



**EFFECT OF ACCELERATED AGING CONDITIONS ON
FLAMMABILITY TEST PERFORMANCE OF THERMAL/
ACOUSTICAL INSULATION BLANKET MATERIALS**

*David Indyke and Khang Tran
The Mexmil Company, Santa Ana
California 92705, USA*

CONTENTS

- INTRODUCTION
- RADIANT PANEL SYSTEM
- CALIBRATION
- MATERIALS
- AGING PROCESSES
- TESTING RESULTS
- SUMMARY AND CONCLUSION

INTRODUCTION

- The long-term exposure of fuselage thermal/acoustical blanket materials to the use-environment will eventually result in changes in the flammability properties of the material. This process is referred to as “aging”.
- The accelerated aging methods for the fuselage thermal/acoustical blanket include
 - 1/ Dry Heat Process.
 - 2/ Freeze/Thaw Cycling Process.
- Flammability and flame propagation properties of the normal and aged specimens are examined using a Radiant Panel Testing Apparatus.

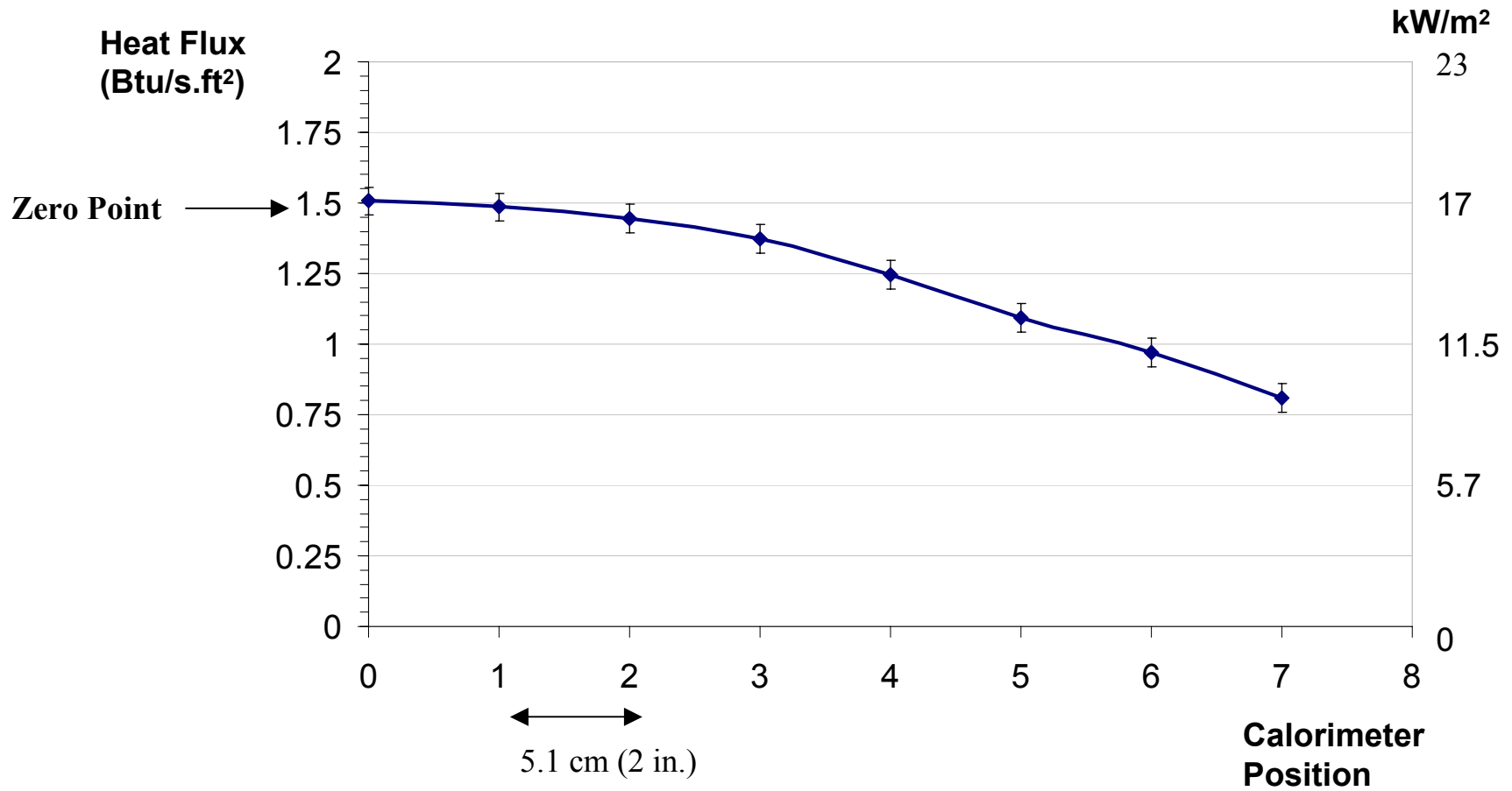
RADIANT PANEL TESTING APPARATUS



- Propane Pressure: 0.28 Mpa (40 psi)
- Radiant panel Readout: 629 °C (1165 °F)
- Pre-calibration heat flux: 16.8-17 kW/m² (1.48-1.5 Btu/s.ft²)
- Post-calibration heat flux: 16.8-17 kW/m²
- Watlow Controller Set Point: 641 °C (1185 °F)
- Pilot Burner Flame Length: 2.7 cm (3/4 in.)
- Cabinet Temperature: 293-304 °C (560-580 °F)



CALIBRATION CURVE FOR RADIANT PANEL SYSTEM





TESTING SPECIMENS

Dimension 32 cm x 58.4 cm (12.5 in. x 23 in.)

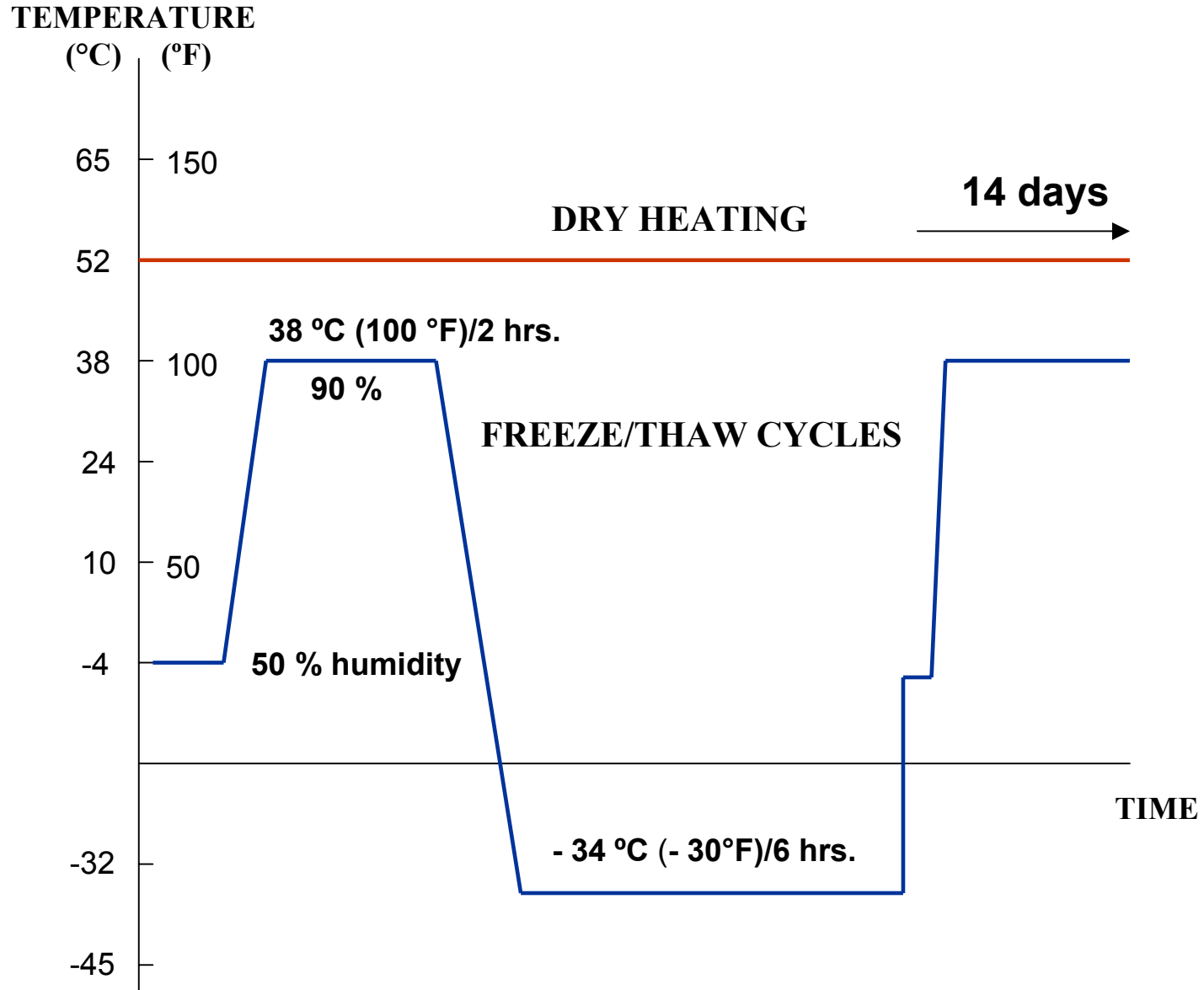
Materials

- Fiberglass 6.7 kg/m³ (0.42 pcf), 2.54 cm (1 in.) thick, 2 layers.
- Cover Film: Polyimide (PI), Polyester (PET), Polyvinyl Fluoride (PVF), and Metalized-Polyvinyl Fluoride (MPVF).

Specimen Preparation

- Reference specimens
- Specimens aged by dry heat condition at 52 °C (125 °F)/14 days
- Specimens aged by freeze/thaw cycles at 38 °C (100 °F)/2hrs, + 90 % humidity and -34 °C (-30 °F)/6hrs + ambient humidity.
- For specimens with PI, MPVF, and PET cover, one side is half-covered with associated tape.
- Specimens covered with PVF film contain no tape.

ACCELERATED AGING PROCESSES



(a) Normal
specimen

(b) Aged
specimen
No film
shrinkage
was observed.



DRY HEAT AGED PI SPECIMENS WITH NO TAPE
No flame propagation and no film shrinkage.

(b) aged specimen
with tape.
No film
shrinkage was
observed.

(a) normal
specimen with
tape. Adhesive
is burning (30 s).

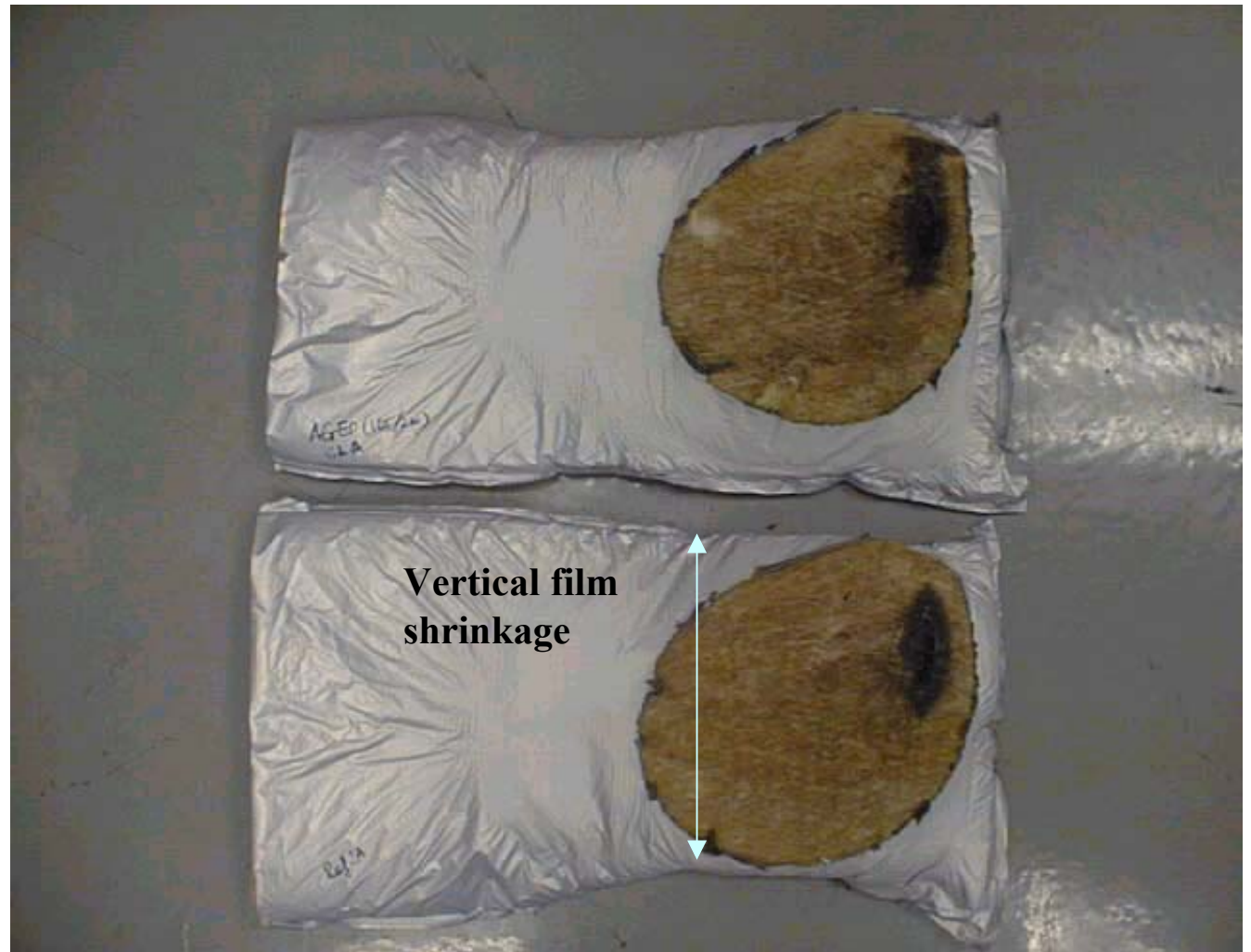


25.4 cm (10 in.)

DRY HEAT AGED PI SPECIMENS WITH TAPE
No film shrinkage and specimen deformation

(b) aged specimen:
less vertical film-
shrinkage was
observed.

(a) normal specimen:
Vertical shrinkage
is about 4 cm (< 2 in.)
more than the aged
sample.

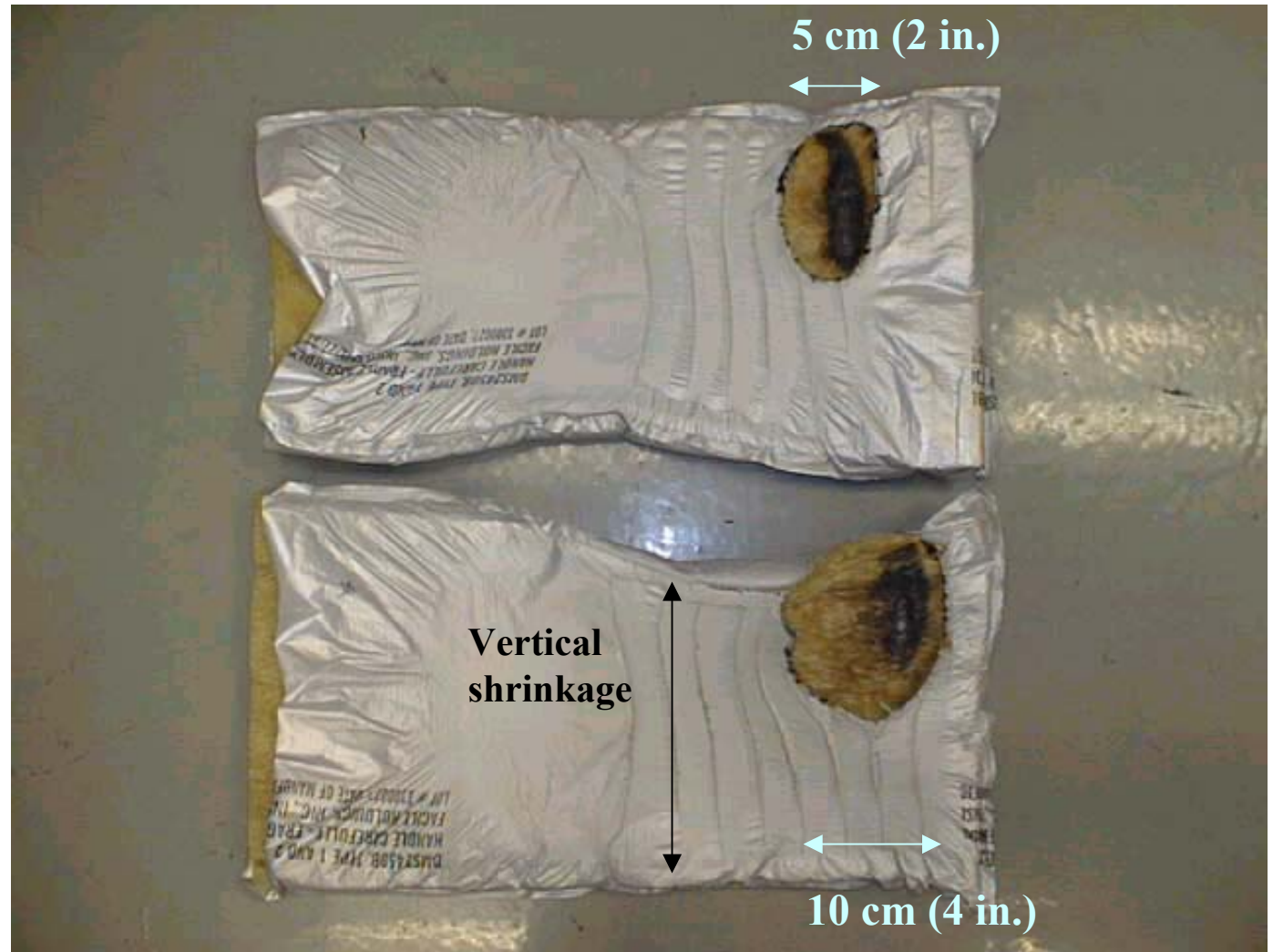


23 cm (9 in.)

DRY HEAT AGED MPVF SPECIMENS WITH NO TAPE
Specimens were deformed due to the vertical film-shrinkage.
Film melted away but no flame propagation

(b) aged specimen:
film melting length is
shorter than normal
specimen.

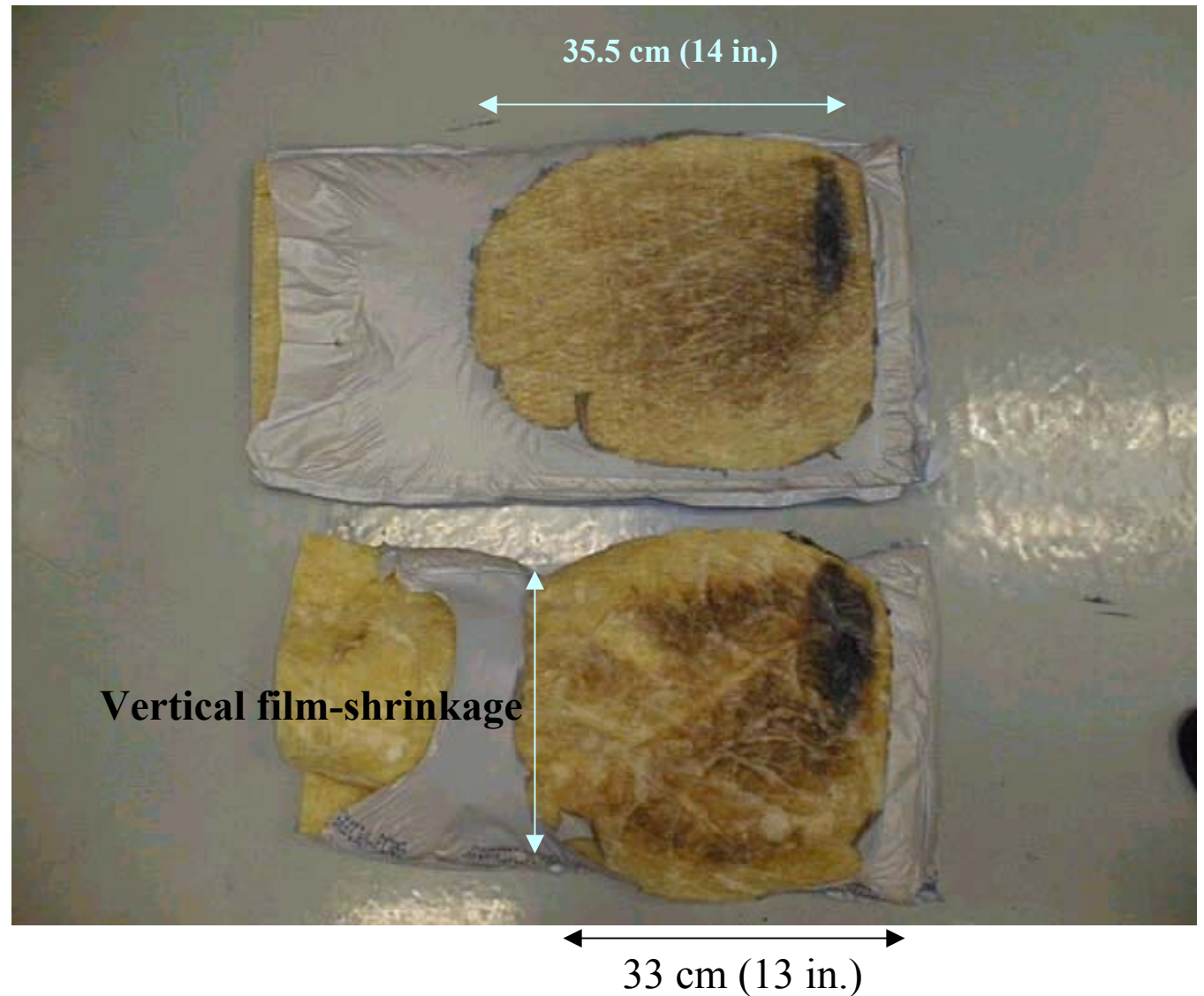
(a) normal specimen:
vertical shrinkage is
nearly the same as
the aged sample.



DRY HEAT AGED MPVF SPECIMENS WITH TAPE
Melting length is less for specimens with tape.
No flame propagation.

(b) aged specimen:
less vertical film-
shrinkage was
observed.

(a) normal specimen:
vertical shrinkage is
7.5 cm (3 in.) more
than the aged sample
causing specimen
deformation.
Film melted away to
the other side of
blanket.



DRY HEAT AGED PVF SPECIMENS
(No tape was used on PVF film)
Film melted away and no flame propagation.

(b) aged specimen:
much less sample
deformation was
observed.



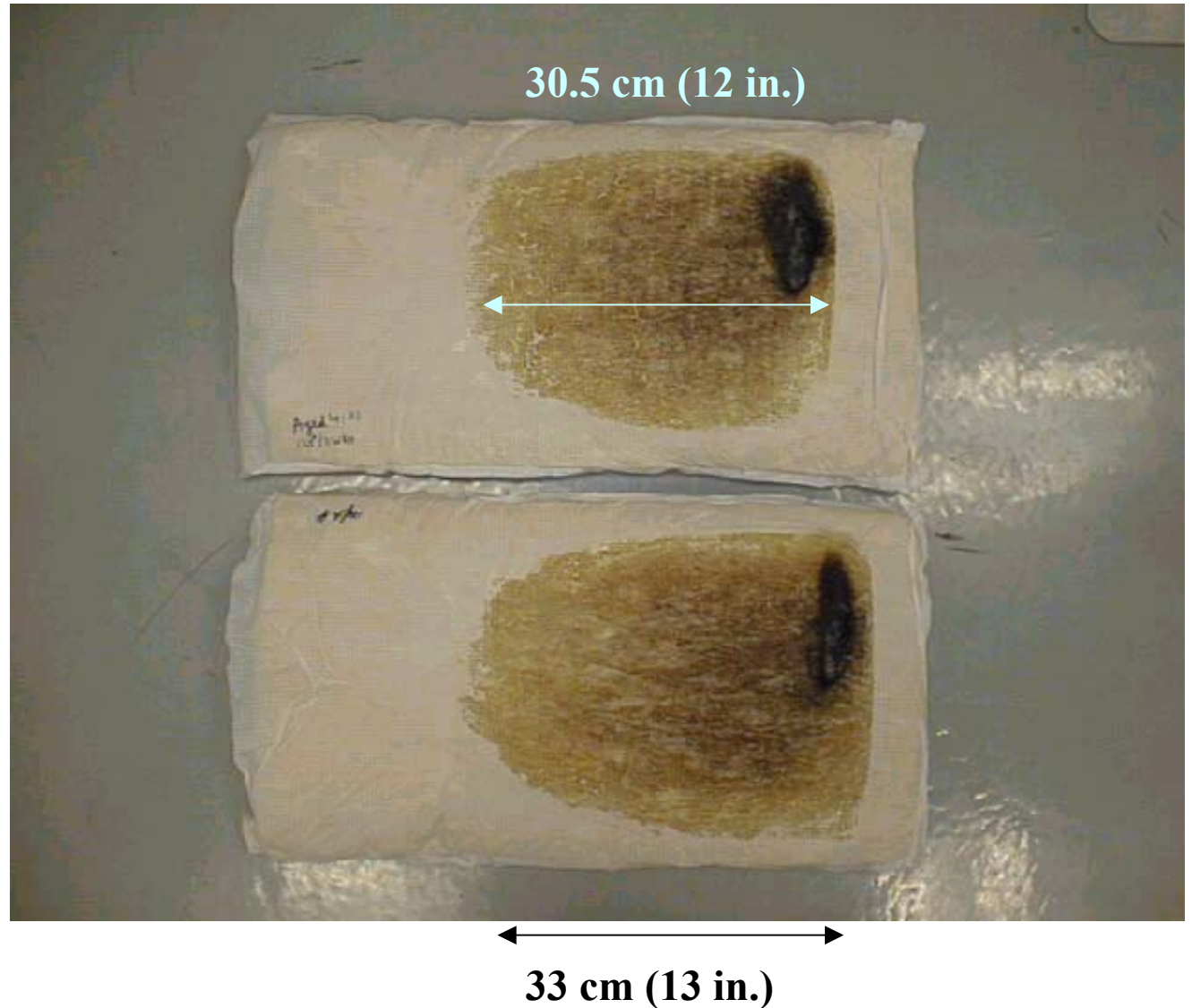
(a) normal specimen:
Film shrinkage and
sample deformation are
more than the aged
sample.



OTHER SIDE OF DRY HEAT AGED PVF SPECIMENS

(b) aged specimen:
No specimen
deformation was
observed.

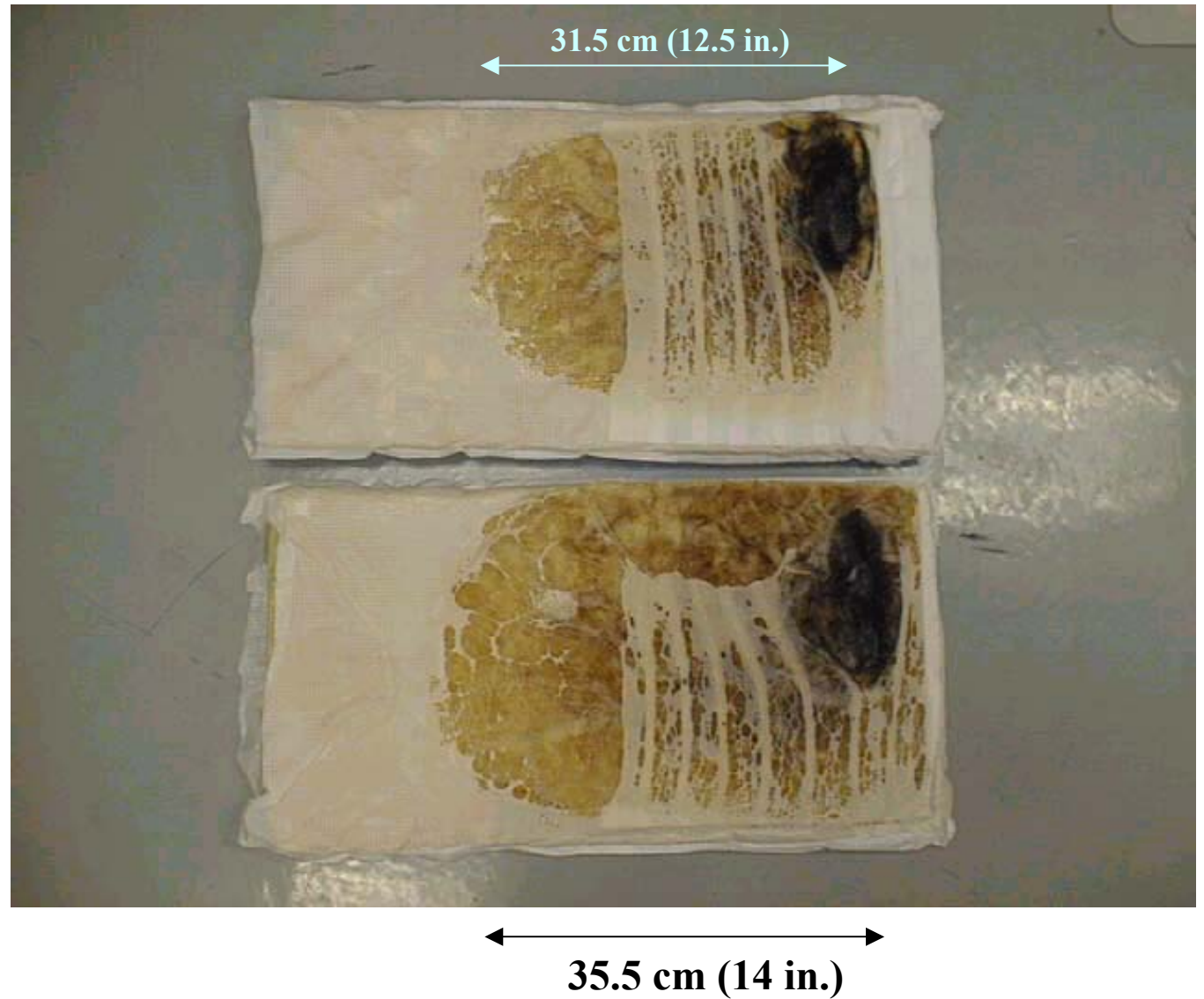
(a) normal specimen:
No specimen
deformation was
observed.



DRY HEAT AGED PET SPECIMENS
Film partially melted away
No flame propagation

(b) aged specimen:
No specimen
deformation was
observed.

(a) normal specimen:
No specimen
deformation was
observed.



DRY HEAT AGED PET SPECIMENS WITH TAPE
No flame propagation



PI film without tape.

PVF film (burned side).

FREEZE/THAW AGED SPECIMENS

No shrinkage or deformation was observed on both specimens.

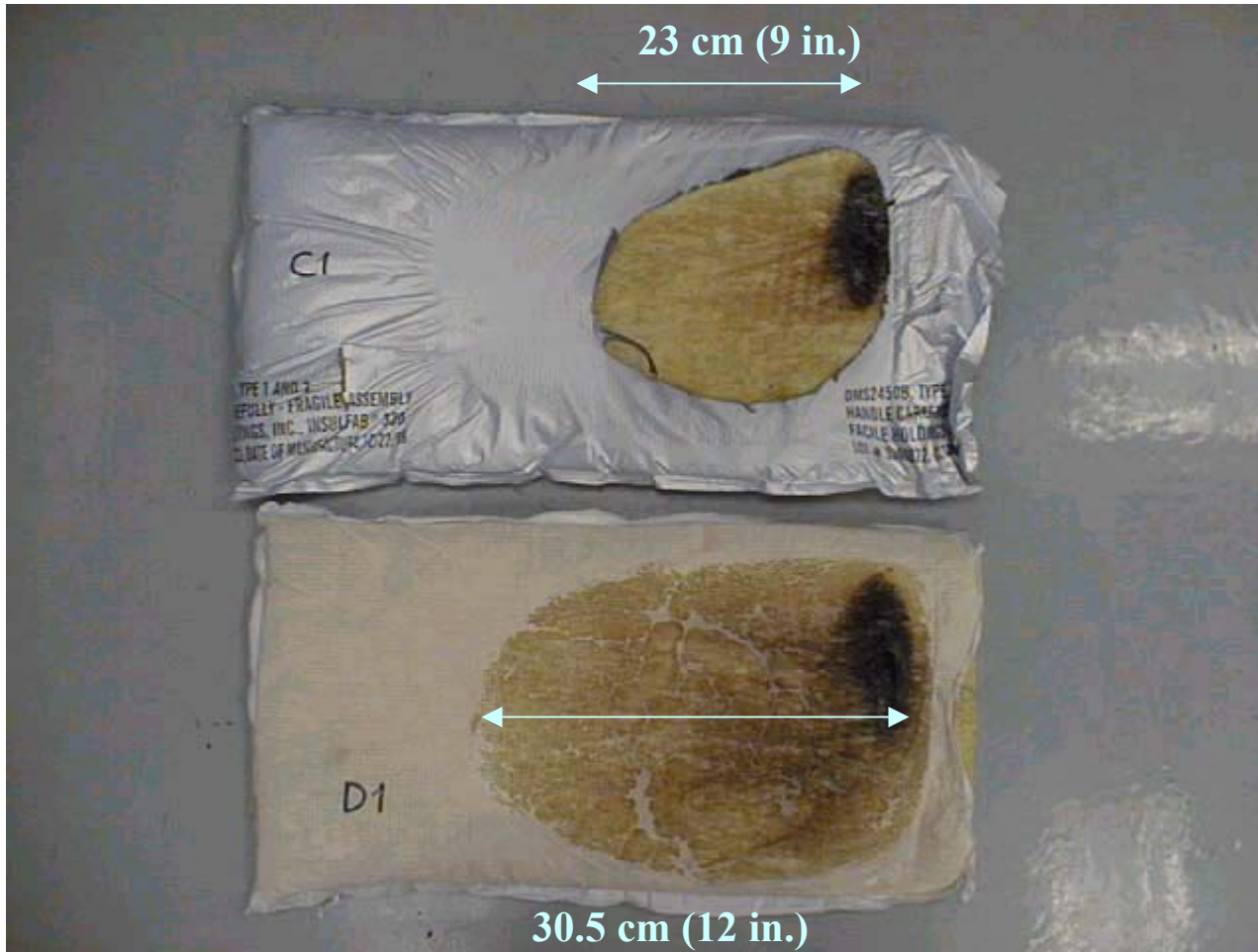
PVF film melted away. No flame propagation on both specimens.



PI film with PI tape.
No flame propagation.

PVF film (unburned side).

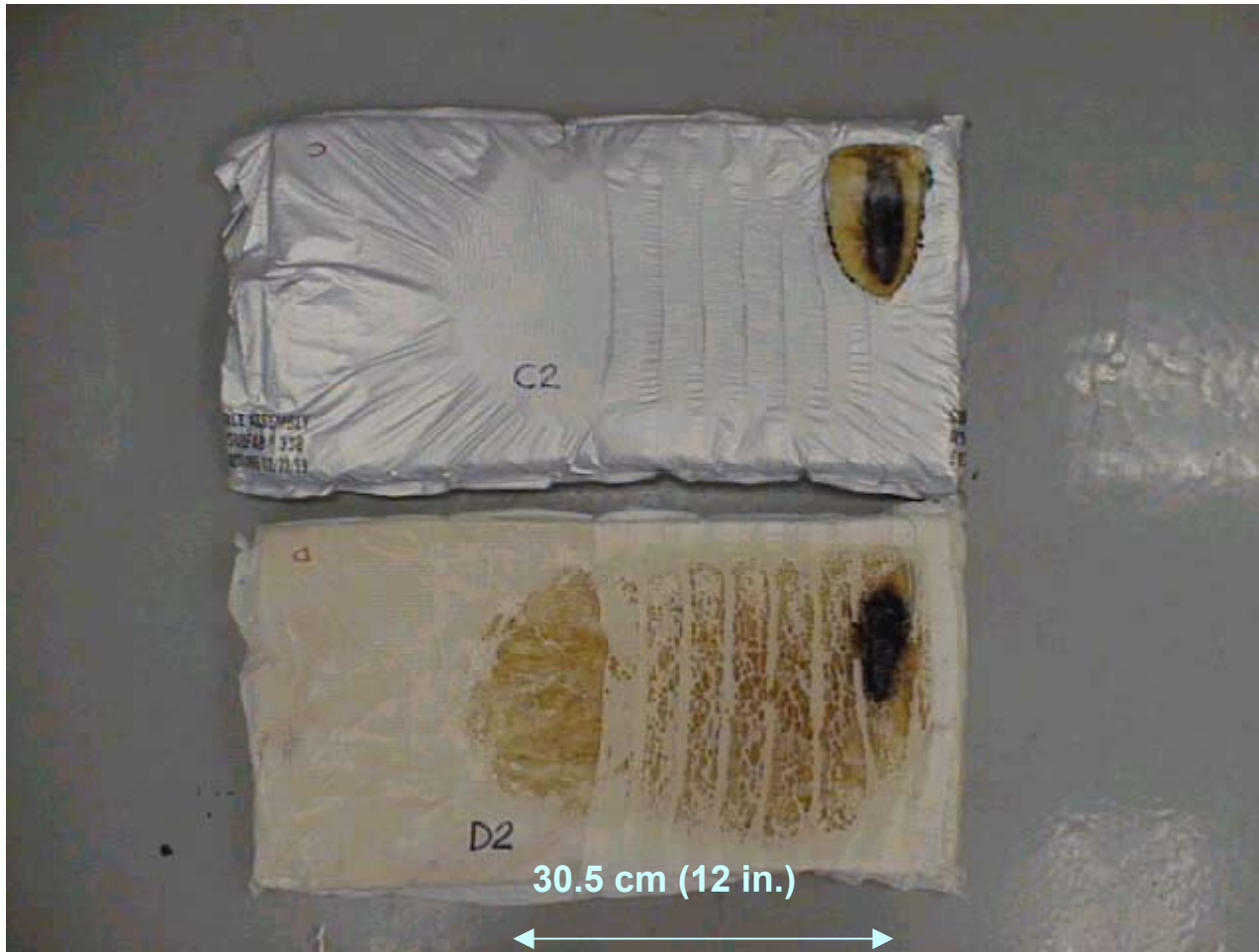
FREEZE/THAW AGED SPECIMENS
No shrinkage or deformation was observed.



MPVF film without tape.
No deformation.

PET film without tape.
No deformation.

FREEZE/THAW AGED SPECIMENS
Film melted away. No flame propagation.



MPVF film with MPVF tape.
Film melting length is ~ 5 cm
(2 in.)

PET film with PET tape.
Film and tape melt away
partially

FREEZE/THAW AGED SPECIMENS

No flame propagation

No specimen deformation was observed for both

SUMMARY AND CONCLUSION

The effect of accelerated aging conditions on flammability test performance of thermal/acoustical insulation blanket materials was investigated using a radiant panel flame spread testing system.

- 1. Under dry heat aging conditions : 52 °C (125 °F)/14 days**
 - For specimens covered with PVF and MPVF film, shrinkage was less after aged.**
 - Aged specimens with MPVF film and tape showed shorter melting length.**
 - For specimens with PI film and tape, aged samples suppressed flame propagation.**
 - PET films showed melting away that are unaffected by aging process.**

- 2. Under freeze/thaw aging conditions**

90 % RH, 38 °C (100 °F)/2 hrs. and -34 °C (- 30 °F)/6 hrs. for 14 days

 - All aged specimens showed no flame spread.**
 - PVF, MPVF, and PET film melted away partially but showed no specimen deformation.**