

ABSTRACT

A STUDY OF THREE TESTING MODES FOR DEVELOPING SHELF-AGED R-VALUES FOR POLYURETHANE FOAM THERMAL INSULATION

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The permeation of external air gases into polyurethane foam cells occurs first/most in cell stratas nearest the external foam surfaces. Their cell gas composition becomes diluted, resulting in reduced R-value. Centermost foam stratas, thus "protected" from permeating air gases, are affected last/least and retain their original R-value the longest. *The R-value per inch of 3 1/2 inch thick polyurethane thermal insulation is almost 23% greater than the R-value per inch of 1 inch thick foam after 180 days.*

Foam insulation specimens were made from commercial formulations of spray polyurethane chemicals and HCFC 141b blowing agent. Thermal tests were conducted at various time intervals in accordance with ASTM C518-91 heat flow meter and ASTM C236-89 guarded hot box test methods.

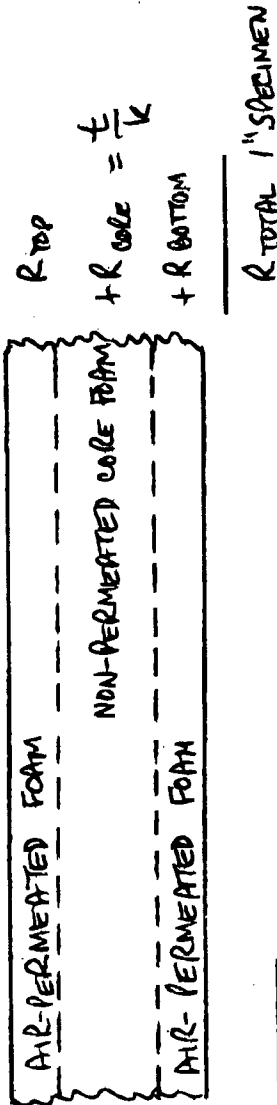
Mode 1- Full-thickness (3 1/2 in.) conditioning, followed by removal of the two major surface layers before thermal testing as 1 in. core foam, exhibited **no change in R-value per inch over one year's conditioning time.**

Mode 2- Conditioning and testing as 1 in. core foam, demonstrated logarithmic Primary Stage R-value decay as expected. No transition point into a less severe Secondary Stage decay was identified after one year's conditioning.

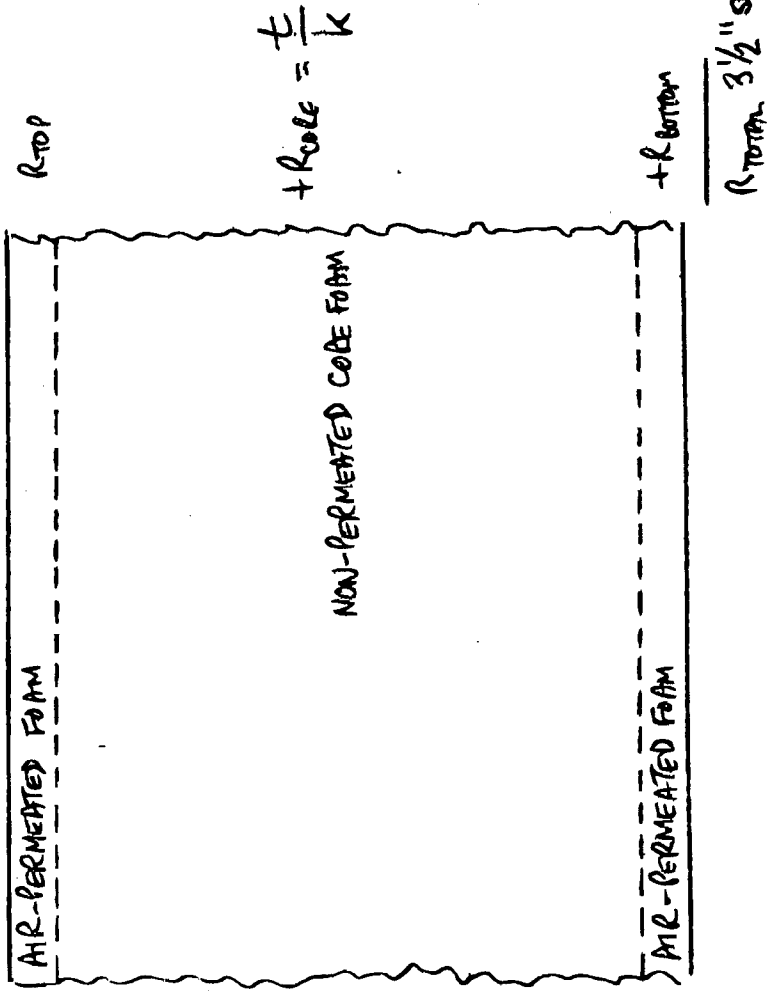
Mode 3- Full-thickness (3 1/2 in.) conditioning and testing measured the time-protected thermal resistance value of the inner foam stratas and also the two major surface layers, resulting in a more realistic representation of R-value for the entire product.

Regression analysis was used to develop mathematical models for R-value per inch thickness vs days aging time, using a commercially available electronic calculator. Predictions were made for R-value per inch at 1 year age for each test method and conditioning mode studied, and comparisons were made against test results.

Thermal test data is presented for all three test modes, their logarithmic regression model formulas and model-predicted aged R-values through five years age conditioning.



$R_{TOTAL} \text{ 3 1/2" SPECIMEN} > R_{TOTAL} \text{ 1" SPECIMEN}$
 BECAUSE OF MUCH GREATER THICKNESS
 OF NON-AIR PERMEATED CORE FOAM



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