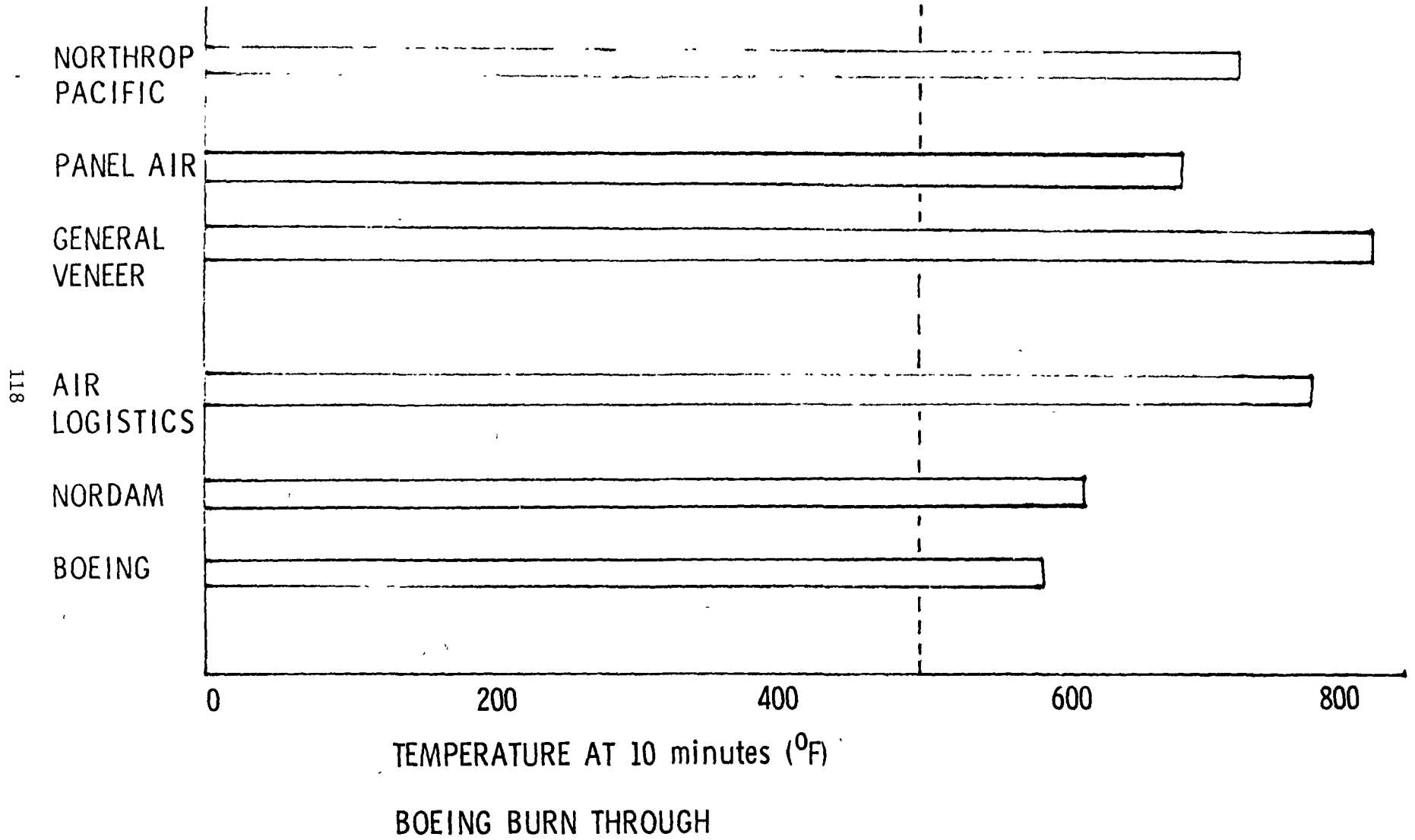
ADHESIVE - Modified phenolic film (Narmco 9252)

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



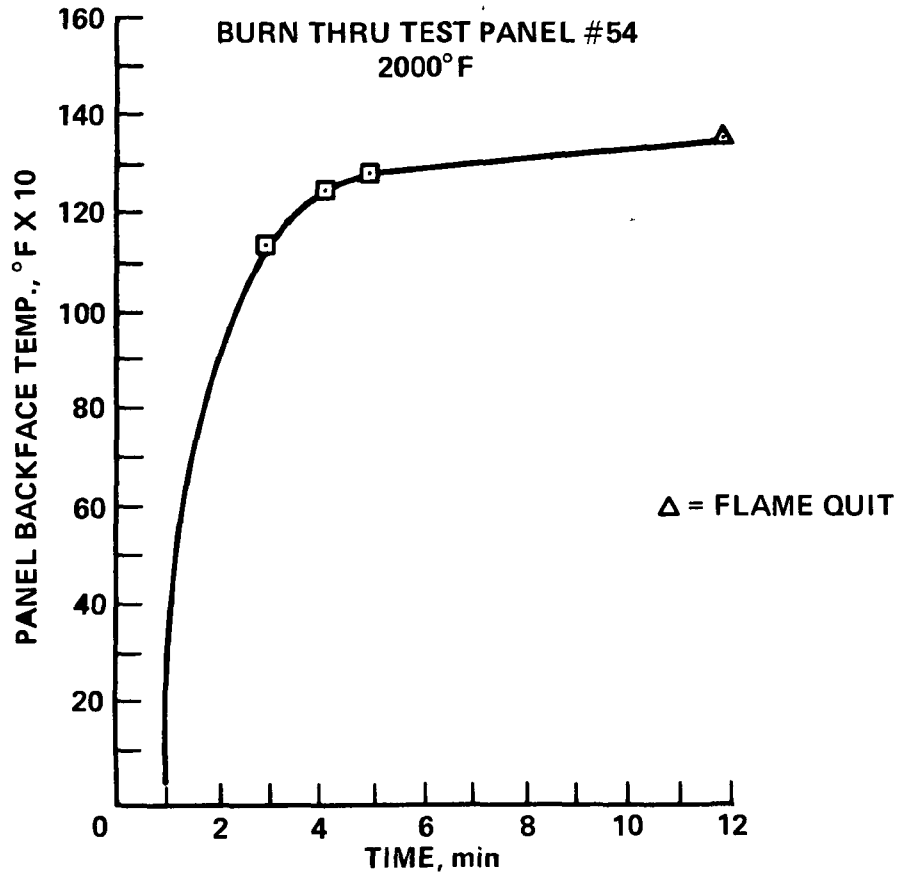
Boeing Burnthrough Apparatus

RESULTS



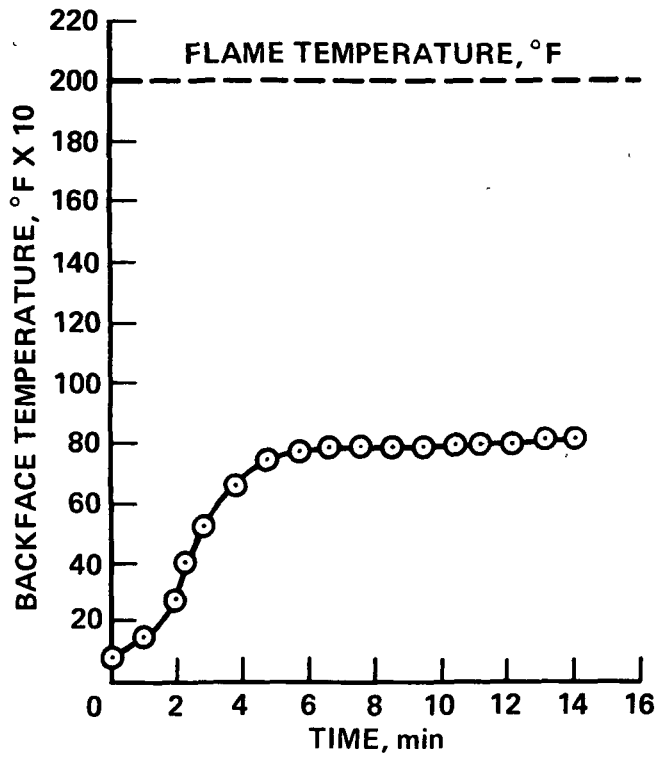
LENNOX OIL BURNER

BURN THRU TEST PANEL #54
2000°F



LENNOX OIL BURNER

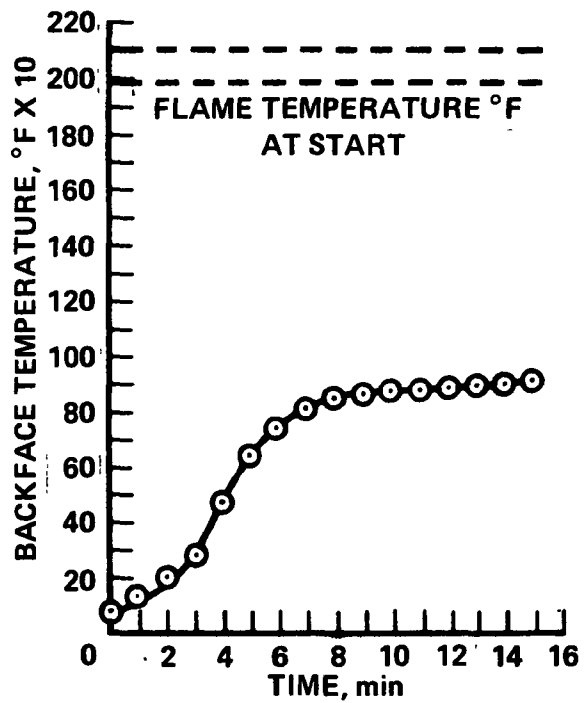
BURN THRU TEST PANEL #76
2000°F OIL BURNER BLOWER



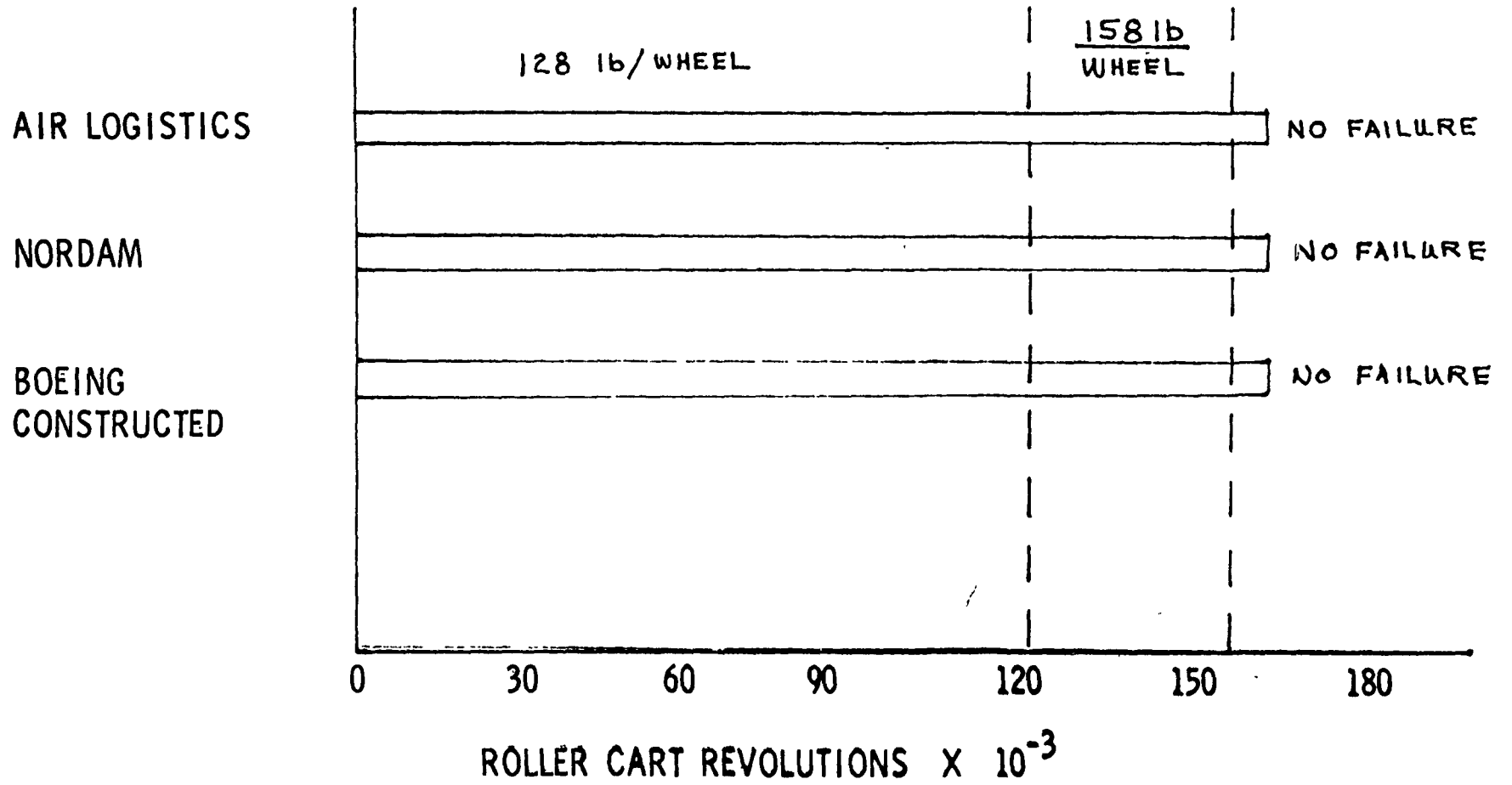
LENNOX OIL BURNER

BURN THRU TEST PANEL #68

2000° F OIL BURNER BLOWER AT 3.5 INCHES FROM FACE



RESULTS

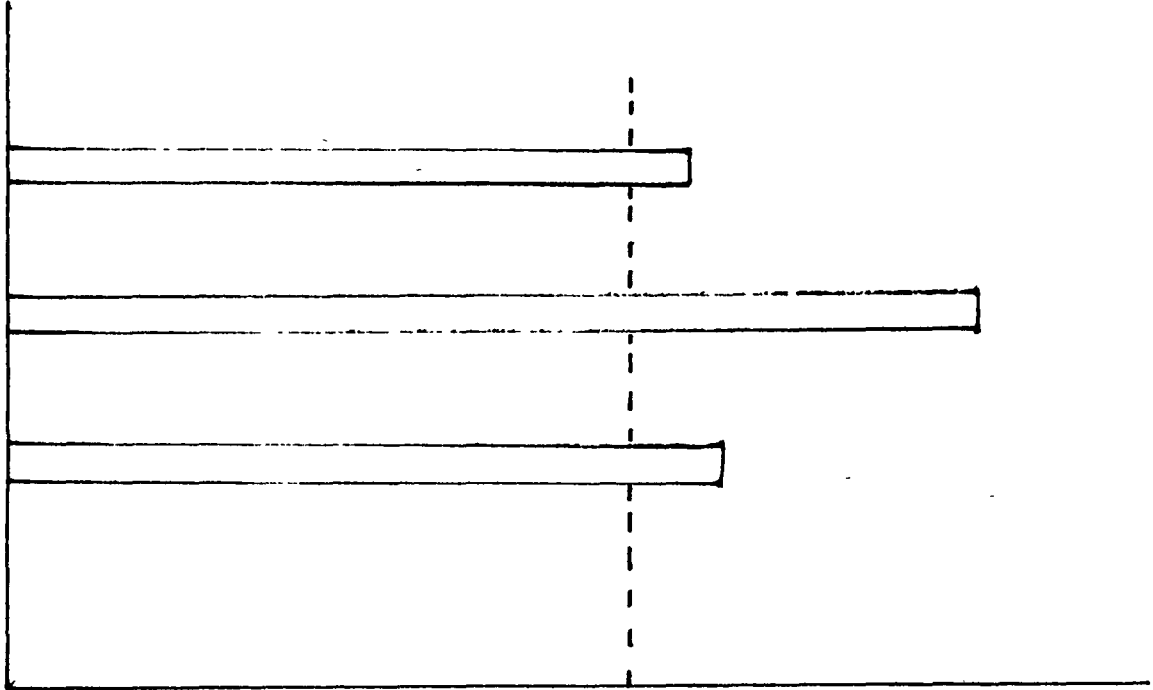


RESULTS

AIR
LOGISTICS

NORDAM

BOEING



0 .20 .40 .60 .80 1.00
WEIGHT lb/ft²

SUMMARY

○ CONCLUSION

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