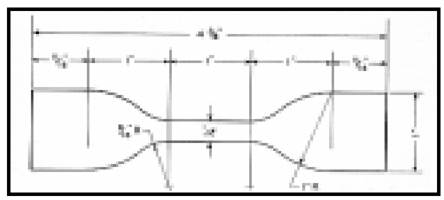
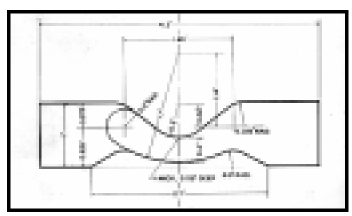
Chapter VI. C

Retention of Properties During Environmental use

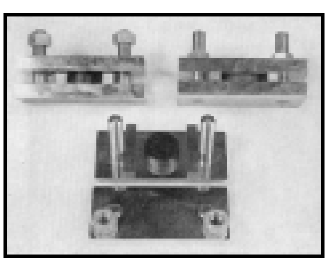
Environment Controlled Test Chamber



Tensile Test Sample

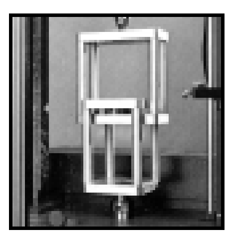


Tear Resistance Sample



Compression Set Fixture

Compression Modulous Test Fixture



RETENTION OF PROPERTIES AT ENVIRONMENTAL USE

Which properties, both physical and chemical, should be of the most concern to the rubber design engineer and the oil tools design engineer? What do both really look for as an indication of compound reaction in the environment where it will work? The design properties at room temperature in the laboratory are set high enough to take care of plant production losses, but they only indicate (when checked) that processed material has been mixed with the chemicals and in quantities called for. What is needed are the actual physical and chemical properties in the environment where the product works. This in turn can best be expressed by the retention of original properties over a temperature and chemical condition range as tested in the laboratory.

To better explain this, we must realize that elevated temperatures lower the physical properties of a rubber compound. Continued aging at these temperatures accelerates the degradation of properties and long enough aging causes permanent loss. The same is true when rubber products are exposed to various chemical environments.

In the design of rubber compounds we have allowed for processing losses and we know the values for a full range of room temperature properties. The same values should be obtained at various temperatures and in various chemical atmospheres in order to have a means of comparison as to what can be expected of the finished product. The comparison of the room temperature values vs. the controlled environment values can be expressed as retention of properties. These retention values when plotted can be used in choosing one formulation over another for use in a finished product.

This information can be best explained by viewing the charts numbered 1thru 6. Two 90 durometer compounds designed for use in packer rubbers were tested in the laboratory over a range of temperatures at room temperature, 150 F, 200 F, 250 F and 300 F. The samples were prepared and aged as indicated and actually tested at the temperatures of aging. Aging of the samples was performed in accordance with ASTM test procedures and in an ASTM #3 oil bath. Immersion or aging periods were varied from 4 to 48 hours and tests for the various properties were run according to standard ASTM procedures.

The retention charts show the deficiencies of the rubber compounds as they are aged and are an adequate tool to use to choose the proper compound for the product use. The charts shown are for the most commonly used properties, but other tests should be devised that better equate to actual performance of the end product. It must be kept in mind to always equate test equipment, procedures and conditions to those to

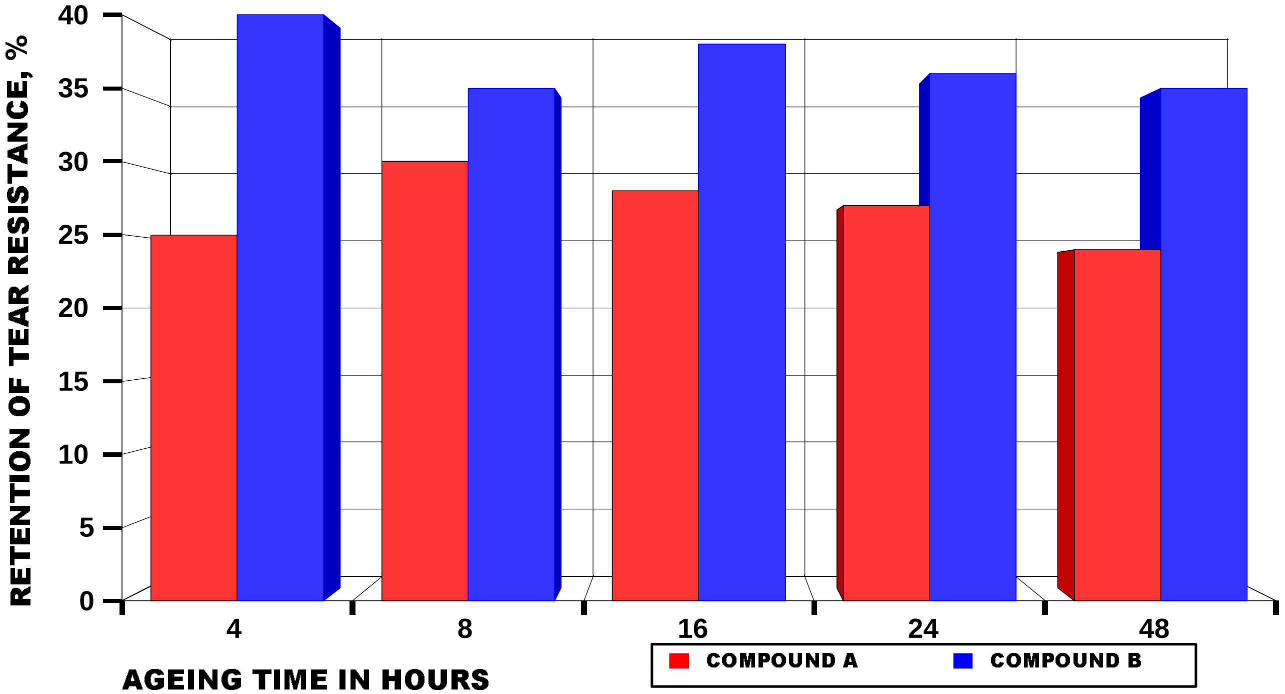
be met at product function point.

An evaluation has been collected and shown in Charts 7 and 8 for the compression stress values for the two 90 durometer stocks mentioned above. It can readily be seen that this has been another indicator for choosing the most adequate rubber compound for the product needs.

Many other testing methods and values are available and should be used. The oil tool design engineer should familiarize themselves with those comparing to this product requirements and they should work with the rubber design engineer to establish these goals. The oil tool engineer may come in complete control of the product if they will take time to set compound retention limits and require the vendor to set up quality check points to insure the limits have been met.

CHART 1

% RETENTION OF TEAR RESISTANCE AT 150^{O}F



% RETENTION OF TEAR RESISTANCE AT 200^{O}F

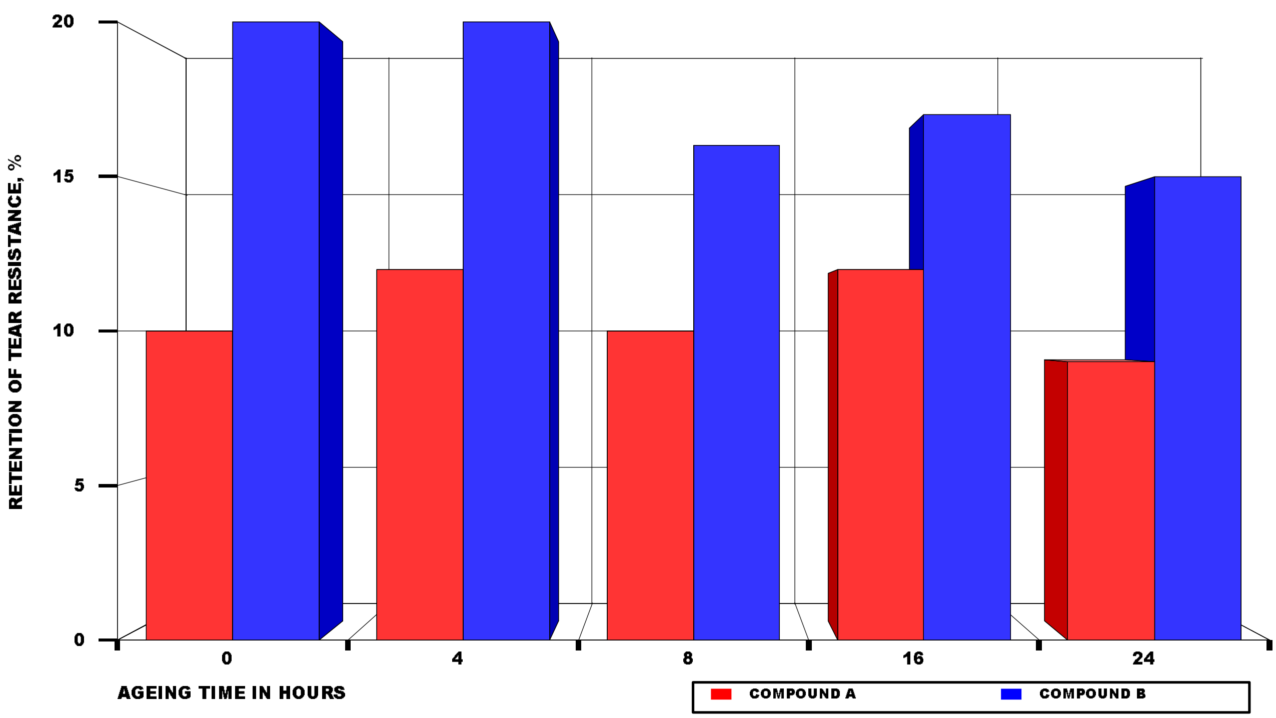
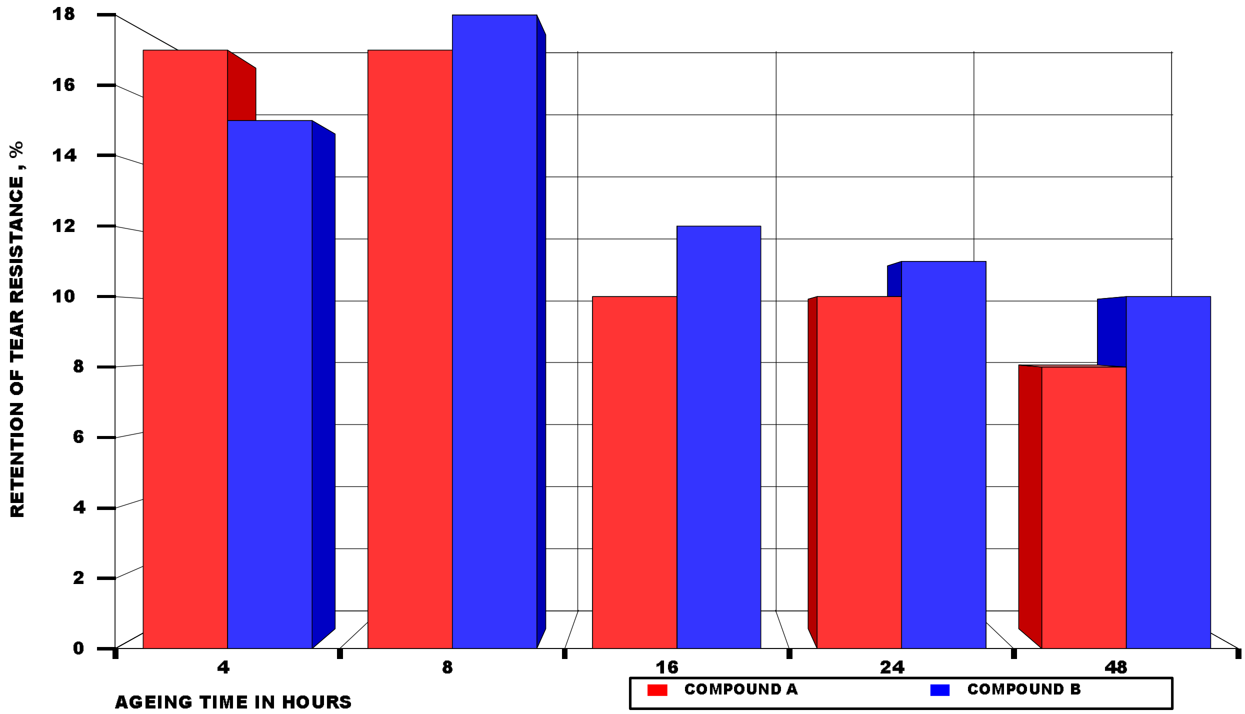


CHART 2

% RETENTION OF TEAR RESISTANCE AT 250^{O}F



% RETENTION OF TEAR RESISTANCE AT 300^{O}F

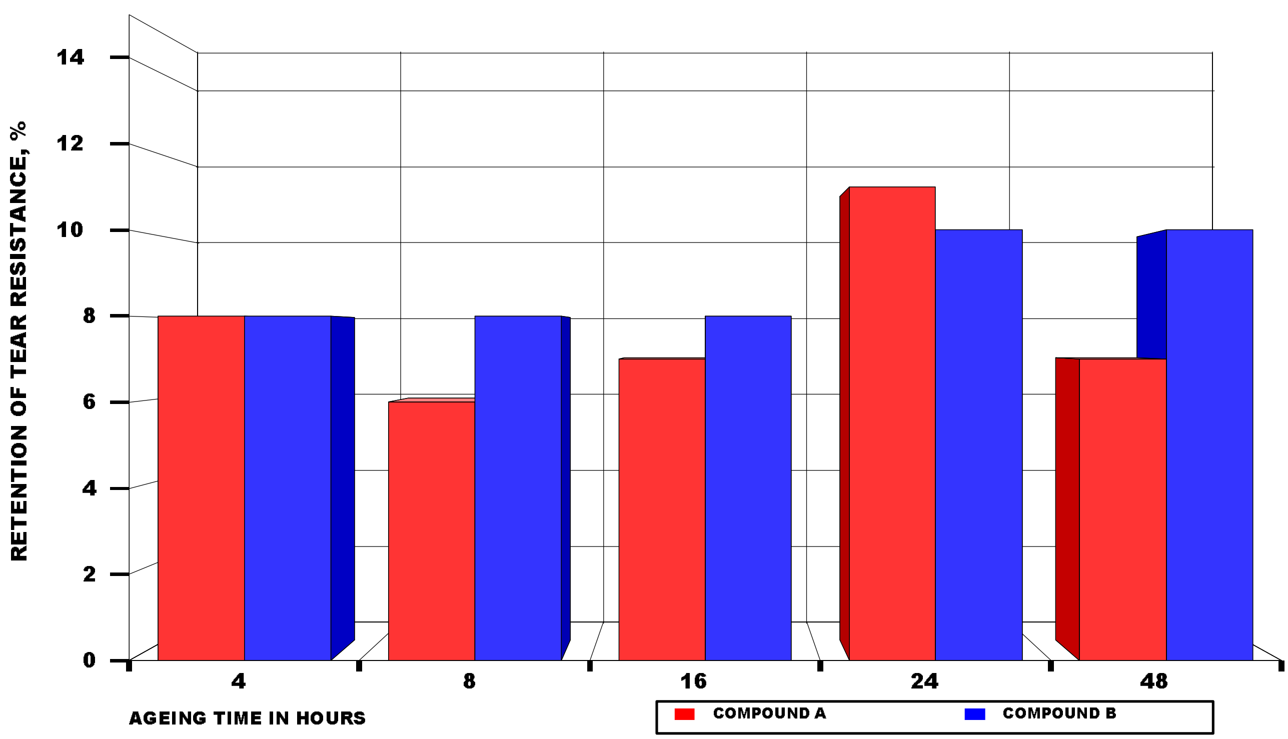
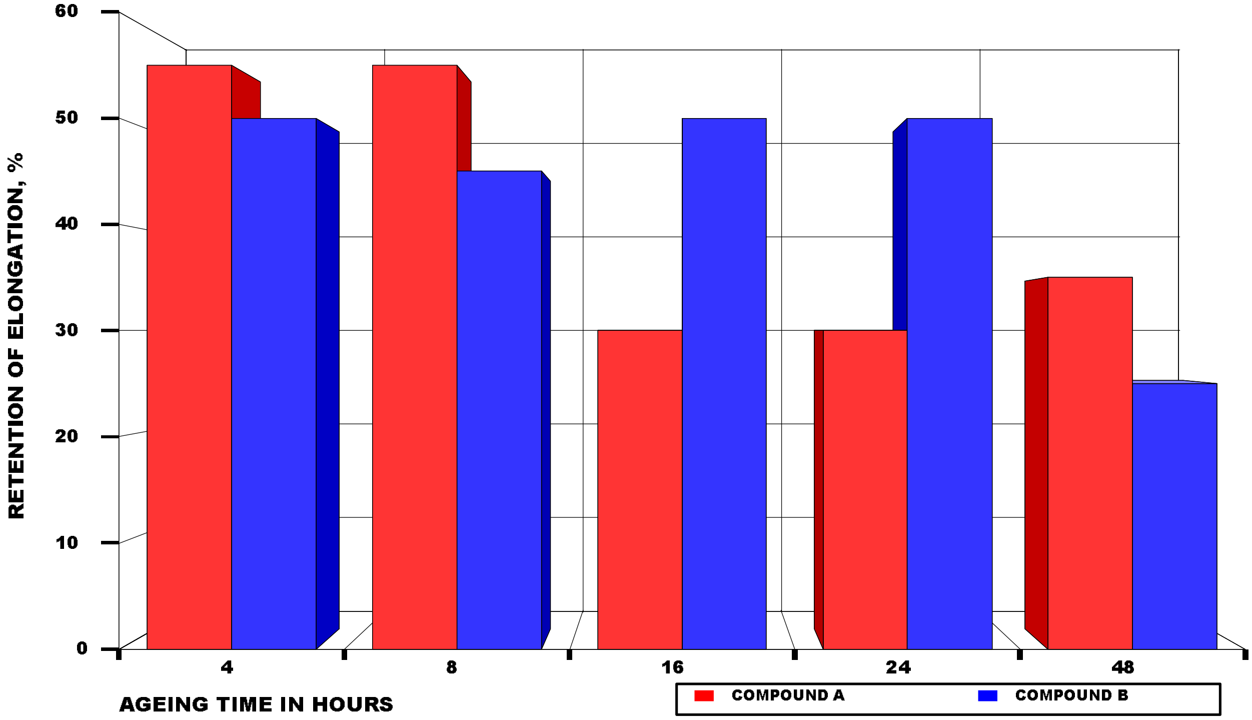


CHART 3

% RETENTION OF ELONGATION AT 150°F



% RETENTION OF ELONGATION AT 200°F

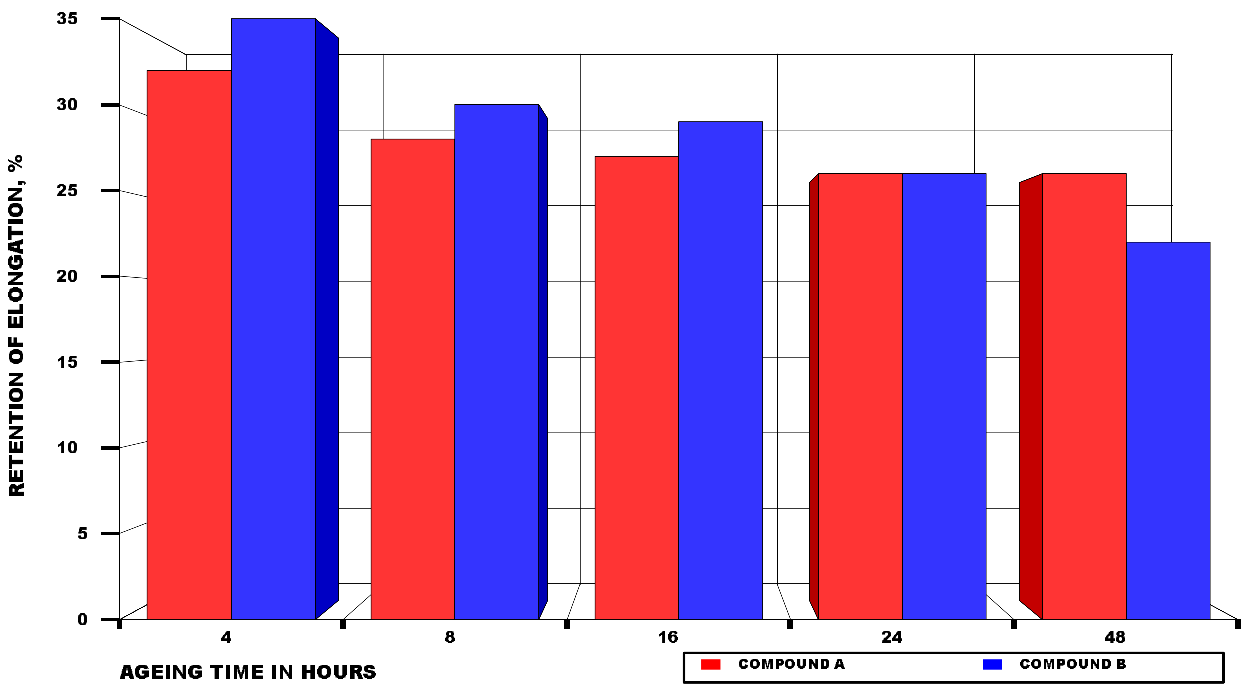
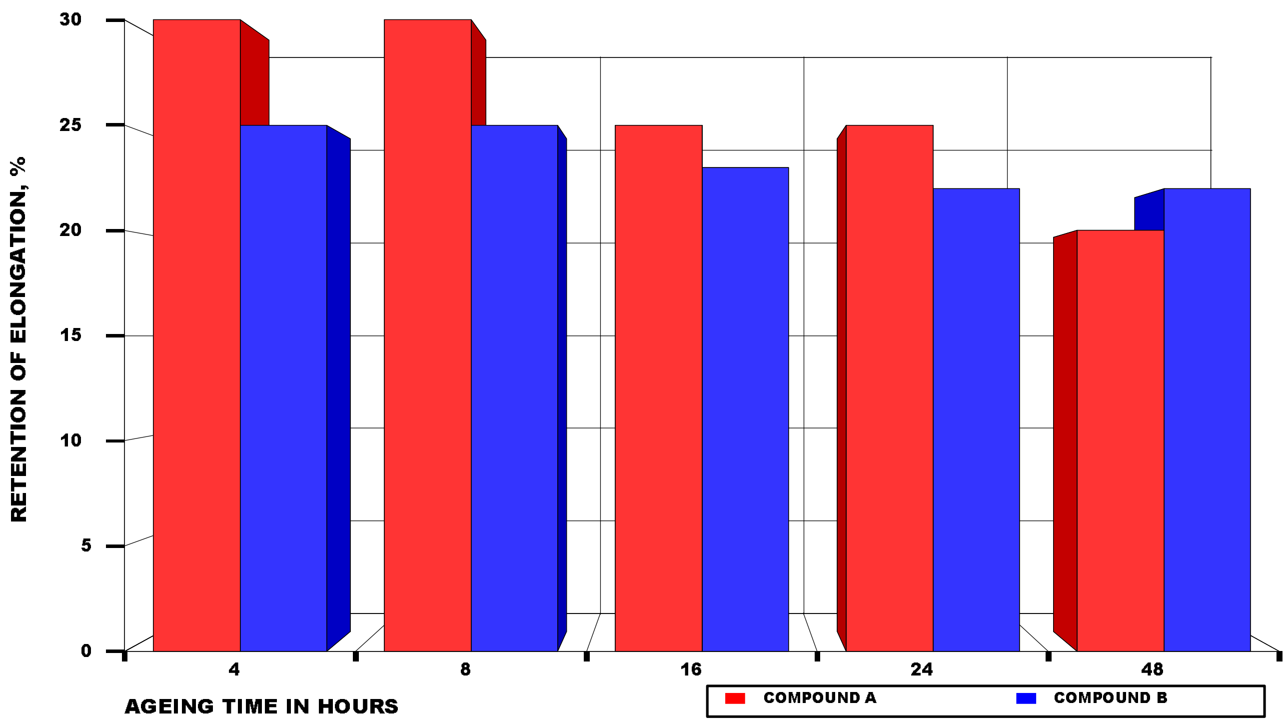


CHART 4

% RETENTION OF ELONGATION AT 250^{O}



% RETENTION OF ELONGATION AT 300^{O}F

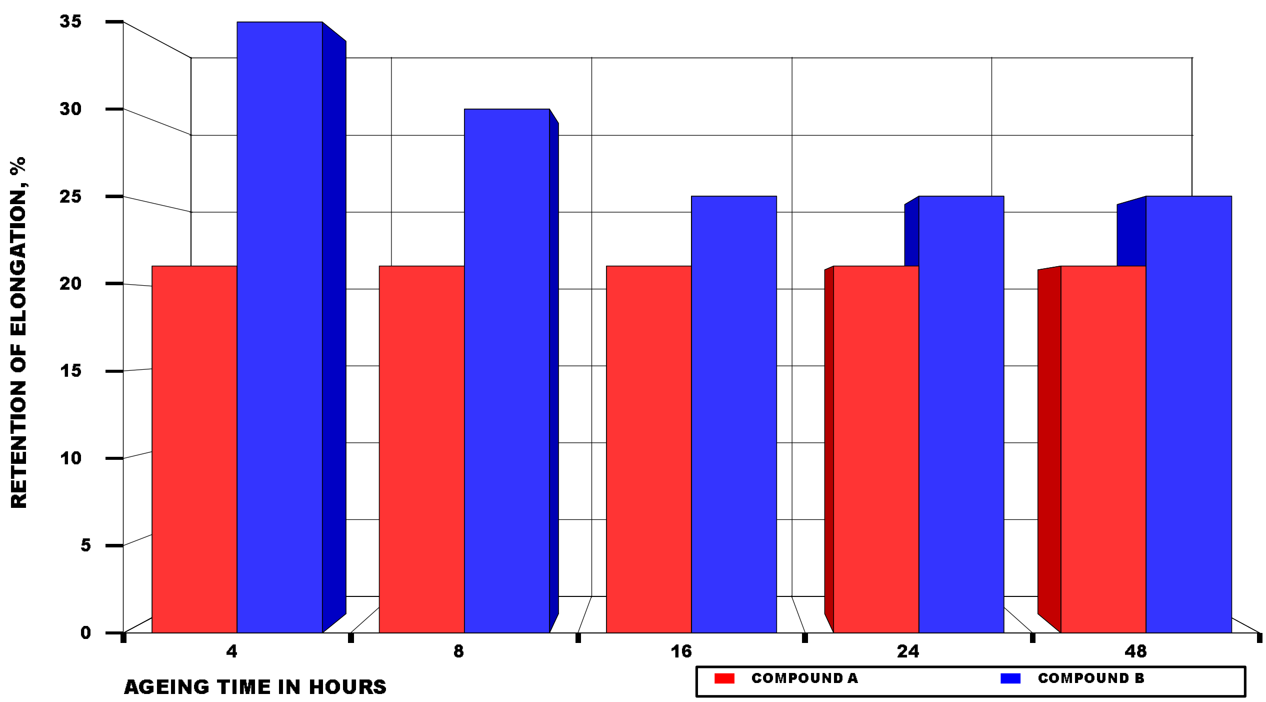
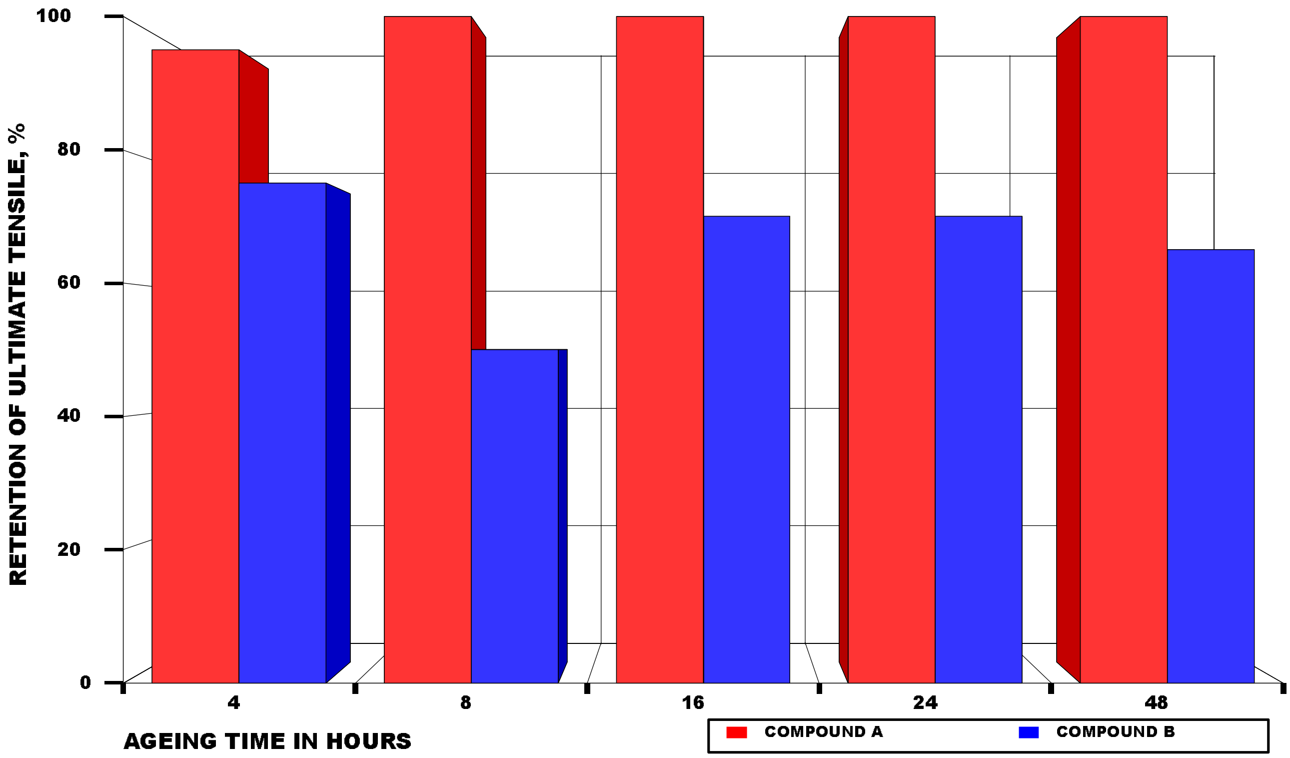


CHART 5

% RETENTION OF ULTIMATE TENSILE AT 150^{O}F



% RETENTION OF ULTIMATE TENSILE AT 200^{O}F

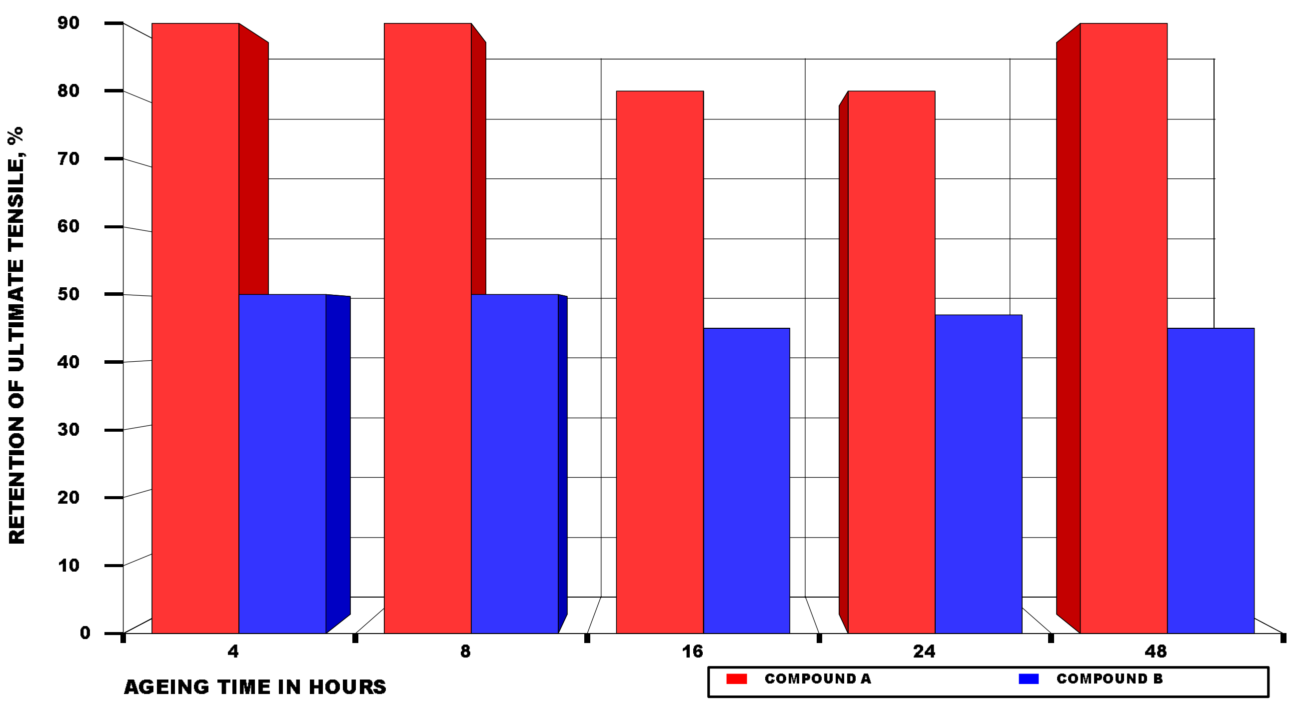
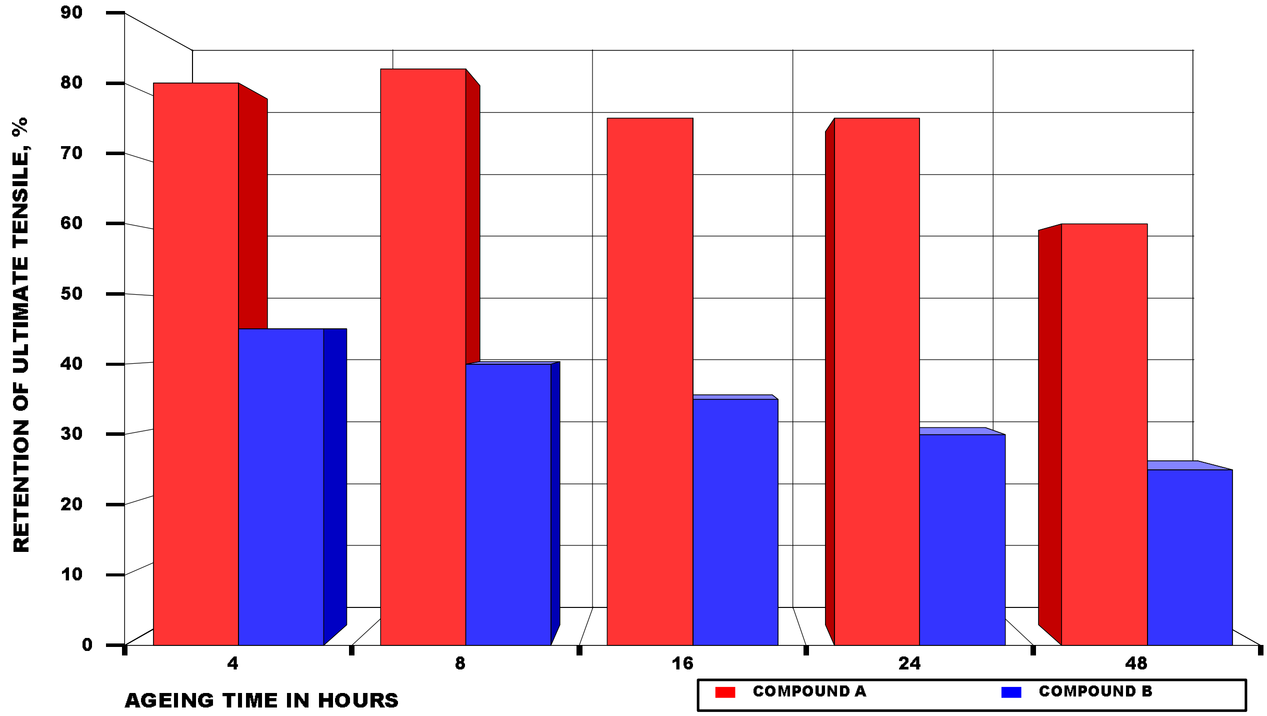
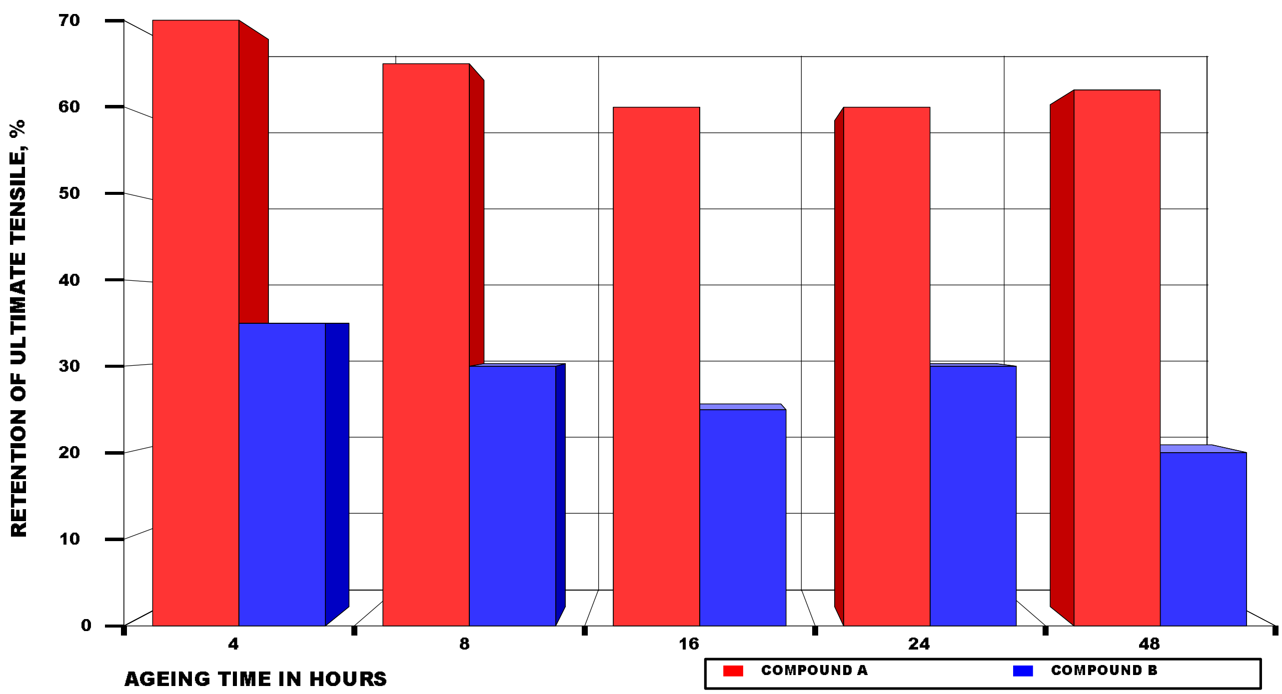


CHART 6

% RETENTION OF ULTIMATE TENSILE AT 250^{O}F



% RETENTION OF ULTIMATE TENSILE AT 300^{O}F



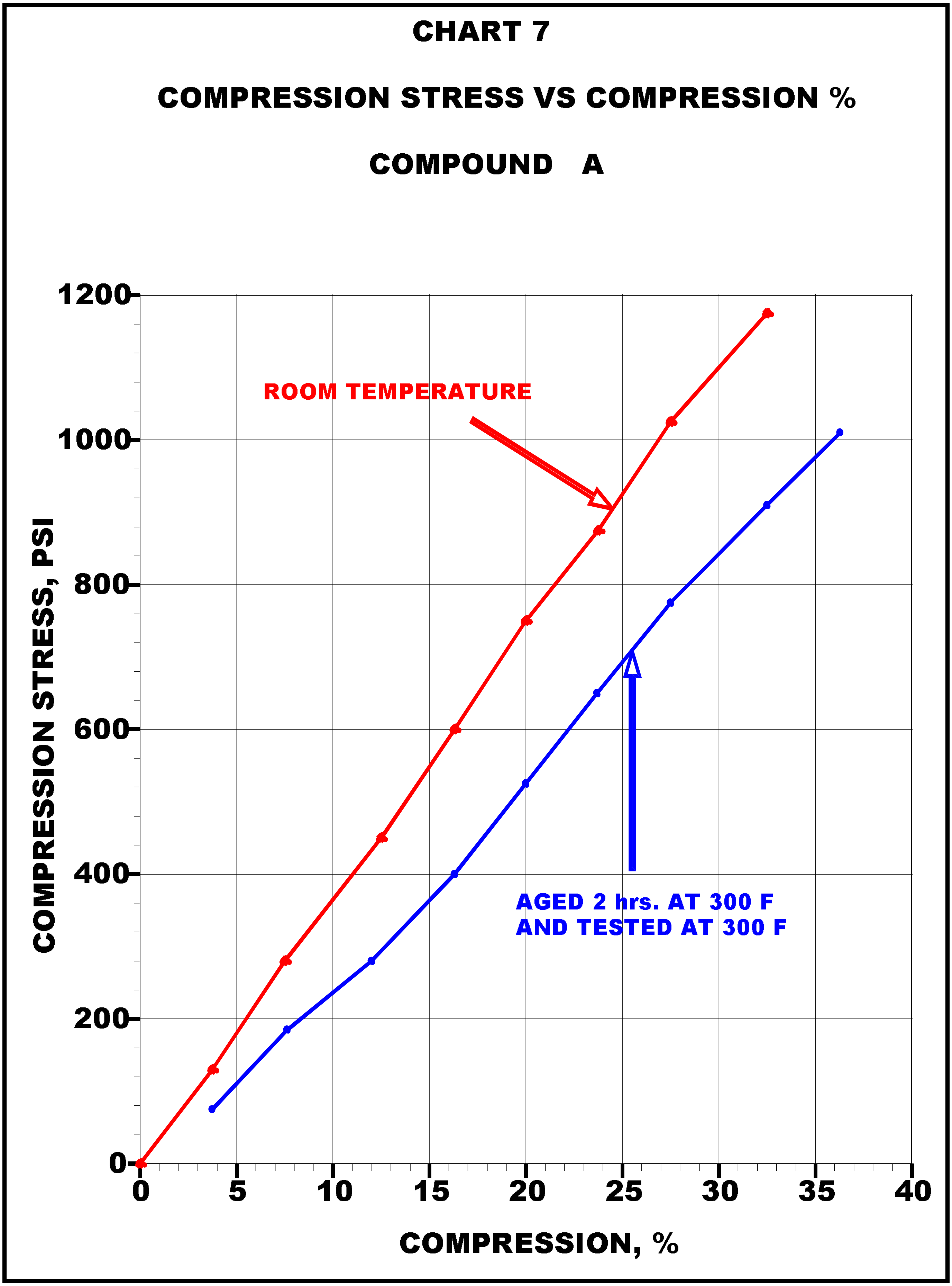
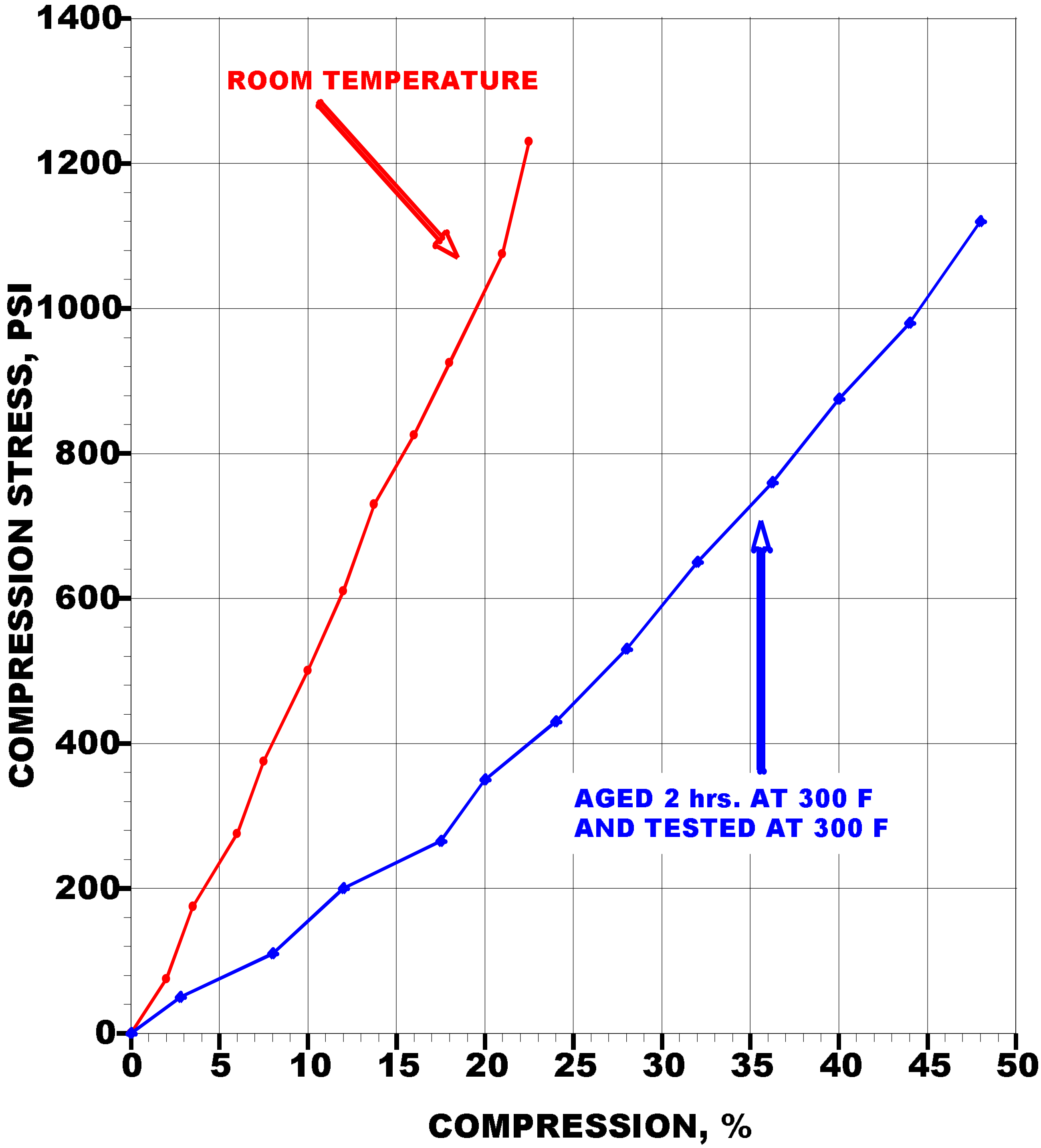


CHART 7
COMPRESSION STRESS VS COMPRESSION %
COMPOUND A
ROOM TEMPERATURE
AGED 2 hrs. AT 300 F
AND TESTED AT 300 F
COMPRESSION STRESS, PSI
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
COMPRESSION, %

CHART 8

COMPRESSION STRESS VS COMPRESSION %

COMPOUND B



Everything that can be said can be said clearly.