FINAL TECHNICAL REPORT
RESEARCH ON THE EXPLOITATION OF ADVANCED COMPOSITE MATERIALS TO LIGHTLY LOADED STRUCTURES

NASA GRANT NGR 22-009-781

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I. INTRODUCTION

This is the final technical report of NASA Grant NGR 22-009-781 "Research on the Exploitation of Advanced Composite Materials to Lightly Loaded Structures". As originally conceived and envisioned the research was to tackle the overall system, i.e., the influence of advanced composites on the aerodynamic performance and vice versa, the influence of fabrication procedures on the advanced composites and vice versa, the influence of advanced composites on the design process and vice versa were all to be studied. As can be seen by an examination of Figure 2.1, this proved to be a very ambitious undertaking. Many pieces of the overall system have been investigated but none have been carried to the resolution required for engineering application. Nonetheless, interesting and useful results have been obtained.

II. PENULTIMATE SAILPLANE

At the beginning of this program it was decided to motivate the work by focusing on the design of a 19 meter sailplane. This resulted in the original plan for the exploitation of advanced composite materials for lightly loaded structures as shown in Figure 2.1. As can be seen it was a very ambitious undertaking and in hindsight the funds available were not sufficient to accomplish the various tasks in the time allotted. A brief summary of accomplishments not covered in later parts of this report is as follows:

2.1 Our assessment of the present performance regime of high performance sailplanes is shown in Figure 2.2. The curve shows the wing loading, $\frac{W}{S}$, for the best cross country speed. It was the goal of the Penultimate Sailplane Group to use the advanced composite materials to widen the boundaries of the performance map. This is depicted in Figure 2.2. The objective was to create a sailplane which could fly in weaker thermals than present day sailplanes (by being lighter) and to fly in stronger thermals than present sailplanes (by carrying more water ballast).

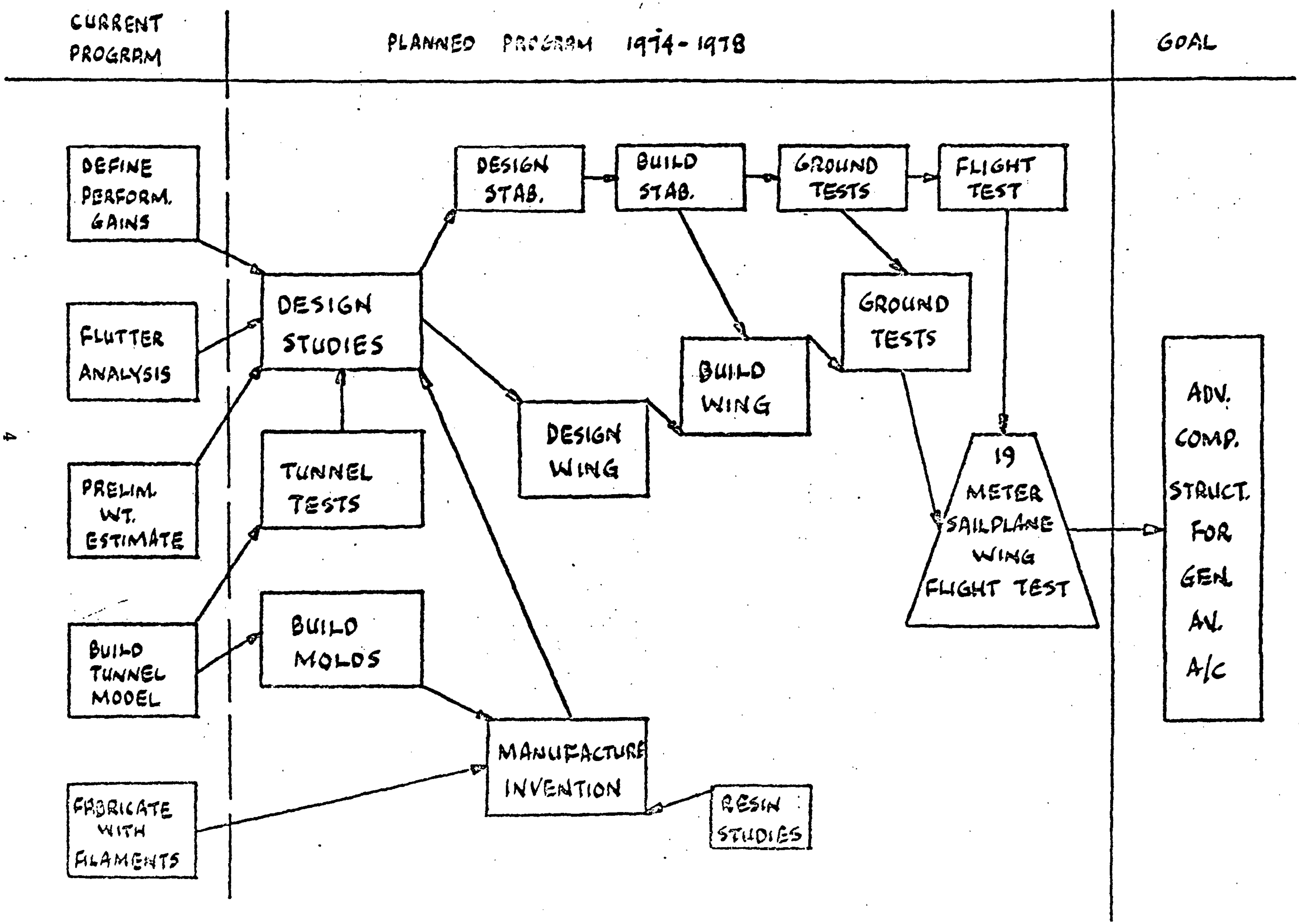
2.2 A computer program to calculate the time of flight for a sailplane in thermals was written. This software is called SADOR, Sailplane Aerodynamic Design Optimization for Racing. A simplified block diagram is shown in Figure 2.3. This program, which has been exercised and tested to a limited degree, is quite lengthy and will not be documented in this report. The program is available.

2.3 A flutter analysis and the requisite computer program to carry out the flutter analysis were accomplished.

This was reported by Michael Pustejovsky in the Proceedings of the Second International Symposium on the Technology and Science of Low Speed and Motorless Flight, M.I.T., Sept. 11-13, 1974.

2.4 The core of a sailplane structural wing design program is in being. This program calculated aerodynamic loads, inertia loads, shear stresses, bending stresses, skin thicknesses and iterates this process until a prescribed degree of convergence is achieved. The airfoil section (Wortman FX-67-170/17) and the material properties of the advanced composite laminates are specified as inputs. While a block diagram of the design process seems straightforward, the translation into a computer aided design software program has proved to be difficult.

ADVANCED COMPOSITE MATERIALS FOR LIGHTLY LOADED STRUCTURES



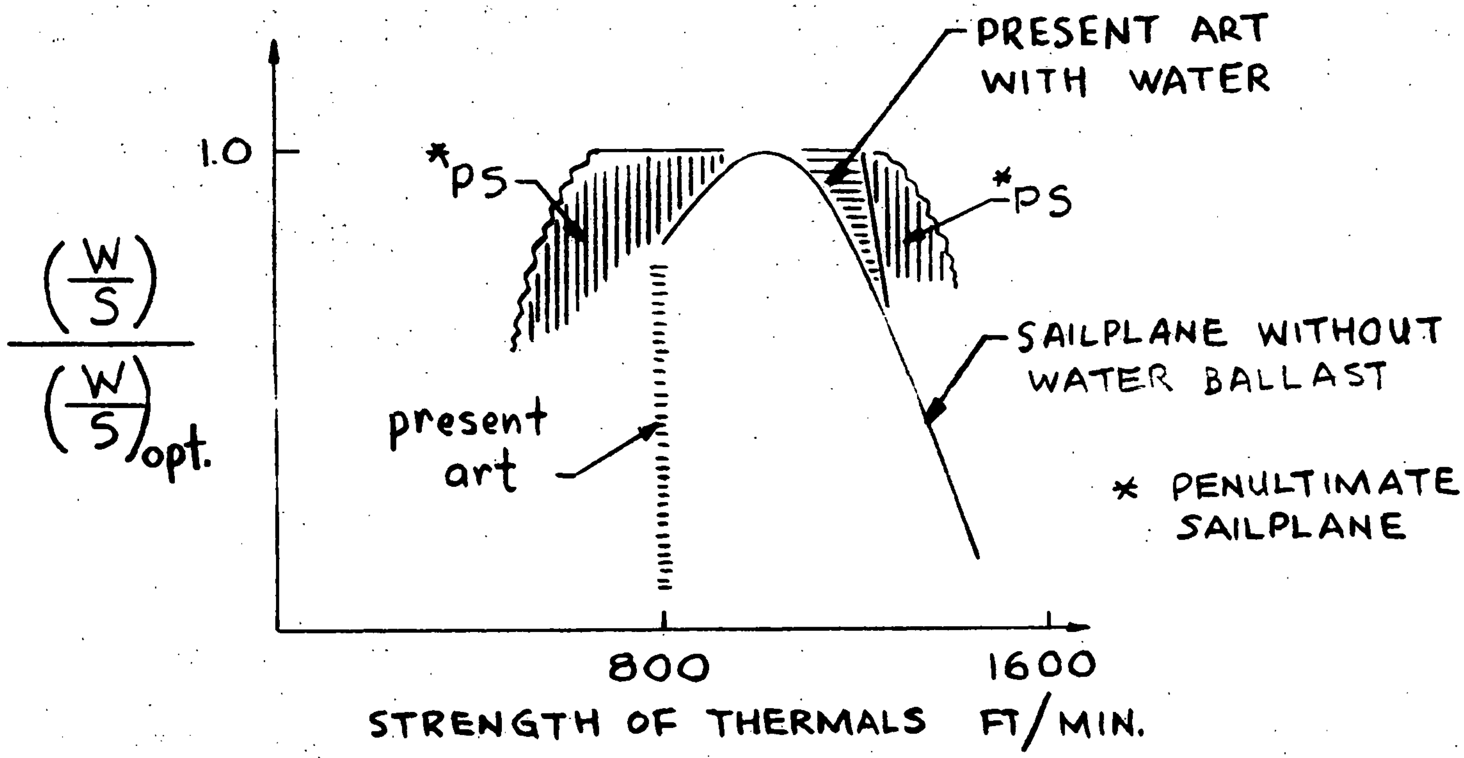
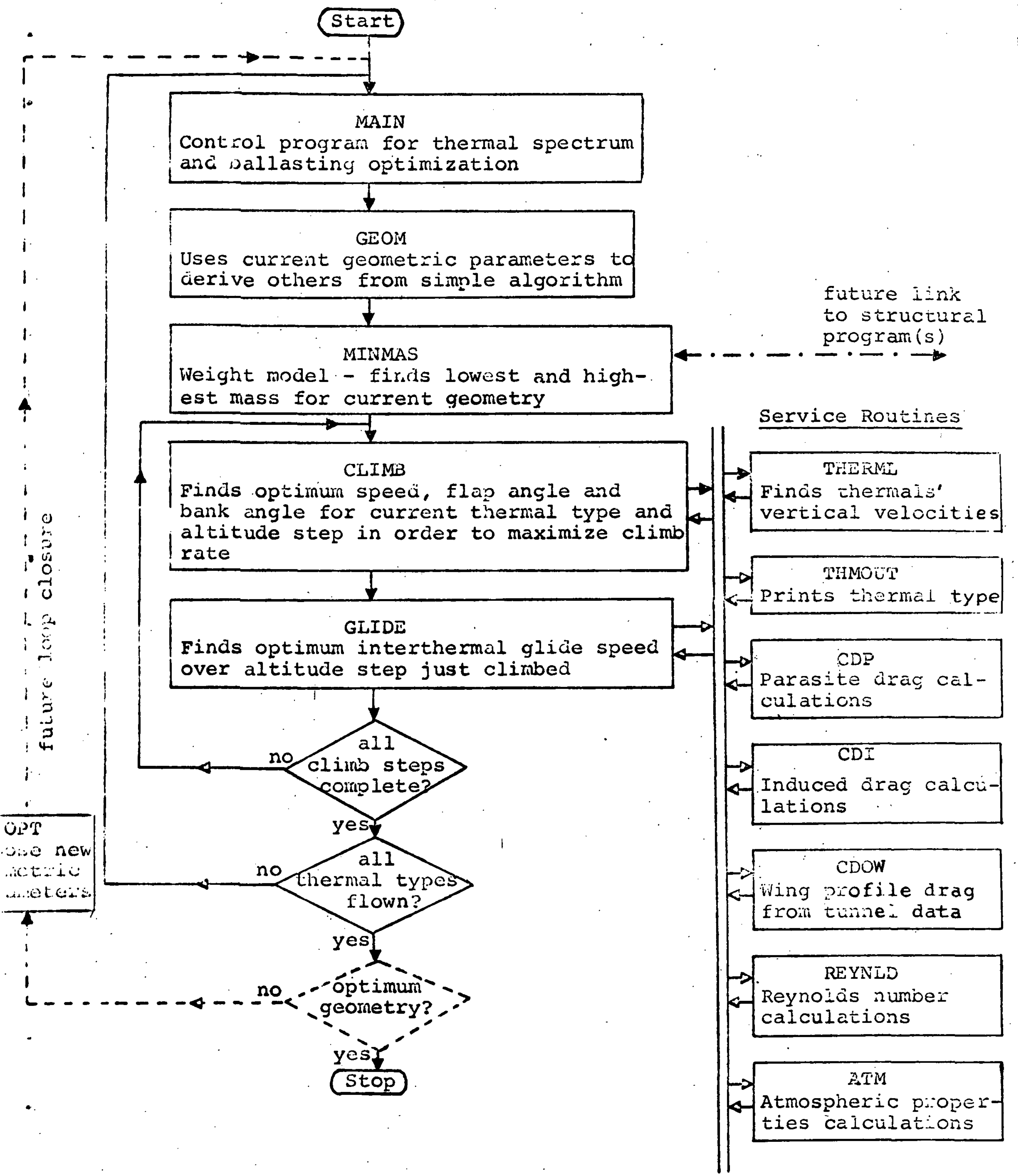


Figure 2.2 *PS REGIME

Figure 2.3 Simplified Block Diagram for SADOR.

Simplified Block Diagram for Program SADOR*



* Sailplane Aerodynamic Design Optimization for Racing

III. HORIZONTAL STABILIZER FOR THE SCHWEIZER 1-34 SAILPLANE

3.1 A number of activities which loosely can be termed manufacturing research were carried out. Some of these were as follows: (a) the use of salt as a master mold for the filament winding of shells of revolution. It was discovered that PVA (polyvinyl alcohol) mixed with salt (the kind used for salt lick for livestock) would form a hardened mold material which was rugged and unchanged by an oven cure of 250°F for two hours. After baking, the salt-PVA is water soluble and represents a potential material to be used as a washout mandrel; (b) experiments using clear plastic oven wrap as a vacuum material, burlap as the bleeder material and perforated oven wrap as the release layer between the bleeder and the wet layup; (c) the use of mylar as a sheath for filament winding of graphite filaments; (c) filament winding of Kevlar on a polystyrene foam mold. It was discovered that Kevlar cannot be sanded. Any spot which is sanded develops localized tufts of fuzz denser than on the skin of a peach. Hence it was concluded that a suitable finish is best achieved on Kevlar with matched die molding.

3.2 It was decided to design, analyze, fabricate, test, and fly an advanced composite horizontal stabilizer for the Schweizer 1-34 sailplane. The objective of the stabilizer design program was to design a structure with minimum weight that matched the stiffness and strength properties of the original part and complied with the FAA airworthiness requirements.

Before such a structure could be designed, it was first necessary to determine the magnitude and the distribution of the most critical loads imposed on the structure. A survey was made of various airworthiness requirements including the OSTIV and FAA criteria. A series of papers by Professor Dr. Ing. Pierro Morelli[(1).(2),(3),(4)] was selected as representing the most rational means of establishing the most critical loads and his method was followed in the analysis.

The Morelli analysis provides the magnitude of the most critical "up" loads on the horizontal tail and the most critical "down" loads. The method also includes information about the corresponding load factors and points on the v-n manoeuvring envelope from which one can "back figure" the corresponding stabilizer angles of attack and elevator deflections. Finally, information concerning the airfoil geometry and section characteristics were used to establish the breakdown between loads carried by the elevator and the fixed stabilizer, respectively.

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(1) "On the Dynamic Response of Sailplanes to Longitudinal Manoeuvres", Swiss Aero-Revue 5-6/1967.

(2) "Tail Loads Due to Abrupt Longitudinal Manoeuvres", presented at the Twelfth OSTIV Congress, Alpine, USA, 1970.

(3) "A 'Static' Evaluation of the Manoeuvring Tail Load for Instantaneous Longitudinal Manoeuvres of Sailplanes", presented at the Twelfth OSTIV Congress, Alpine, USA, 1970.

(4) "Elevator Induced Manoeuvring Loads from the Standpoint of Airworthiness Requirements for Sailplanes", presented at the Twelfth OSTIV Congress, Alpine, USA, 1970.

Once the magnitudes of the loads were determined, it was then necessary to assume a certain spanwise aerodynamic load distribution. For simplicity, an elliptical load distribution was assumed. After the aerodynamic loads on the elevator and the fixed stabilizer were known, it was then possible to calculate the point loads on the fixed stabilizer transmitted to the structure at the elevator hinge points and the stabilizer mounting fittings. Finally, given the concentrated loads at the fittings and hinges, together with the aerodynamic loads, it was possible to calculate the "limit load" shear force and bending moment diagrams in the spanwise and chordwise directions for the most critical "up" load and "down" load manoeuvres.

For a given configuration, the shear force and bending moment diagrams provided enough information to calculate the loads in the stabilizer spar caps and root rib caps; the number of plies of laminated material necessary follows from the material allowables and the widths of the spar and rib cap flanges. To insure that the structure will withstand the ultimate loads, the material allowables were divided by a factor of 1.5.

3.3 It became apparent through the testing of thin laminates and through the study of published strength data on advanced composite materials that a lightly loaded structure whose shell thicknesses are closely engineered to match the applied load relative to the material allowables will contain structural details whose gauge thicknesses are extremely thin--on the order of a single ply laminate. In this regard, the advanced composite structure for a 19 meter wingspan sailplane may have shear webs and wing skins that are 0.005 inch thick with spar caps hardly any thicker. With such high strength materials and small dimensions, the problem of general buckling as a critical mode of failure becomes most serious and tends to mask the high strength properties of the materials unless innovative ideas are devised.

The problem of skin stabilization is thus of primary importance in the design of lightly loaded advanced composite structures optimized for minimum weight and it is to this constraint that a great deal of design effort was directed.

3.4 In addition to the strength criteria imposed by the aerodynamic and maneuvering loads, an additional anti-crush reinforcement was added to the leading edge near the fuselage at the stabilizer root to accomodate normal ground handling loads as would occur at a typical flying field. Such reinforcement should allow ground crew personnel to pick the tail of the airplane off the runway without damaging the structure.

3.5 A fabrication experiment was conducted in which a simulated 20 inch section of the stabilizer spar was laid up on a 3/4 inch mahogany wood tool. The performance of the tool seem satisfactory and the relatively poor quality of the finished part was attributed to the layup procedure (with the absence of mylar templates and indexing pins) rather than to the tool surface itself. It was concluded that future tool designs should include provisions for indexing pins and mylar templates and that a heat gun was required to alleviate the problem of excessive tackiness of the laminating resin used.

3.6 A design was developed for a male tool that was to be used to mold the one-piece stabilizer skin. This mold, i.e. the plaster "master model" of the Schweizer 1-34 stabilizer was constructed of Red Top Molding Plaster manufactured the U.S. Gypsum Company. A photograph of the "master model" is shown in Figure 3.1.

3.7 The intent has been to use the plaster model as a male mold for the autoclave curing of an advanced composite stabilizer skin. After completion of the model, however, it was decided that before the plaster was subject to autoclave pressures and temperatures the male mold in its present form would be used to construct a female mold out of fiberglass that could be used as a "backup" tool in the event that the plaster mold burst, fractured, ruptured or otherwise failed.

It was decided that the female mold would be produced in two halves by the hand layup procedure. The layup consisted of a 1/16 inch thick layer of high temperature "gel coat" followed by approximately 10 layers of no. 181 fiberglass tooling cloth with high temperature resin. The remainder of the mold consists of prefabricated high temperature fiberglass panels cut into a series of "female rib" sections and spar sections and notched so that they may be mounted on the back of the female tool face in an "egg-crate" configuration.

Approximately 275 man-hours were spent on the fabrication of a fiberglass-epoxy high temperature plastic tool (mold) for use in the planned production of a honeycomb sandwich structural panel. The tool was designed for a service temperature of 350°F and was intended to perform in either a vacuum bag-oven or vacuum bag-autoclave curing environment. The molds were constructed of laminated fiberglass cloth and were produced by a room temperature hand layup procedure. An additional 300 man hours were spent on the evolution of the design for a hollow ribless honeycomb sandwich stabilizer that would provide extremely low weight with good structural stiffness and ease of fabrication. A design was developed in which a three ply laminate was chosen for the outer skin, a one ply laminate was chosen for the inner skin, and an adhesively bonded constant thickness honeycomb core was placed in between.

The fiberglass molds were designed to serve two purposes: (1) to provide smooth surfaces on which to cure thin laminated graphite skins for the honeycomb core facings, and (2) to serve as a bonding jig for the bonding of the skins to the honeycomb and the bonding of the top panel to the bottom panel.

Most of the curing that had been done by the Penultimate Sailplane Group was accomplished by the oven-vacuum bag curing process. Thus, it was felt desirable to design the molds to perform in an oven environment so that already existing techniques and hardware would be employed in the stabilizer fabrication. This meant that the molds were required to have a 350°F service temperature.

A combination of high temperature epoxy gel coat and high temperature epoxy laminating resin was chosen that was capable of curing at room temperature prior to being removed from the master model. Upon curing at high temperature, the resin would retain its stiffness so that the dimensions of the molds would remain stable even after removal from the master model.

Figure 3.2 and 3.3 shows the construction of the fiberglass mold pair. Only the mold faces were laid-up by hand. The remainder of the mold consists in a backup structure cut from prefabricated 1/8 inch fiberglass sheet and a flat sheet backing material bonded to the outside edges of the ribs to provide torsional stiffness for the finished mold.

During the summer of 1975, a prototype fiberglass mold pair was produced and found to be within the overall dimensional tolerance of 0.005 in accuracy. Photographs are shown in Figures 3.4 and 3.5. The molds met or exceeded all of the design specifications regarding strength, stiffness, and high temperature service capability. Unfortunately, during the post curing operation, the temperature control on the oven in which the molds had been placed malfunctioned (the dial rotated due to vibration from 125°C to 325°C) so that the molds were subjected to an estimated 600°F temperature*. This temperature level resulted in blistering of the gel coat surface and vaporizing of the laminating resin of the prefab rib structure. The damage done to both molds was excessive and irreversible. This accident occurred on August 4 and an immediate program was undertaken to produce a replacement mold set.

3.8 An approximate cost breakdown for the fiberglass mold and master model is as follows:

*The fire department even came.

Resin and Gel Coat	$100.00
No. 181 Glass Cloth	30.00
Prefab Glass Sheet	45.00
Solvent	15.00
Squegee, Brushes, Cups, Paper Towels	15.00
TOTAL Materials for Fiberglass Mold	$210.00

Plaster	$ 12.50
Aluminum Template Stock	15.00
Extruded Aluminum Base	40.00
Lacquer	10.00
TOTAL Materials for Master Model	$ 77.50

468 man-hours labor for master model

275 man-hours labor for glass mold

3.9 In order to provide stiffness and dimensional accuracy suitable for an advanced competition sailplane structure, a honeycomb sandwich panel concept was selected. Basically, the structure consists of a spar and a skin which carry the main bending and torsional loads, respectively. Since an unsupported skin does not provide sufficient strength in the lateral direction (bending in planes parallel to the root rib), some form of lateral load bearing structure is necessary to carry lateral bending and shear. In a conventional semi-monocoque structure, this lateral structure is provided by the ribs and stringers to carry the main torsional loads and establish the external aerodynamic shape. In a lightly loaded laminated composite structure, however, the situation is encountered where the proper skin thicknesses as dictated by the applied loads together with the available gauges of prepreg tape led to very thin skin thicknesses. Such ply layups are invariably "unbalanced", that is unsymmetrical about the middle line of the lay up. For an unsupported skin laid over ribs and stringers, this leads to warping and difficulties in achieving dimensional accuracy. A solution is to support the skin by a core material such as balsa, foam, or honeycomb. Care must be exercised, however, that the added weight of the core plus adhesive does not overcome the advantage of graphite/epoxy.

Figure 3.6 shows a minimum weight sandwich panel structure that provides the necessary skin stabilization system, together with a lateral beam-like support system that carries the bending and shear in planes parallel to the root rib. Here a 90° fiber means a fiber that is parallel to the root rib; a 0° fiber means a fiber that is parallel to the spar caps. For the structure shown in Figure 3, the 90° fibers carry the chordwise bending loads, the core carries the chordwise shear loads and the 45° fibers carry the main torsional loads. The only 0° fibers in the structure are located in the spar caps and a part of the leading edge.

Preliminary calculations indicated that the structure shown will carry the design loads with a sufficient factor of safety and margin of safety to be suitable for use on a man-carrying sailplane. Initial weight estimates indicate flying weight of about 3 pounds compared to about 5 pounds for the original aluminum version.

Unfortunately, the August 4, 1975 fire set back this part of the project so that the stabilizer has not been built. However a sample panel has been fabricated. The unbalanced 3-ply lay-up was replaced by a 5-ply balanced lay-up to eliminate warping. Testing of the panel is incomplete but an 'eye-ball' inspection indicates qualitative success. A picture of the sample panel is shown in Figure 3.7.

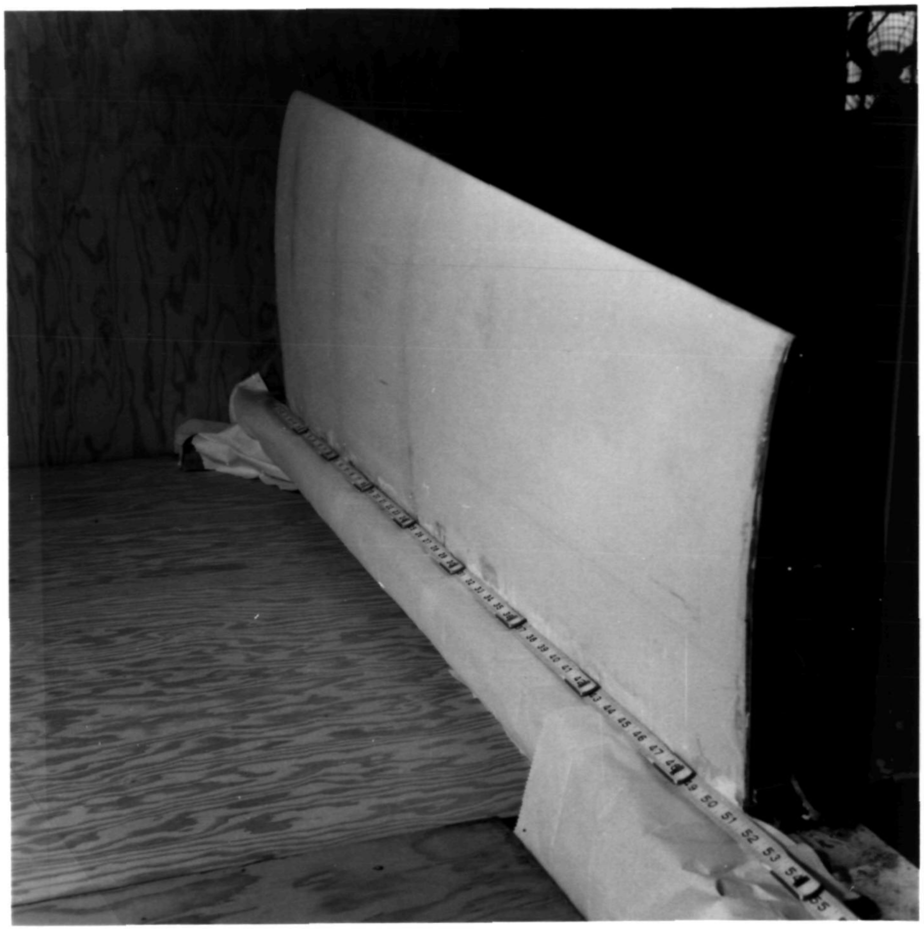


Figure 3.1

FULL SCALE PLASTER MODEL (average chord 15", span 48", taper ratio .5) OF SCHWEIZER 1-34 HORZONTAL STABILIZER

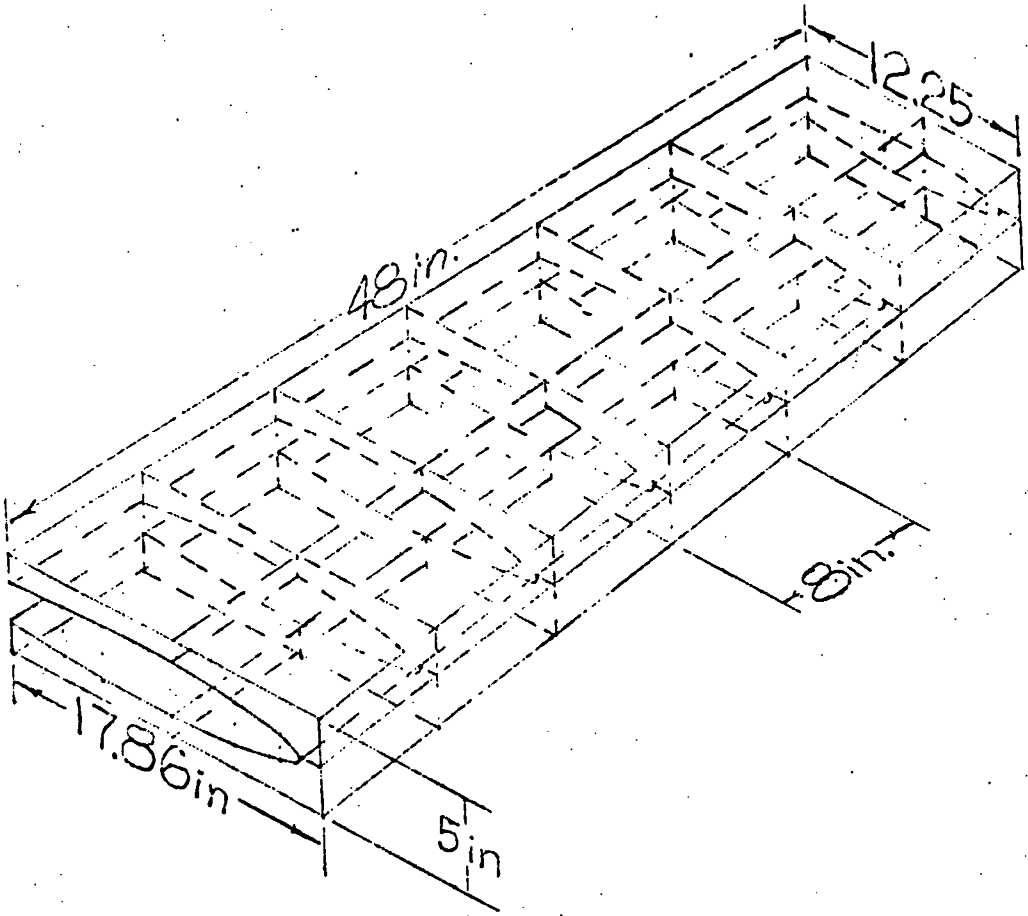
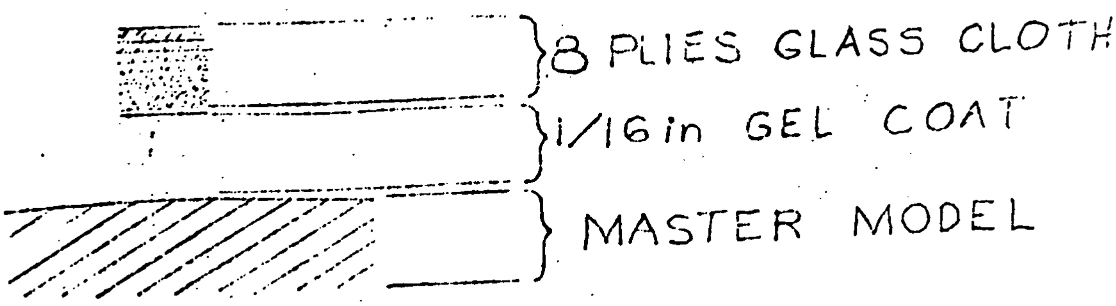


FIGURE 3.2 X-RAY VIEW OF FIBERGLASS MOLD PAIR--MOLD FACES LAID UP BY HAND; BACKUP STRUCTURE CUT FROM 1/8 in PREFAB GLASS SHEET

FIGURE 3.3 STACKING SEQUENCE FOR MOLD FACE



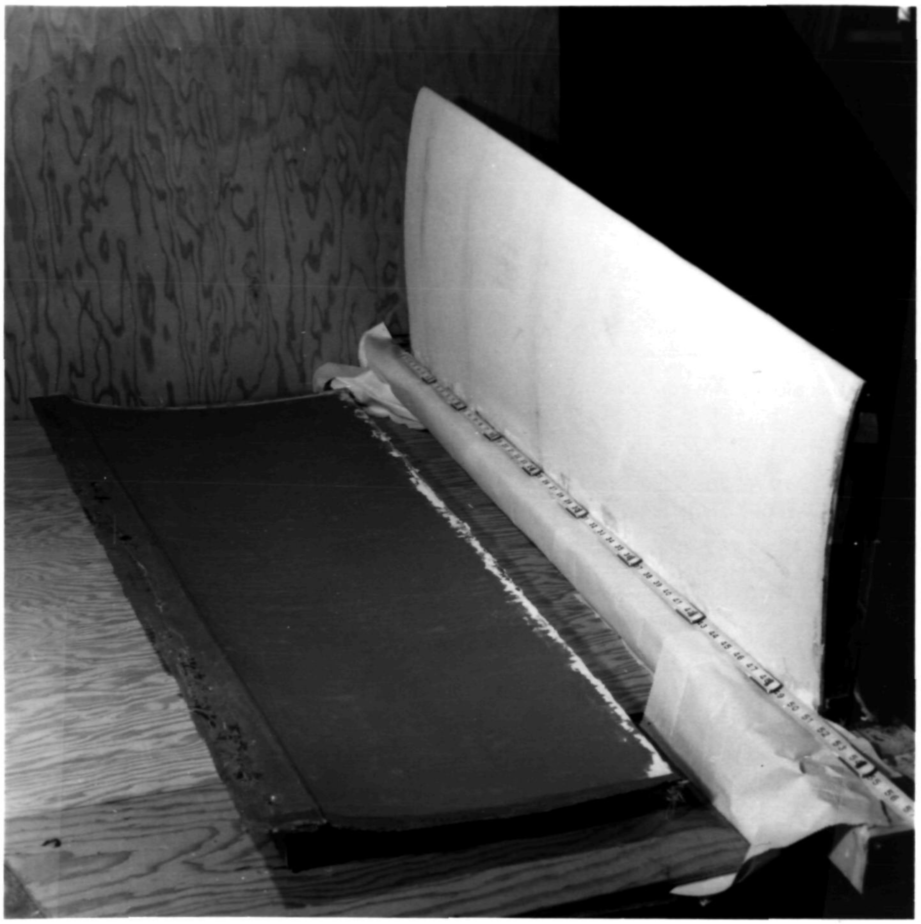


FIGURE 3.4

FRONT OF FIBERGLASS MOLD LAYING NEXT TO PLASTER MOLD

FIGURE 3.5

BACK OF FIBERGLASS MOLD

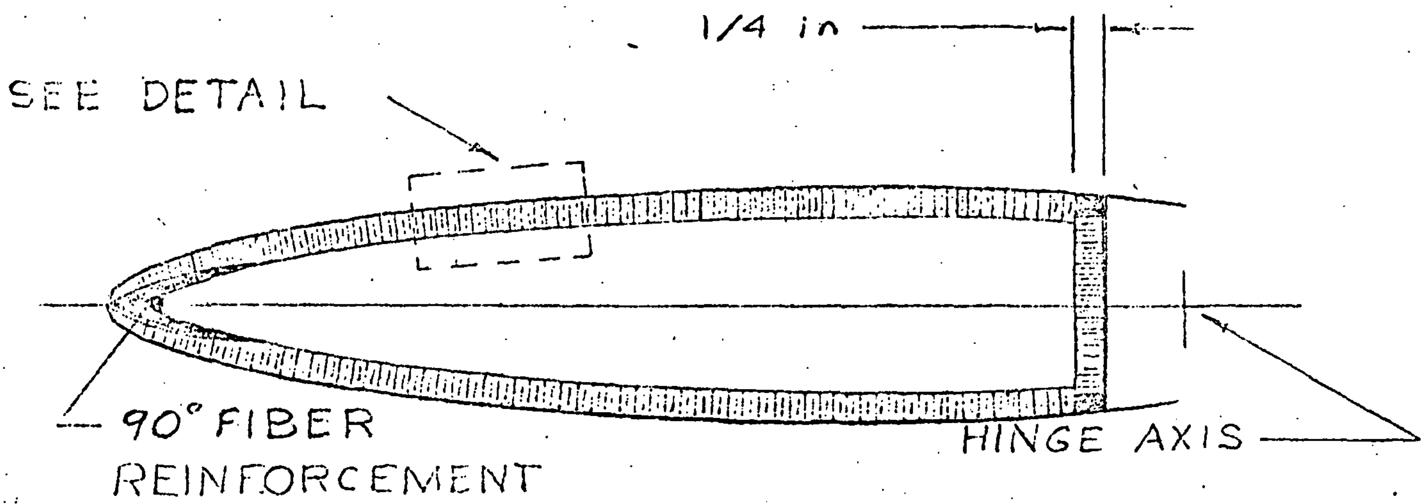


Figure 3.6A Cross-Sectional View of Horizontal Stabilizer.

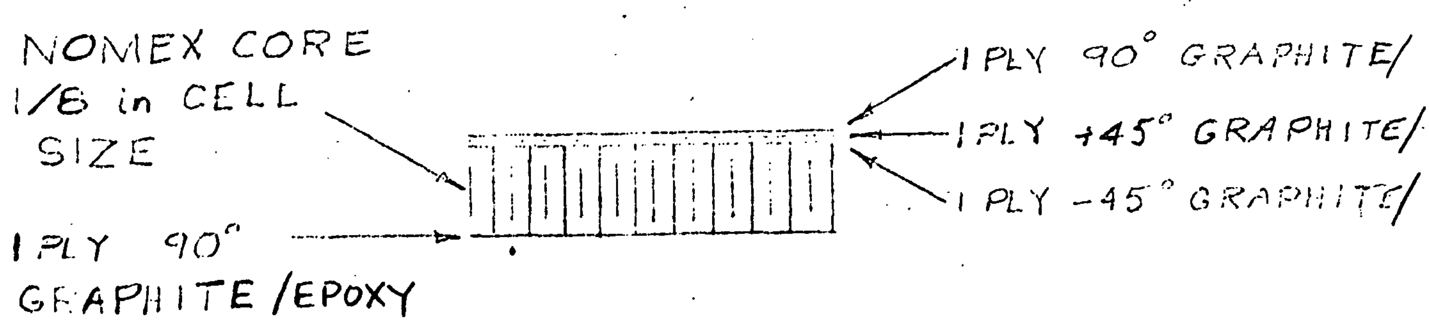


Figure 3.6B Stacking Sequence for Honeycomb Sandwich Panel.

Figure 3.7

SAMPLE PANEL

(12" x 12"; 5 ply ±45, 0, ±45 on top; 1/2" nomex core; 0° on bottom)

IV. TENSILE STRENGTH OF SINGLE GRAPHITE AND KEVLAR FILAMENTS

Both the graphite and Kevlar filaments are brittle materials. It was desired to obtain sufficient data on the tensile strength of single filaments so that statistical analyses could be made. The graphite filament tested was Hercules Type HTS from batch no. 2-2 made in 1974.

4.1 Method of Testing

Two different methods of testing single filaments were used. In both methods a single filament was attached at its ends to a small square of cardboard which had double-stick tape on one surface (see Figure 4.1). The procedure to prepare the specimen filament for test consisted of the following steps: (a) first, the two cardboards were placed in the jaws of the alligator clips of the individual filament holder at the desired spacing (most of the tests were run with a filament length in test of 6.99 centimeters); (b) next, the single filament was pulled from the large tow (with thumb and index finger) and laid on top of the double-stick tape. A piece of Scotch tape was placed on top of the filament sandwiching the filament to the cardboard; (c) finally the filament in the holder was brought to the testing device and transferred to it.

The first method devised loaded the filament with weights in a styrofoam cup. At the top an alligator clip was attached to a ring stand and at the bottom the foam cup. In order to minimize dynamic effects, weights were added to the styrofoam cup while it rested on a platform. The load was applied to the filament by bending the vertical member of the ring stand which then lifted the styrofoam cup from the platform. If the filament did not break, the cup was carefully lowered down onto the platform and .1 gram of mass was added to the cup. This procedure was repeated until fracture occurred. John Russell used this method to obtain 147 data points and Michael Graves obtained another 23. This "cup" method was slow (less than 8 tests per hour). The loading and unloading required in this method may have failed the filament in low cycle (about 30 cycles for the average) fatigue.

The second method which has been dubbed the "railroad" scheme uses an "N" gauge model railroad freight car rolling on a track mounted on a wooden bed which can be inclined by rotation about one end. Photographs of the "railroad" tester are shown in Figure 4.2 and 4.3. The filament is spanned between a block fixed at the one end of the wooden "roadbed" and the model railroad car which sits on the track. A mass of grams was placed in the railroad car and the filament was loaded by raising one end of the bed about a hinge at the other and at a rate of about 2 to 3 degrees of rotation per second until the filament fractured. As can be seen in Figure 4.2 the angle of inclination is read from a graduated arc which is marked every 15 seconds. Over 1000 data points were obtained with this device. By using many filament holders the construction of specimens was facilitated and it become possible to obtain upwards of 15 data points per hour.

The role that static friction of the railroad car may have played in the load carried by the filament was investigated by conducting a series of tests wherein the normal component of the force perpendicular to the railroad track was changed. In most of the graphite tests the mass of the railroad car and the gram mass weight was 30.3 grams. This led to angles of inclination at failure of between 12 and 30 degrees. The Kevlar tests were conducted with a mass of 111.3 grams, leading to angles of inclination between 13 and 26 degrees. A limited number of tests (about 100) were run with the mass of the railroad car and the gram mass weight reduced to 21.4 grams. This resulted in angles of inclination between 17 and 45 degrees.

4.2 Experimental Results

Two of the sets of data are shown in Tables 4.1 and 4.2. Bar graphs of the Table 4.1 and Table 4.2 data depicting the distribution of the tensile strengths are shown in Figures 4.4 and 4.5 respectively. The filament at fracture broke into several segments. It was not possible to determine whether fracture initiated at one point or simultaneously at several points. A plausible explanation is that the initial fracture released a stress wave which then precipitated failures all along the length of the filament.

The diameter of the graphite filament was determined by measuring photographs taken with a scanning electron microscope. One segment of a filament was taken at a magnification of 7000. Three other segments were taken on the same film at a magnification of 2800. Each segment was measured at 3 locations and the results averaged. The averaged results are shown in Table 4.3.

It is of interest to convert the breaking load carried by the filament to failure stress. This is given by the relation

$$F_{TU} = \frac{[9.80665 \times 10^{-3}][x]}{\frac{\pi}{4}[D]^2}$$

where 9.80665×10^{-3} converts a gram mass of force to newtons

x is the failing load in grams

D is the diameter in meters

F_{TU} is in pascals (newtons/sq. meter)

Table 4.4 tabulates stresses obtained over the range of strengths based upon the minimum, average, and maximum diameters.

A typical published value for this kind of a filament is 2.8 giganewtons/per square meter.

4.3 Statistical Analysis of the Experimental Data

The test data have been correlated with both the Gaussian and the Weibull distributions.

The Gaussian distribution (probability density) is given by

$$f_G(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-1/2\left(\frac{x-\mu}{\sigma}\right)^2}$$

where

x is the breaking strength in gram mass

μ is the mean

σ is the standard deviation

$$\mu = \frac{1}{N}\sum_{i=1}^{N} x_i$$

$$\sigma = \frac{\Sigma x_i^2 - N\mu^2}{N-1}$$

x_i is the breaking strength in gram mass of the i^{th} test
N is the total number of tests

The two parameter Weibull distribution (probability density) is given by

$$f(x) = \frac{\alpha}{\beta^\alpha} x^{\alpha-1} e^{-(\frac{x}{\beta})^\alpha}$$

where

α is called the shape parameter

β is the location parameter

The Weibull distribution is attractive because the cumulative distribution $F(x_i)$ has a simple mathematical form

$$F(x_i) = 1 - e^{-(\frac{x_i}{\beta})^\alpha}$$

where $1 - F(x_i)$ is the probability that a load equal to or less than grams applied to a filament will not cause fracture, i.e. the probability that the filament will survive a load of x_i or less.

However the determination of the two Weibull parameters α and β require considerable numerical manipulation. The procedure used is called the maximum likelihood estimate and requires iteration.

Table 4.5 lists the Gaussian and Weibull parameters for the different data sets and combination of sets.

4.4 Conclusions and Observations

1. The cup method and the railroad method give slightly different results. The cup method yielded about a 9% smaller mean and a smaller standard deviation.

2. The half inch graphite test lengths gave about a 10% higher mean which is in conformance with the fracture of brittle materials.

3. Neither the Weibull nor the Gaussian distribution, i.e., the probability density, fit the experimental data very well. In particular the Gaussian which is symmetric cannot match the skewed character of the data. Also the maximum likelihood Weibull parameters do not locate the maximum probability at the point shown by the experimental data.

4. The coefficients of variation (approximately $\frac{1}{\alpha}$ or $\frac{\sigma}{\mu}$, see Table 4.5) are on the order of .16. This corresponds to coefficient of variations for graphite epoxy laminates of .10 to .05. As can be seen from the very limited number of diameter measurements, an appreciable portion of the .16 coefficients of variation may be attributed to the variation in diameter.

5. The question about static friction of the railroad car is still unresolved. If the tests (102 data points, see Table 4.5) run at the higher inclination angles had yielded the same mean as those run at the lower inclination angles, then we were prepared to conclude that static friction was not a factor. This did not occur. In fact the higher angle results show a larger mean. This factor has not been resolved.

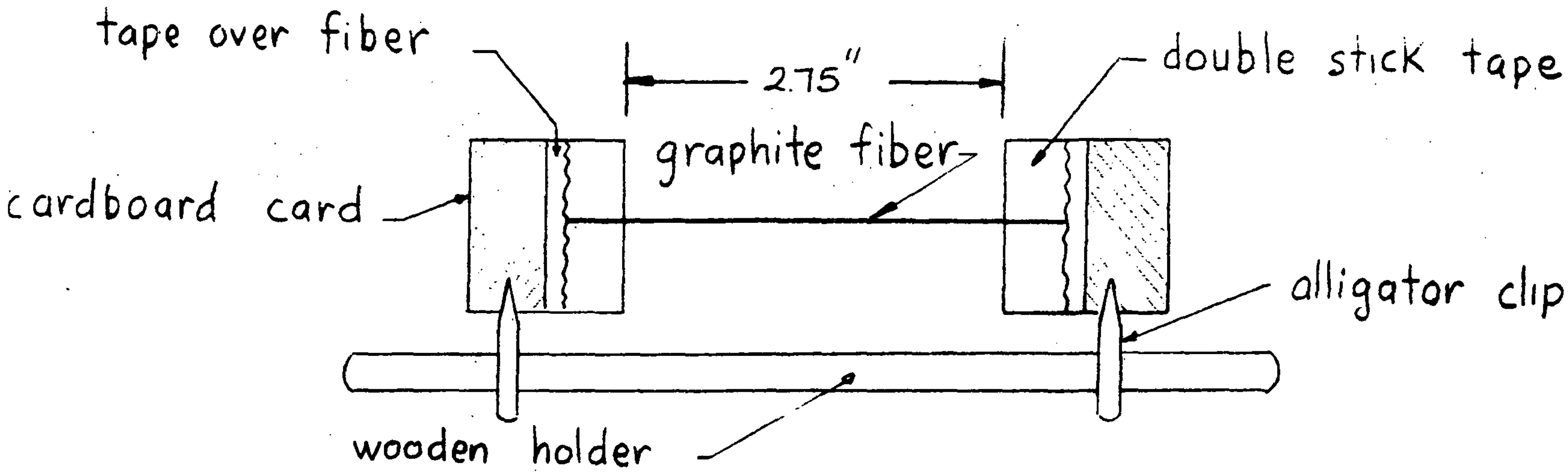


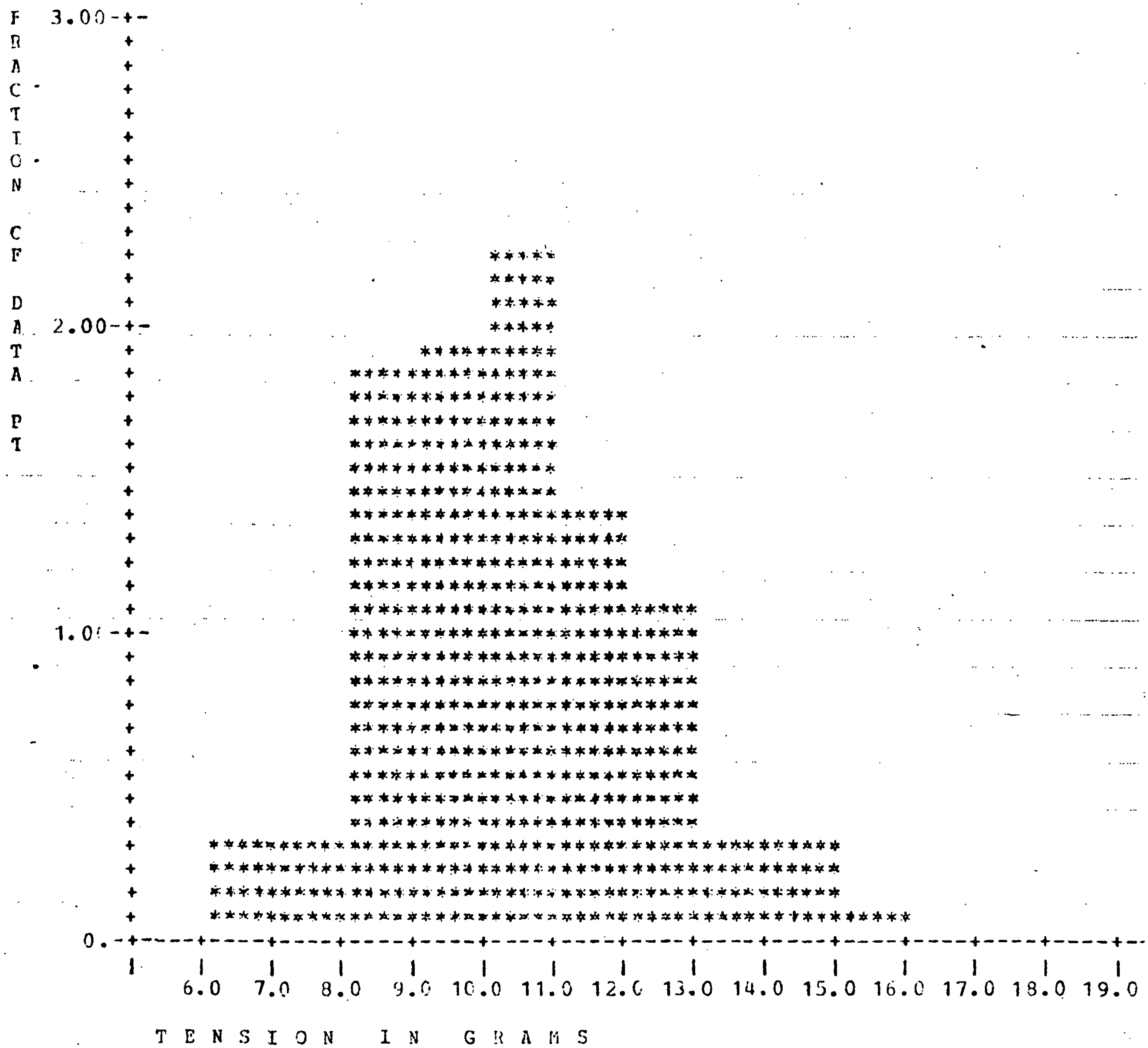
Figure 4.1 INDIVIDUAL FIBER HOLDER

FIGURE 4.2

RAILROAD TESTER FOR INDIVIDUAL FILAMENTS

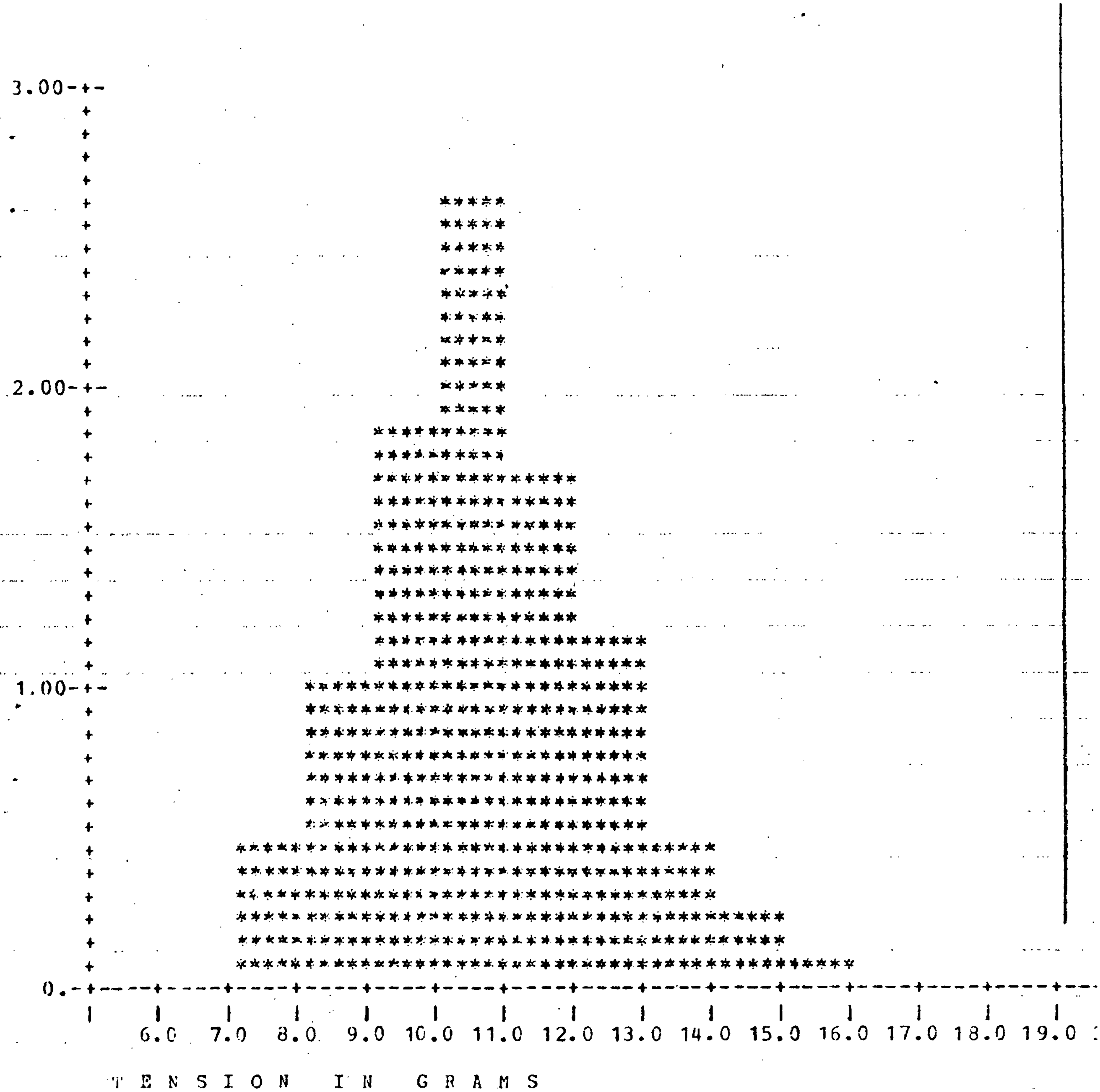
Figure 4.3

CLOSE-UP OF RAILROAD TESTER



THE Y-AXIS VALUES HAVE BEEN MULTIPLIED BY 10.0C
GRAPHITE FIBERS GAGE LENGTH = 2.75 INCHES TESTED BY: GRAVES
97 DATA POINTS

Figure 4.[illegible] Bargraph of Table 4.1 Data.



E Y-AXIS VALUES HAVE BEEN MULTIPLIED BY 10.00
APHITE FIBERS GAGE LENGTH = 2.75 INCHES TESTED BY: SHULTZ
141 DATA POINTS

Figure 4.5 Bar Graph of Table 4.2 Data.

DATA VALUES:

0.106E 02	0.725E 01	0.101E 02	0.715E 01	0.109E 02	0.995E 01	0.975E 01	0.685E 01	0.865E 01	0.875E 01
0.143E 02	0.128E 02	0.119E 02	0.124E 02	0.795E 01	0.845E 01	0.825E 01	0.108E 02	0.965E 01	0.106E 02
0.101E 02	0.104E 02	0.114E 02	0.895E 01	0.133E 02	0.845E 01	0.124E 02	0.885E 01	0.875E 01	0.955E 01
0.995E 01	0.116E 02	0.109E 02	0.955E 01	0.875E 01	0.113E 02	0.129E 02	0.114E 02	0.865E 01	0.635E 01
0.835E 01	0.103E 02	0.113E 02	0.106E 02	0.124E 02	0.114E 02	0.895E 01	0.965E 01	0.965E 01	0.108E 02
0.101E 02	0.118E 02	0.126E 02	0.146E 02	0.106E 02	0.885E 01	0.825E 01	0.109E 02	0.126E 02	0.114E 02
0.116E 02	0.955E 01	0.114E 02	0.114E 02	0.113E 02	0.955E 01	0.985E 01	0.151E 02	0.109E 02	0.108E 02
0.985E 01	0.995E 01	0.885E 01	0.635E 01	0.955E 01	0.925E 01	0.995E 01	0.103E 02	0.126E 02	0.935E 01
0.975E 01	0.129E 02	0.119E 02	0.109E 02	0.124E 02	0.965E 01	0.121E 02	0.108E 02	0.885E 01	0.103E 02
0.885E 01	0.835E 01	0.139E 02	0.109E 02	0.106E 02	0.144E 02	0.133E 02			

GAGE LENGTH = 2.75 INCHES TESTED BY: GRAVES

Table 4.1 Strength Data of Graphite Filaments.

DATA VALUES:

0.715E 01	0.101E 02	0.705E 01	0.114E 02	0.985E 01	0.129E 02	0.116E 02	0.116E 02	0.985E 01	[illegible]
0.109E 02	0.148E 02	[illegible]	0.131E 02	0.865E 01	0.935E 01	0.103E 02	0.126E 02	0.955E 01	0.106E 02
0.113E 02	0.101E 02	0.825E 01	0.815E 01	0.119E 02	0.935E 01	0.114E 02	0.109E 02	0.108E 02	0.955E 01
0.985E 01	0.119E 02	0.101E 02	0.116E 02	0.104E 02	0.104E 02	0.895E 01	0.109E 02	0.119E 02	0.845E 01
0.775E 01	0.835E 01	0.121E 02	0.705E 01	0.108E 02	0.675E 01	0.106E 02	0.104E 02	0.136E 02	0.104E 02
0.108E 02	0.116E 02	0.101E 02	0.121E 02	0.915E 01	0.101E 02	0.825E 01	0.945E 01	0.101E 02	0.895E 01
0.156E 02	0.113E 02	0.635E 01	0.945E 01	0.121E 02	0.109E 02	0.925E 01	0.129E 02	0.895E 01	0.111E 02
0.111E 02	0.965E 01	0.106E 02	0.111E 02	0.111E 02	0.111E 02	0.925E 01	0.101E 02	0.915E 01	0.123E 02
0.116E 02	0.101E 02	0.133E 02	0.995E 01	0.109E 02	0.124E 02	0.101E 02	0.119E 02	0.119E 02	0.138E 02
0.118E 02	0.123E 02	0.114E 02	0.114E 02	0.108E 02	0.101E 02	0.131E 02	0.103E 02	0.126E 02	0.765E 01
0.111E 02	0.965E 01	0.111E 02	0.134E 02	0.955E 01	0.106E 02	0.965E 01	0.715E 01	0.855E 01	0.119E 02
0.119E 02	0.121E 02	0.119E 02	0.925E 01	0.915E 01	0.109E 02	0.101E 02	0.129E 02	0.975E 01	0.113E 02
0.151E 02	0.113E 02	0.144E 02	0.111E 02	0.104E 02	0.124E 02	0.121E 02	0.805E 01	0.875E 01	0.136E 02
0.124E 02	0.114E 02	0.995E 01	0.113E 02	0.106E 02	0.106E 02	0.925E 01	0.103E 02	0.128E 02	0.104E 02
0.955E 01	0.101E 02	0.121E 02	0.855E 01	0.106E 02	0.975E 01	0.915E 01	0.101E 02	0.975E 01	0.143E 02
0.141E 02	0.815E 01	0.955E 01	0.136E 02	0.121E 02	0.965E 01	0.104E 02	0.735E 01	0.104E 02	0.129E 02
0.925E 01	0.865E 01	0.144E 02	0.119E 02	0.106E 02	0.905E 01	0.935E 01	0.855E 01	0.965E 01	0.103E 02
0.129E 02	0.805E 01	0.825E 01	0.965E 01	0.103E 02	0.104E 02	0.138E 02	0.915E 01	0.104E 02	0.945E 01
0.945E 01	0.104E 02	0.124E 02	0.146E 02	0.108E 02	0.106E 02	0.945E 01	0.106E 02	0.129E 02	0.144E 02
0.131E 02	0.108E 02	0.134E 02	0.935E 01	0.865E 01	0.108E 02	0.129E 02	0.104E 02	0.995E 01	0.835E 01
0.164E 02	0.128E 02	0.101E 02	0.101E 02	0.106E 02	0.124E 02	0.975E 01	0.104E 02	0.965E 01	0.108E 02
0.109E 02	0.925E 01	0.101E 02	0.895E 01	0.104E 02	0.109E 02	0.755E 01	0.935E 01	0.965E 01	0.118E 02
0.104E 02	0.113E 02	0.855E 01	0.106E 02	0.715E 01	0.139E 02	0.109E 02	0.106E 02	0.134E 02	0.128E 02
0.106E 02	0.915E 01	0.111E 02	0.915E 01	0.104E 02	0.119E 02	0.895E 01	0.124E 02	0.116E 02	0.945E 01
0.114E 02	0.945E 01	0.109E 02	0.106E 02	0.735E 01	0.103E 02	0.755E 01	0.985E 01	0.895E 01	0.775E 01
0.915E 01	0.151E 02	0.945E 01	0.835E 01	0.119E 02	0.945E 01	0.106E 02	0.101E 02	0.895E 01	0.101E 02
0.885E 01	0.815E 01	0.111E 02	0.119E 02	0.765E 01	0.805E 01	0.144E 02	0.101E 02	0.965E 01	0.885E 01
0.101E 02	0.106E 02	0.755E 01	0.955E 01	0.103E 02	0.111E 02	0.101E 02	0.131E 02	0.118E 02	0.116E 02
0.111E 02	0.935E 01	0.109E 02	0.119E 02	0.121E 02	0.935E 01	0.735E 01	0.109E 02	0.116E 02	0.975E 01
0.113E 02	0.995E 01	0.111E 02	0.965E 01	0.123E 02	0.925E 01	0.116E 02	0.149E 02	0.101E 02	0.805E 01
0.103E 02	0.108E 02	0.156E 02	0.124E 02	0.131E 02	0.119E 02	0.845E 01	0.815E 01	0.116E 02	0.151E 02
0.106E 02	0.136E 02	0.975E 01	0.128E 02	0.128E 02	0.955E 01	0.121E 02	0.111E 02	0.114E 02	0.121E 02
0.123E 02	0.109E 02	0.775E 01	0.133E 02	0.124E 02	0.129E 02	0.965E 01	0.119E 02	0.111E 02	0.825E 01
0.114E 02	0.775E 01	0.144E 02	0.121E 02	0.785E 01	0.129E 02	0.108E 02	0.103E 02	0.131E 02	0.106E 02
0.121E 02									

GAGE LENGTH = 2.75 INCHES TESTED BY: SHULTZ

Table 4.2 Strength Data on Graphite Filaments.

TABLE 4.3

Filament	Diameter Centimeters
1	8.21×10^{-4}
2	7.79×10^{-4}
3	7.93×10^{-4}
4	8.68×10^{-4}
average	8.15×10^{-4}

TABLE 4.4

	F_{TU} giga pascals		
x grams	minimum diameter 7.79×10^{-4} cm.	average diameter 8.15×10^{-4} cm.	maximum diameter 8.68×10^{-4} cm.
6.0	1.23	1.13	.99
10.6	2.18	1.99	1.76
16.0	3.29	3.01	2.65

Table 4.5 TENSILE STRENGTHS STATISTICAL PARAMETERS

FILAMENT MATERIAL	GAGE LENGTH cm	NO. OF DATA POINTS	WEIBULL		GAUSSIAN		TEST METHOD
			α	β grams	μ grams	σ grams	
Graphite	6.99	146	6.62	10.477	9.79	1.60	cup
"	"	23	6.83	10.53	9.88	1.46	"
"	"	169	6.65	10.48	9.80	1.56	"
G	6.99	341	6.21	11.43	10.67	1.78	RR
"	"	97	6.19	11.19	10.43	1.78	"
"	"	438	6.14	11.36	10.60	1.82	"
Graphite	6.99	102	6.50	12.47	11.64	1.92	RR
"	1.27	437	4.64	12.38	11.34	2.53	"
KEV	1.27	226	8.61	43.36	40.98	5.59	RR
"	6.99	102	9.29	38.01	36.08	4.45	RR

V. COMPRESSIVE STRENGTH OF ONE PLY AND TWO PLY GRAPHITE/ EPOXY LAMINATES ON VARIOUS CORE MATERIALS

The bulk of the strength data for the advanced composite materials has been obtained from experiments on laminates which contain six or more plies. For lightly-loaded structures, the purely strength requirements can be satisfied, theoretically, by fewer than six plies. This then requires the use of light weight core materials to stabilize the thin laminates so that adequate strengths can be developed. The work carried out in obtaining compressive mechanical property data is described in this section.

5.1 Construction of Specimens

The specimens are wide sandwich beams in which a 13 cm (5 1/8 inch) long test section is integral with mahogany loading blocks at each end. Graphite-epoxy plies are bonded onto the top and bottom facings of the specimen. A typical specimen with nominal dimensions is shown in Figure 5.1.

Different materials have been used for the cores of the sandwich beams. The materials used are two densities of styrofoam (2 lb/ft^3 and 3 lb/ft^3), rigid polyvinylchloride (PVC) foam (6.7 lb/ft^3), urethane foam (4 lb/ft^3), nomex honeycomb (4 lb/ft^3), and aluminum honeycomb (4.5 lb/ft^3). (The cited densities are those nominally specified by the manufacturer.) The facing sheets of the sandwich are one or two plies of graphite/epoxy uni-directional material manufactured by Hercules Corporation and bears their designation of type AS/3502-5.

The fabrication of each composite beam consisted of three distinct steps. These were: (1) curing and sizing of the graphite/epoxy plies; (2) preparation of the core; and (3) the secondary bonding of the graphite/epoxy plies to the core.

The preparation of the graphite/epoxy was the most difficult as well as the most important step in the construction process. The temperature during cure appeared to make some difference in final properties and the measure of vacuum was important in determining the quality of interlaminar bonding as well as the ply thickness and weight. The layup procedure involved placing the pre-preg tape between blotting layers (fiberglass cloth) and release material (peel-ply cloth) and mounting the several layers upon a steel plate to prevent crushing or distortion during cure. (See Figure 5.2). The entire layup was then sealed inside a nylon vacuum bag, evacuated, and cured at elevated temperature. At the end of its curing cycle the large sheet of laminate was cut to proper size on a sheet-metal shear. For a one-ply sheet of graphite, the bottom layers of fiberglass and peel-ply were eliminated and the graphite was placed directly on the teflon-covered plate. No additional pressure (such as in an autoclave) was applied to the bag; thus, the graphite was cured under a pressure of approximately 14 psia. Different temperature schedules for the thermal cycle were used but most of the specimens were cured at 1 1/2 hours for 350°F, followed by one hour at 300°F. This approximates the factory recommended curing cycle. Typical thicknesses after curing for the graphite/epoxy plies were .007 inches for a one-ply sheet and .013 inches for a two-ply sheet. These thickness dimensions are larger than the factory specified nominal thickness of .0052 inches per ply. This can be attributed to the much lower pressure used during cure. The factory recommended curing cycle requires a pressure of 100 psia to be applied to the graphite sheet during cure.

After curing, the graphite sheet was cut into three inch wide strips. Each was measured with a micrometer at ten random locations in the test section to determine the average thickness of the strip. For each specimen, the strips were selected such that the top and bottom facings were of similar or identical thickness.

The loading blocks on either side of the test section were made of mahogany and were carefully produced on accurate wood working equipment to insure consistency in specimen dimensions. Mahogany was chosen because it provided an inexpensive, easily machined, relatively high modulus, crush-resistant material for the loading blocks.

The test section cores were sanded to the correct width and length, and were then bonded onto the end blocks with epoxy adhesive. On all the cores except PVC foam the core thickness was left oversize at this stage and was later sanded to match the thickness of the end blocks. The PVC foam is available only in 3/4" slabs, so that the end blocks were thicker than the test section. In this case, the end blocks were machined to match the core thickness.

For the urethane, styrofoam, and nomex honeycomb, the test section was carefully hand sanded until the core and end blocks were the same thickness. Extreme care was taken to avoid "scalloping" the core and to eliminate waviness in the test section. Since this sanding opens the closed-cell structure of styrofoam, the cells were resealed after this sanding by the judicious application of heat from a hot air blower.

The preparation of the aluminum honeycomb specimens was more complicated. The cells of the honeycomb were filled with water which was then frozen. The ice supported the cell walls during machining. The frozen specimen was placed in a horizontal milling machine, and the core was milled until it and the end blocks were a constant thickness. The ice was then melted away.

PVC foam core specimens were also machined on a horizontal milling machine. In this case, the end blocks were milled until they and the core were a constant thickness. The specimen received a final light sanding to remove any burrs or roughness.

The third step in the construction process was to bond the cured graphite sheets onto the cores. For the specimens with foam cores, a two-part room temperature curing epoxy (Smooth-On Corporation type EA-40) was used to bond the graphite sheets to the specimens. This epoxy cures in approximately 12 hours. A film adhesive was used for those specimens which have a honeycomb test section. The film adhesive, which is a thin film of semi-cured epoxy on a fine muslim carrying cloth, is type FM-123-2 manufactured by American Cyanimide and was cured at 250°F for three hours. For both foam and honeycomb specimens, the lamination process was conducted in a vacuum bag to ensure even and substantial pressure across the face of the specimens. The vacuum bag layup for the lamination process was similar to the layup for curing a 2-ply sheet of graphite. In addition, a wood frame was placed around the specimens to prevent the bag from crushing the outside edges of the specimens.

After the lamination process, the cores were sanded again to remove any excess graphite or epoxy. Strain gauges (Micro Measurement EA-13-187BB-120) were bonded to the top and bottom of the specimen in the center of the test section.

5.2 Testing Procedure

The specimens were tested in four-point bending with the bending moment being gradually increased until the specimen failed. The loading geometry is shown in Figure 5.3.

The load was applied to the test fixture by a Baldwin-Emery SR4 Model FGT test machine. The load was increased in small steps (usually ten to fifteen steps before failure), and the load, compressive strain, and tensile strain of the specimen were recorded at each step. When the specimen failed, the load at failure was noted. A listing of the stress-strain output for most of the specimens is given in the Appendix 5.1 at the end of this section.

5.3 Experimental Data

A total of 101 specimens with uni-directional plies have been fabricated for this project. The first 37 were constructed by M. Graves and K. Shultz, and the remaining 64 were constructed by C. Flanigan. In addition, six specimens by Flanigan attempted to use extremely light Nomex honeycomb (1.8 lb/ft^3), and these specimens crushed during construction. Another set of 20 specimens with 2 plies, one oriented at 0° and the 90° (crossplied) were constructed and tested by D. Hoon.

The 109 specimens which are reported herein are comprised of the categories shown in Table 5.1.

After some of the early tests, the reduction of the data into stress-strain diagrams was generated by means of a computer format. This tabulation of the data is presented in figures shown in Appendix 5.1.

Three different failure modes were exhibited by the specimens. Failure mode "a" is characterized as a tension failure of the foam core which allowed the graphite facing to buckle outward. (See Figure 5.4). It was found to occur only with the Urethane foam core beams. The uni-directional laminates had one-half buckle wavelengths of approximately 3/8" to 11/16". The cross-plied specimens, after failure, had one-half buckle wavelengths of approximately 5/8" to 1 3/8" and these dimensions varied from one edge of the beam to the other. Failure was very rapid and was always accompanied by a "popping" sound as the graphite/epoxy ply buckled away. The failures of the urethane core specimens occurred at lower levels of stress than did the 3 lb. stryofoam core beams (urethane is denser than 3 lb. styrofoam). Usually the single ply uni-directional specimens failed in a "gentle" fashion with the facing ply showing little damage. The two ply uni-directional specimens failed more "energetically" and the facing plies were usually broken.

Failure mode "b" is characterized as a compression failure of the core (see Figure 5.5), and is seen on the beam as a straight, sharp V-shaped indentation. For uni-directional laminates with styrofoam cores, both the 2# and 3# density specimens exhibited buckle failure into the core as shown in Figure 5.5. The 2# styrofoam specimen failed at a much lower level than the 3# styrofoam. For a 1-ply facing, the buckling was sufficiently gentle such that the laminate only cracked slightly at the "V" in the buckle. For the 2-ply samples, the compression facing broke "violently" and was often accompanied by some interply delamination. This mode of failure occurred on six of the twelve occasions with the PVC foam core crossplied specimen.

Failure mode "c" is characterized as a compression failure of the graphite facing (see Figure 5.6). This failure mode occurred on five of twelve occasions where PVC foam was used as the core material for the crossplied specimens. The failure line for the crossplied specimens was very jagged through the facing with little apparent permanent deformation of the core material. The remaining specimens using PVC foam, Nomex honeycomb, and aluminum honeycomb exhibited similar failure modes (see Figure 5.6). In these cases, i.e., failure mode "c", the failures do not appear to be triggered by rupture of the core material.

The stress-strain curves and associated parameters have been calculated from the basic load-strain information gathered during testing and from the measured specimen size. The thickness of the specimen has been taken as the average of the thickness at the four corners of the test section area of the finished area. Thus, the core thickness is the specimen thickness minus the graphite/epoxy thickness, and hence the calculated core thickness includes both the actual core dimension plus the thickness of the epoxy adhesive. The width and length of the test section were measured directly from the specimen.

The bending moment applied to the beam can be calculated from the known loading fixture geometry and from the measured load applied to the fixture. In this case, the bending moment is given by

$$M_b = 1.38 \times \text{Failing Load (in-lb)}$$

The cores which are low density and low stiffness are assumed to provide negligible contribution to the bending stiffness and it is also assumed the stress is uniformly distributed across the graphite/epoxy ply thickness. Thus, the load carrying ability of the ply thickness is given by

$$N = \frac{M_b}{(t_c + t_F)w} \quad (\frac{\text{pounds}}{\text{inch}})$$

where t_c and t_F are the core and ply thicknesses, respectively.

The stress in the ply is given by

$$\text{Stress} = \frac{N}{t_F} \quad (\frac{\text{pounds}}{\text{sq. in.}})$$

The modulii of elasticity of the compression ply and the tension ply were calculated by using a least squares method to fit a straight line to the first portion of the stress-strain diagram. Generally, only the data points below one half of the failing stress were used.

A summary of the averages from each category of test is given in Table 5.2. The results for each category are tabulated in Tables 5.3 through 5.14. Stress strain curves are shown in Appendix 5.1 to this section.

5.4 Properties of Core Materials

The compressive moduli of elasticity and the crushing strengths of the core materials were obtained by tests of blocks of material. Deflections were read by dial gages which measured the relative motion of the loading platens. Results are shown in Table 5.15

5.5 Statistical Analysis of the Data

Statistical analyses of the data have been made. Each table of data shows the average of the parameter, e.g. average ply thickness, average stress at failure, etc. and the standard deviations. The average and the standard deviation can be considered as the statistical parameters for the Gaussian (normal) distribution:

$$f_G(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-1/2} \left(\frac{x-\mu}{\sigma}\right)^2$$

where

x is the parameter, such as N or thickness

μ is the mean

σ is the standard deviation

and

$f_G(x)dx$ is the number of specimens having the property lying between $f_G(x)$ and $f_G(x+dx)$

The data has also been fitted by the maximum-likelihood estimate method to the two parameter Weibull distribution

$$f(x) = \frac{\alpha}{\beta^\alpha} x^{\alpha-1} e^{-(\frac{x}{\beta})}$$

where

α is the shape parameter

β is the location parameter

The Weibull parameters for each set of tests are shown in Table 5.16.

5.6 Correlation of the Data

Plots of the average compressive strength, N, have been made against the following parameters:

(a) Core density (grams/cc)

(b) Core crushing strength (psi)

(c) Core compressive modulus of elasticity (psi)

(d) Structural parameter $\frac{E_f E_c t_f^3}{12 t_c}$ $((\text{lb/in})^2)$

where

E_f = ply modulus of elasticity

E_c = core compressive modulus of elasticity

t_f = thickness of ply

t_c = thickness of core

The plots for the first three correlations are shown in Figures 5.7, 5.8, 5.9 and Table 5.17 lists the data used. Bands have been drawn which roughly bound the data at the $\pm\sigma$ (standard deviation) values.

The justification for the structural parameter is that the square root of it is dimensionally N. (The data could have been plotted against the square root of the structural parameter.) Also this is a parameter which arises in the study of beams on elastic foundations.

Correlation (d) is shown in Figure 5.10 and the data used is shown in Table 5.18. All the sets of data have approximately the same slope with exception of the styrofoam 2 (nominally 2 lbs/ft^3). These latter data, i.e. those using styrofoam 2 as the core were the first specimens constructed and tested; thus the group was still learning and hence the confidence level is lower for this set. (Additionally, the group feels that styrofoam 2 is <u>not</u> a good structural material).

The lines joining the data for the single ply and two ply tests have been fitted to the relation given by

$$N = K\left[\frac{E_f E_c t_f^3}{12 t_c}\right]^m$$

and values for the structural parameter are given in Table 5.19.

5.7 Conclusions and Observations

1. The beginnings of a data base for the compression allowable of one and two ply uni-directional graphite/epoxy bonded onto low density cores have been obtained. There is still an insufficient number of test specimens upon which to base design allowables. About 40 specimens are desirable from a statistical point of view.

2. There is an appreciable variation in the properties of the foam materials of nominally the same density. The characterization of the foam did not receive sufficient attention. Again, a larger statistical basis is required. Also, an investigation of the production controls used by the suppliers of the foam materials would be desirable before an engineering commitment to the use of these materials should be made.

3. The nominal 2 pound per cubic foot styrofoam does not appear to be suitable as a core material for sandwich beams. The coefficient of variation (standard derivation divided by the mean) which is a measure of the scatter of the data is the largest for the specimens using this material.

4. On a strength to weight ratio, i.e. average N (load/unit width) divided by the core density, the materials rank as follows (with styrofoam 3 as the reference):

Core Material	1 ply	2 ply
Styrofoam 3	1.00	1.00
Urethane Foam	.72	.59
PVC Foam	.90	.77
Nomex Honeycomb	1.34	1.08
Aluminum Honeycomb	1.21	

Thus, styrofoam is the best of the three foam cores but the Nomex and aluminum honeycomb are better core materials than the styrofoam 3.

5. A number of people participated in making and testing the specimens. Even though the art was passed from one student to another there still was an appreciable learning process required.

6. The modulus of elasticity in compression, as determined by linear least-square fit of the stress-strain data, was generally but not always found to be smaller than the tension modulus.

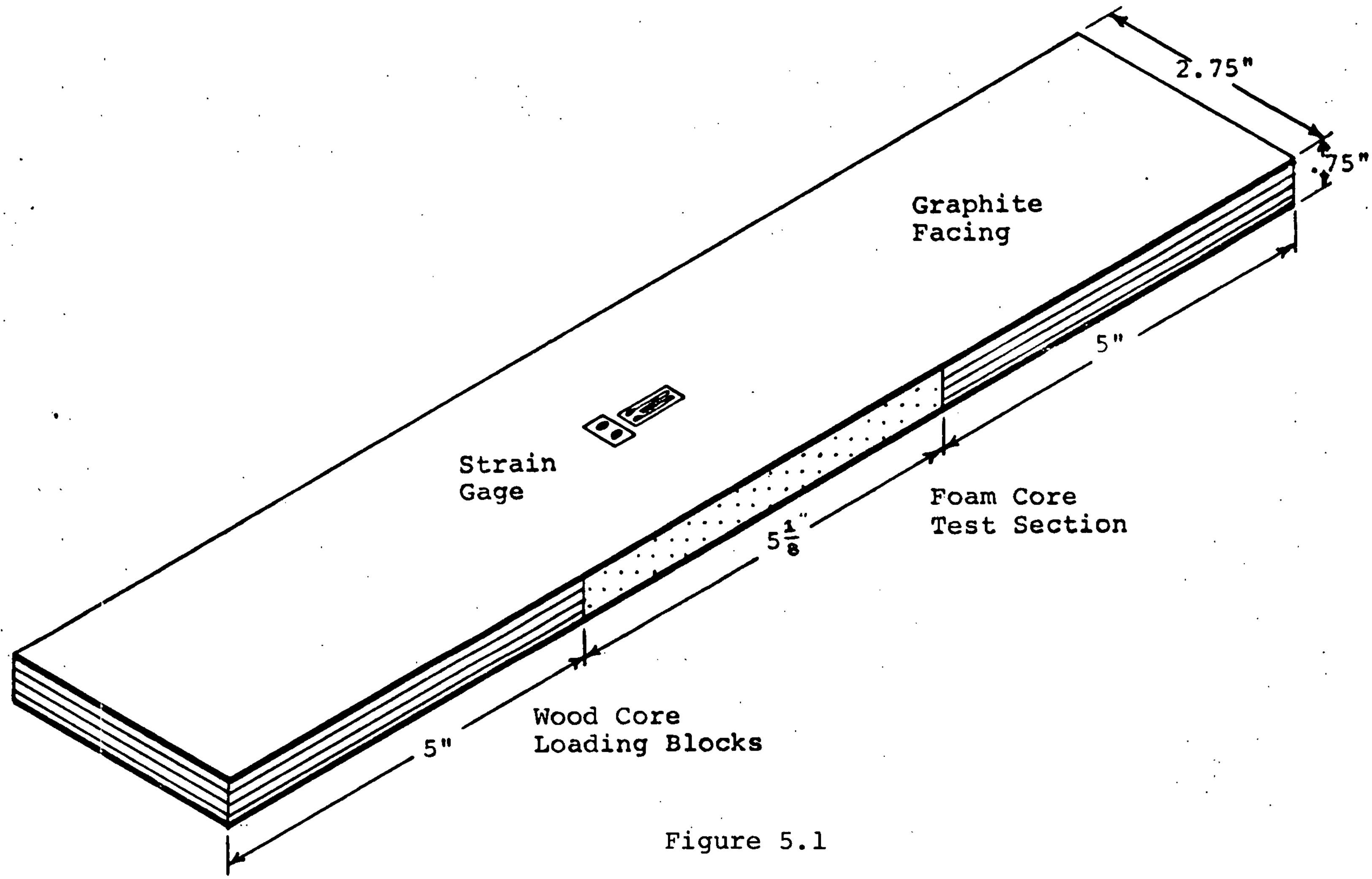
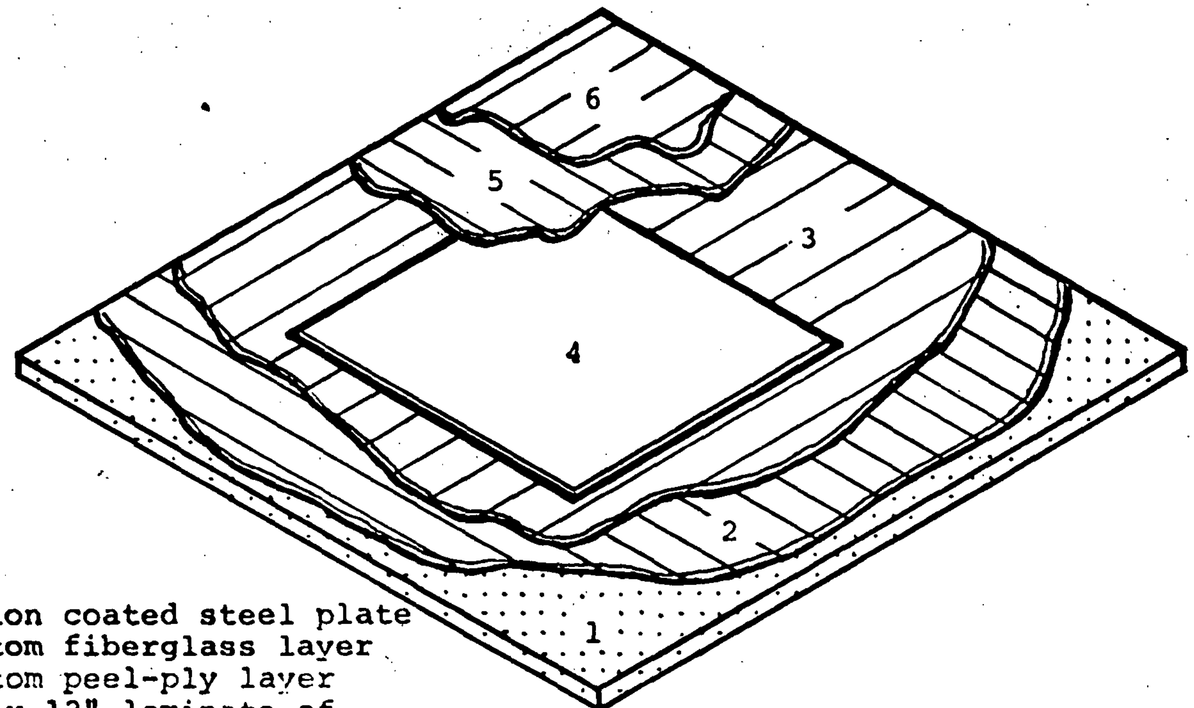


Figure 5.1

BEAM SPECIMEN CONFIGURATION



1--Teflon coated steel plate
2--Bottom fiberglass layer
3--Bottom peel-ply layer
4--16" x 12" laminate of
graphite/epoxy
5--Top peel-ply layer
6--Top fiberglass layer
Not shown--nylon vacuum bag

Figure 5.2

LAYUP FOR CURING OF GRAPHITE/EPOXY

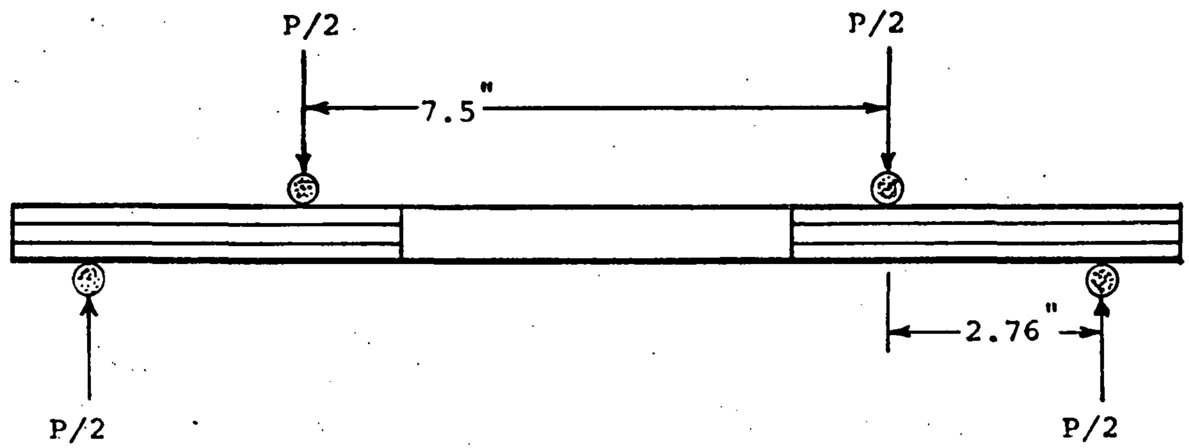


Figure 5.3

4-POINT BEAM LOADING CONFIGURATION

Figure 5.4

TENSION MODE FAILURE OF CORE

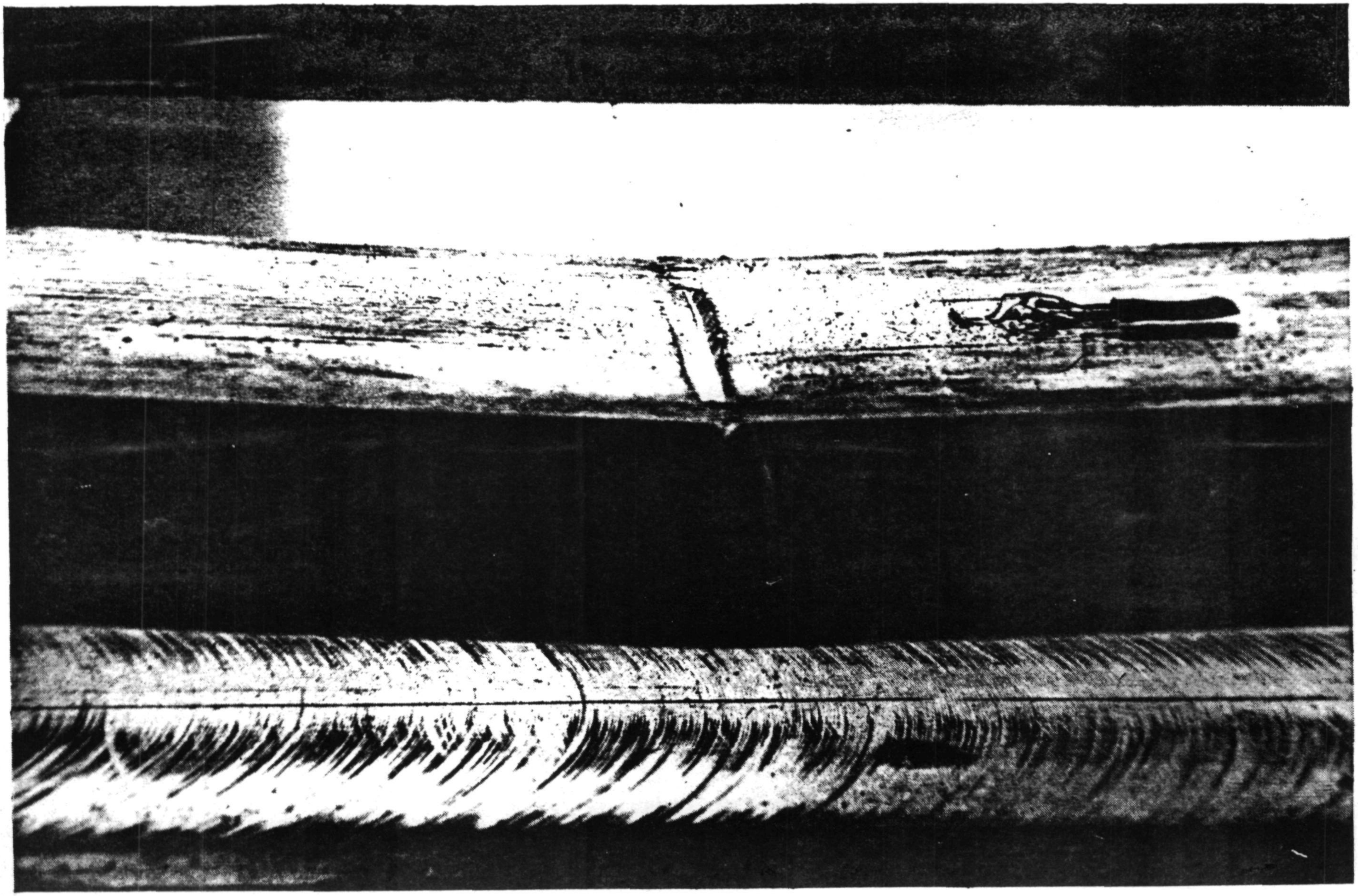


Figure 5.5

COMPRESSION FAILURE OF CORE

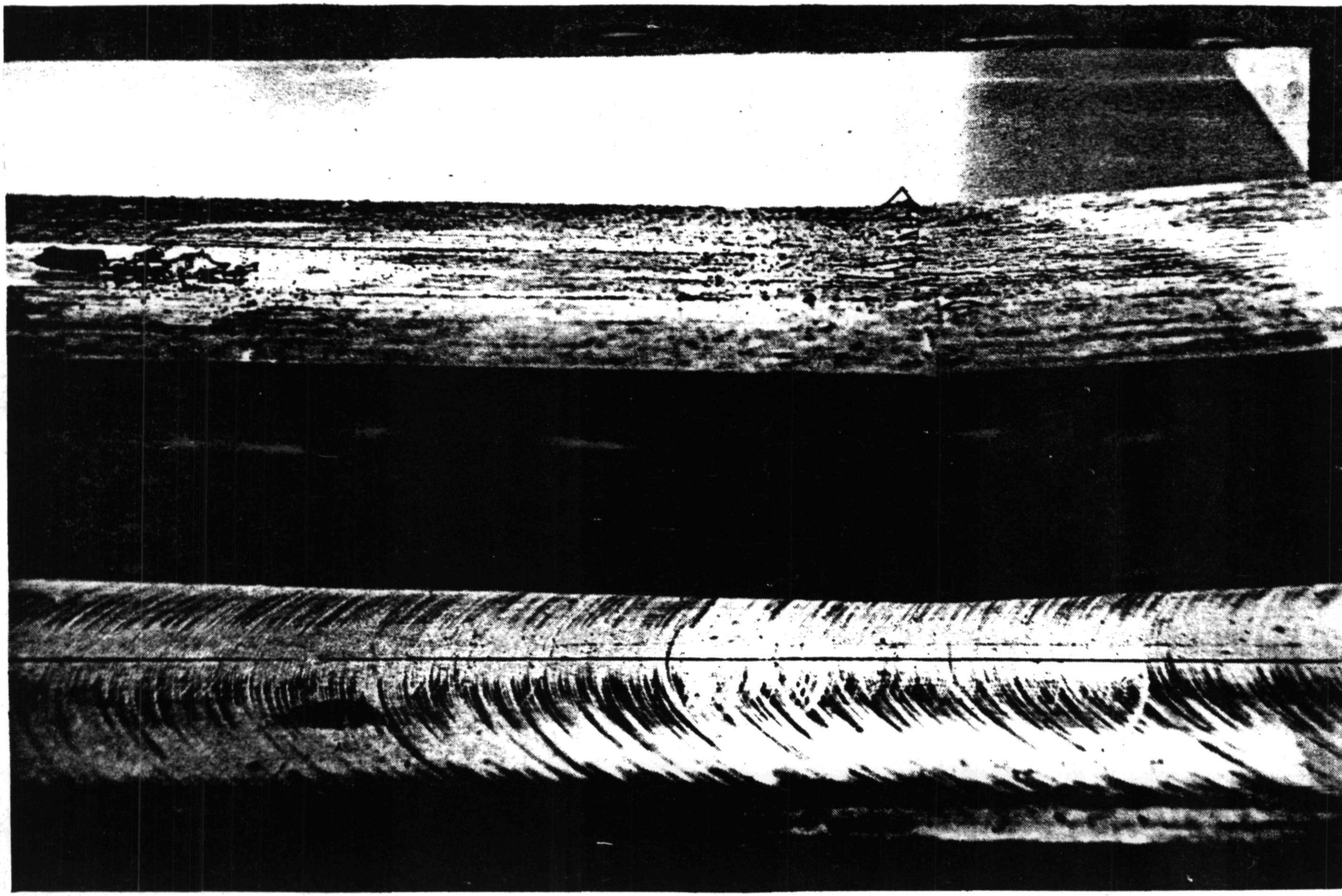
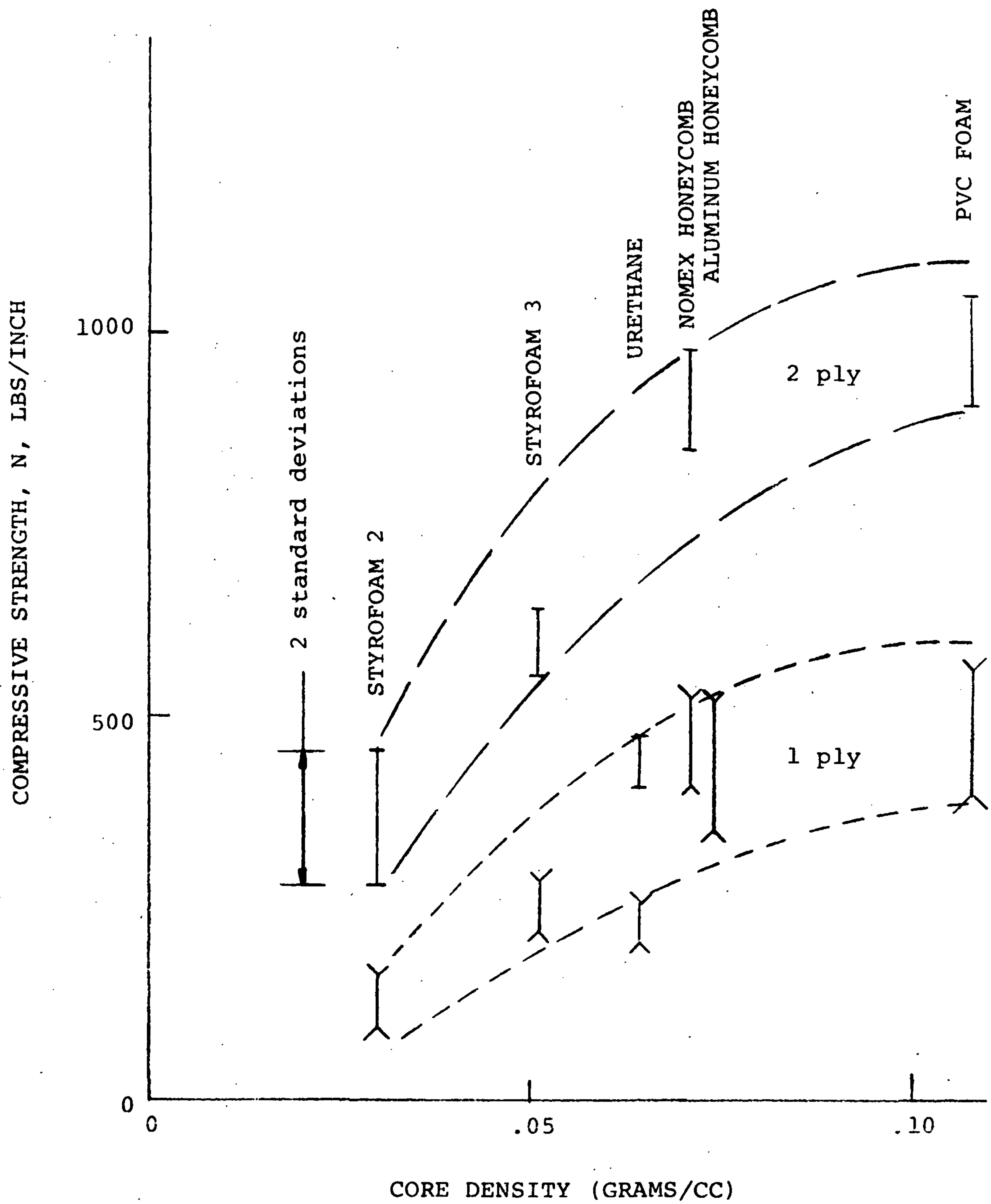


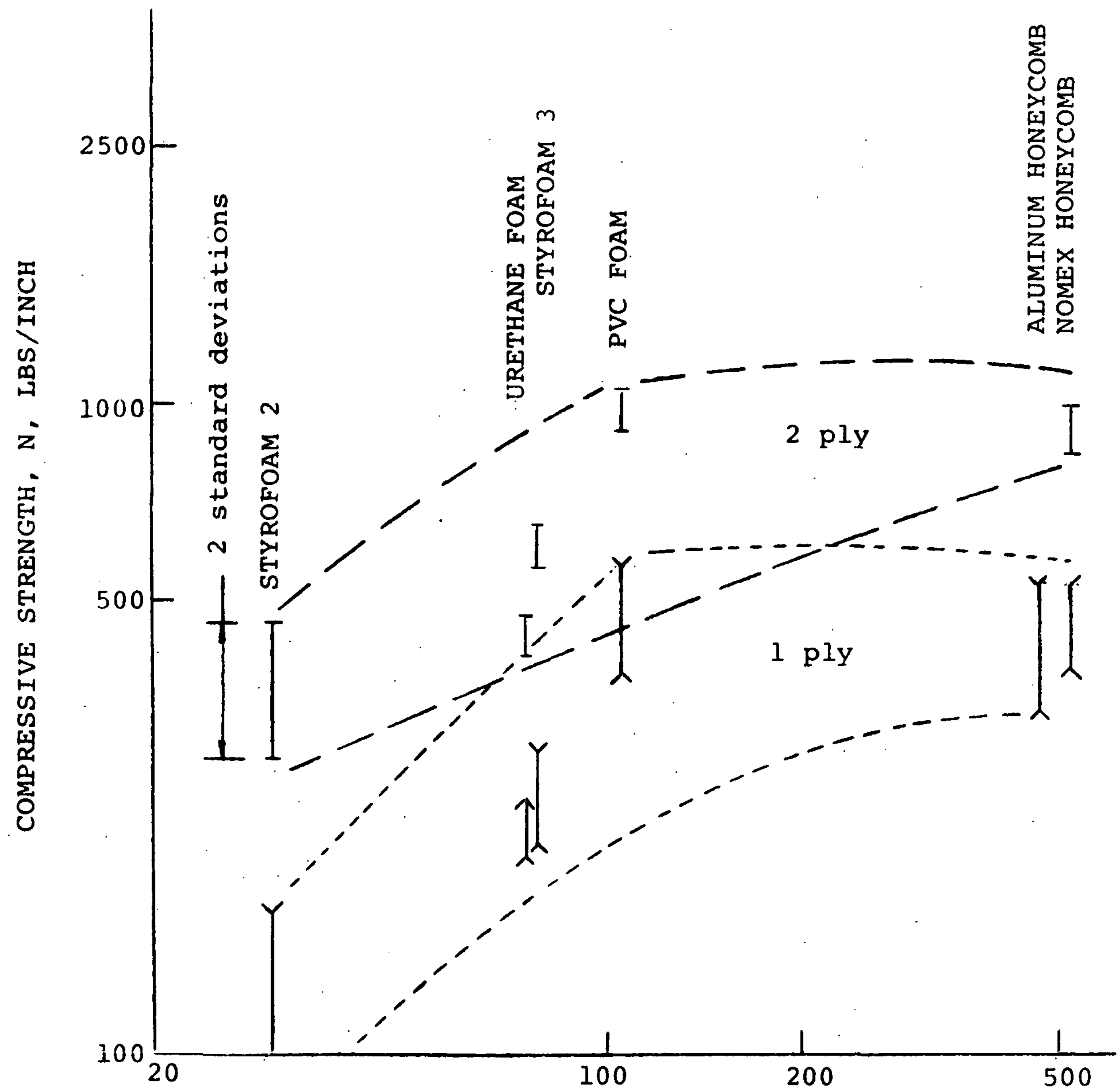
Figure 5.6

COMPRESSION MODE FAILURE OF FACING



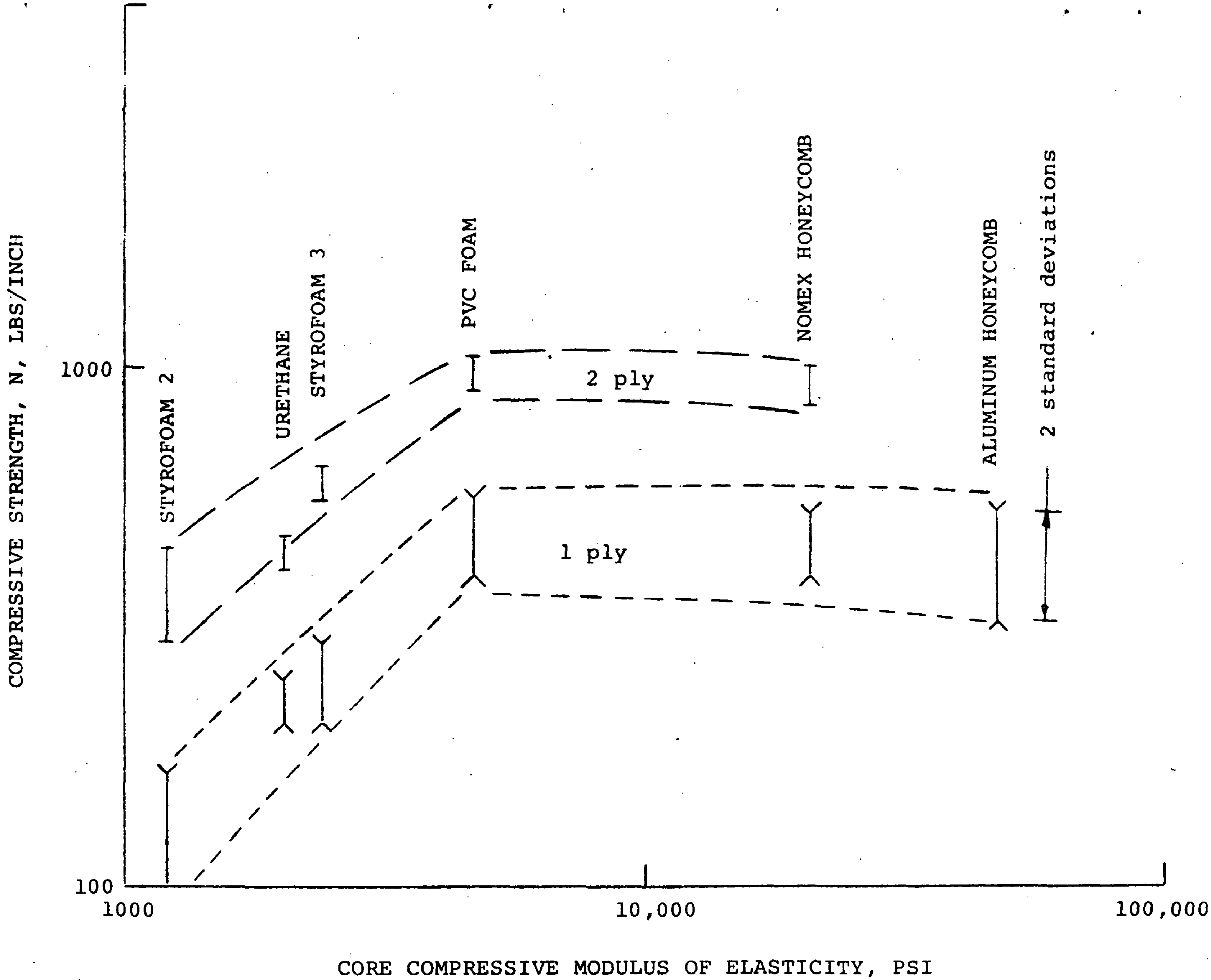
COMPRESSIVE STRENGTH, N, LBS/INCH
1000
500
0
0
.05
.10
CORE DENSITY (GRAMS/CC)
2 standard deviations
STYROFOAM 2
STYROFOAM 3
URETHANE
NOMEX HONEYCOMB
ALUMINUM HONEYCOMB
PVC FOAM
2 ply
1 ply

FIGURE 5.7



CRUSHING STRENGTH OF CORE, PSI

FIGURE 5. 8



COMPRESSIVE STRENGTH, N, LBS/INCH
CORE COMPRESSIVE MODULUS OF ELASTICITY, PSI
1000
100
1000
10,000
100,000
STYROFOAM 2
URETHANE
STYROFOAM 3
PVC FOAM
NOMEX HONEYCOMB
ALUMINUM HONEYCOMB
2 standard deviations
2 ply
1 ply

FIGURE 5.9

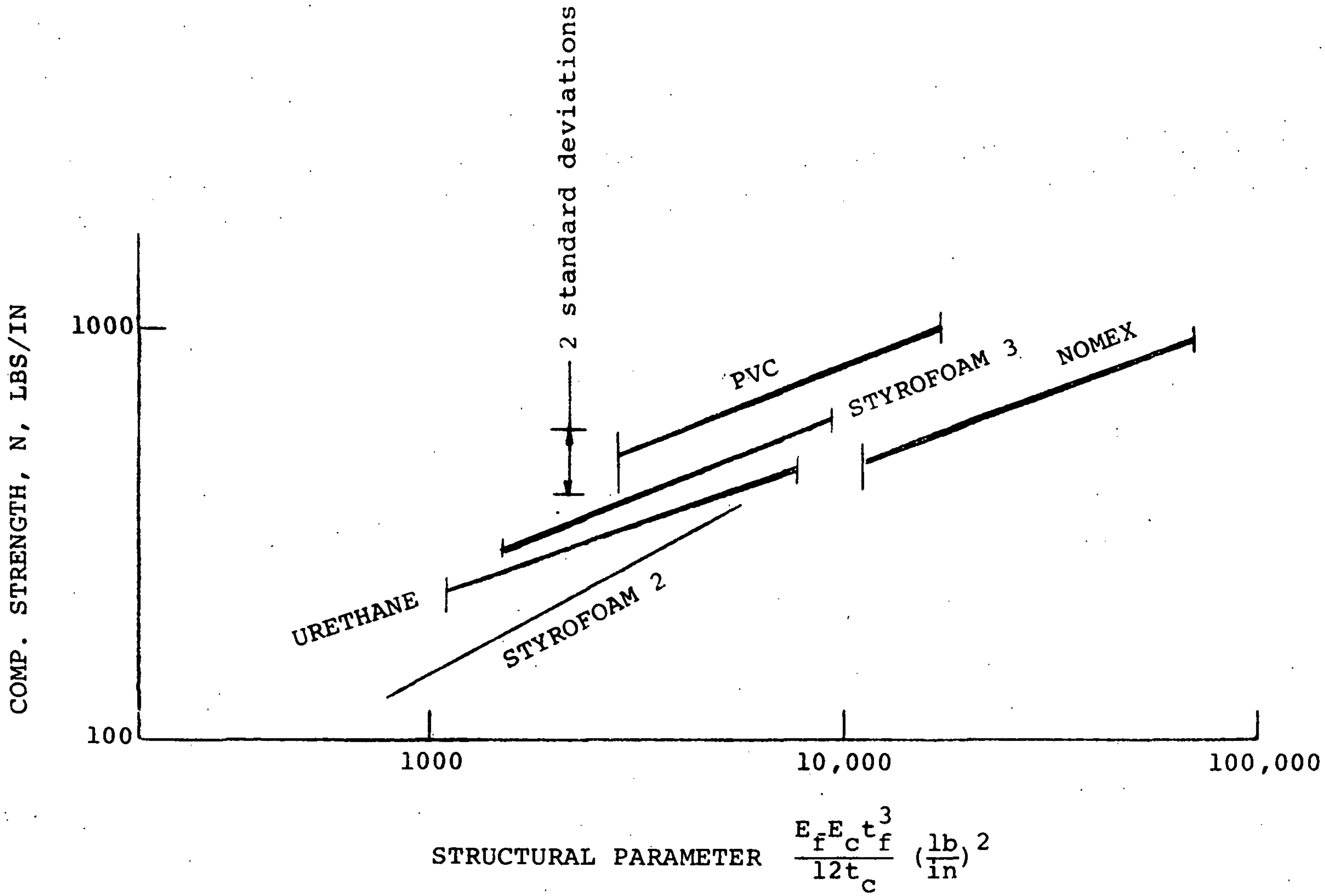

2 standard deviations
COMP. STRENGTH, N, LBS/IN
1000
100
PVC
STYROFOAM 3
NOMEX
URETHANE
STYROFOAM 2
1000
10,000
100,000
STRUCTURAL PARAMETER $\frac{E_f E_c t_f^3}{12 t_c} \left(\frac{lb}{in}\right)^2$

FIGURE 5.10

TABLE 5.1

CATEGORIES OF SPECIMENS

No. of Tests	Type of Core	No. of Plies
10	2# Styrofoam	1
2	"	2
10	3# Styrofoam	1
4	"	2
8	Urethane Foam	1
4	"	2
16	PVC Foam	1
10	"	2
12	Nomex Honeycomb	1
8	"	2
5	Aluminum Honeycomb	1
8	Urethane Foam	2, crossplied
12	PVC Foam	2 crossplied

No. of Plies	Core Material	Ply Thickness (in)	Aver. Stress (ksi)	N (lb/in)	Elastic Modulus (msi) Tens.	Elastic Modulus (msi) Compr.
1	2# Styrofoam	.0078	16.75	126	12.45	
2	2# Styrofoam	.0146	26.24	371	13.92	
1	3# Styrofoam	.0077	32.97	251	13.16	
2	3# Styrofoam	.0152	40.49	598	13.44	
1	Urethane foam	.0071	32.23	228	15.03	14.87
2	Urethane foam	.0138	32.38	443	14.48	14.02
1	PVC foam	.0075	63.44	476	13.38	12.63
2	PVC foam	.0130	75.21	975	15.26	14.90
1	Nomex honeycomb	.0076	61.38	463	12.56	12.50
2	Nomex honeycomb	.0130	71.73	919	15.22	15.06
1	Aluminum honeycomb	.0078	55.72	434	11.99 (1)	
2 (2)	Urethane foam	.0152	17.11	260	6.82	7.02
2	PVC foam	.0143	34.62	495	7.59	7.38

(1) These early tests combined the output of the strain gages on the tension and compression side into a single reading.

(2) Crossplied.

SUMMARY OF AVERAGE RESULTS

TABLE 5.2

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	ELASTIC MODULUS (msi)
----	Smooth-On Metalset	.0081	14.76	120	16.37
J2U3	Eccomold L-28	.0081	21.29	160	13.53
J2U4	Smooth-On EA-40	.0081	11.86	91	14.17
6231	"	.0065	33.69	219	14.50
7181	Eccomold L-28	.0083	10.50	87	9.23
7182	"	.0082	14.80	121	10.18
7183	"	.0080	14.00	112	11.55
7184	"	.0076	15.90	121	12.41
7185	"	.0077	15.80	122	10.67
1-F2-040-1075	Smooth-On EA-40	.0075	14.86	111	11.91
AVERAGE		.0078	16.75	126	12.45
STANDARD DEVIATION		.0005	6.59	38	2.20

TEST OF 1-PLY 2# STYROFOAM

TABLE 5.3A

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	ELASTIC MODULUS (msi)
M2	Eccomold L-28	.0081	28.41	430	13.16
6162	"	.0065	24.08	313	14.68
AVERAGE		.0081	26.25	372	13.92
STANDARD DEVIATION		.0011	3.06	83	1.07

TEST OF 2-PLY 2# STYROFOAM

TABLE 5.3B

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	ELASTIC MODULUS (msi)
-----	Smooth-On Metalset	.0081	27.67	225	12.13
J371	Eccomold L-28	.0081	20.12	154	13.81
M3	Smooth-On EA-40	.0065	35.77	233	17.60
7111	Eccomold L-28	.0086	27.29	235	10.94
7112	"	.0078	32.79	256	12.51
7113	"	.0079	38.04	301	12.81
7114	"	.0074	37.00	274	13.08
7115	"	.0075	35.77	268	12.48
1-F3-038-1075	Smooth-On EA-40	.0075	35.26	264	12.75
1-F3-039-1075	"	.0075	40.04	300	13.53
AVERAGE		.0077	32.97	251	13.16
STANDARD DEVIATION		.0006	6.13	43	1.75

TEST OF 1-PLY 3# STYROFOAM

TABLE 5.4

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	ELASTIC MODULUS (msi)
M1	Grumman Metalset	.0081	40.87	618	14.10
M4	Eccomold L-28	.0081	40.45	647	13.80
6263	"	.0070	41.86	586	13.03
6233	"	.0070	38.79	543	12.83
AVERAGE		.0076	40.49	598	13.44
STANDARD DEVIATION		.0006	1.28	45	.61

TEST OF 2-PLY 3# STYROFOAM

TABLE 5.5

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
1-URE-083-0476	Smooth-On EA-40	.0073	31.73	232	14.50	13.83
1-URE-084-0476	"	.0072	24.33	175	15.02	14.49
1-URE-085-0476	"	.0070	33.96	238	15.38	15.61
1-URE-086-0476	"	.0070	32.88	230	13.77	13.86
1-URE-098-0676	"	.0072	35.28	254	15.31	14.54
1-URE-099-0676	"	.0069	33.70	233	15.85	14.87
1-URE-100-0676	"	.0070	33.56	235	15.08	16.32
1-URE-101-0676	"	.0070	32.42	227	15.35	15.35
AVERAGE		.0071	32.23	228	15.03	14.87
STANDARD DEVIATION		.0001	3.37	23	.64	.86

TESTS OF 1-PLY URETHANE FOAM

TABLE 5.6

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
2-URE-094-0676	Smooth-On EA-40	.0140	31.20	435	13.99	13.54
2-URE-095-0676	"	.0142	34.59	491	14.24	13.87
2-URE-096-0676	"	.0132	32.94	435	14.70	14.33
2-URE-097-0676	"	.0133	30.80	411	15.00	14.33
AVERAGE		.0137	32.38	443	14.48	14.02
STANDARD DEVIATION		.0005	1.74	34	.45	.39

TEST OF 2-PLY URETHANE FOAM

TABLE 5.7

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
1-PVC-045-1175	Smooth-On EA-40	.0087	58.67	510	12.11	11.34
1-PVC-046-1175	"	.0079	70.31	555	12.90	12.19
1-PVC-047-1175	"	.0079	66.26	523	13.51	11.25
1-PVC-048-1175	"	.0079	67.25	531	11.82	12.08
1-PVC-053-0176	"	.0069	79.52	549	15.17	13.24
1-PVC-054-0176	"	.0069	68.67	474	14.45	13.09
1-PVC-055-0176	"	.0078	73.38	615	11.86	12.00
1-PVC-056-0176	"	.0084	58.30	455	12.59	11.55
1-PVC-057-0176	"	.0075	43.46	326	13.24	13.41
1-PVC-058-0176	"	.0075	49.00	358	13.01	12.52
1-PVC-059-0176	"	.0079	63.45	501	12.82	11.55
1-PVC-060-0176	"	.0083	47.81	397	12.08	11.48
1-PVC-061-0176	"	.0069	69.02	476	14.12	13.53
1-PVC-062-0176	"	.0068	51.18	348	14.78	13.51
1-PVC-063-0176	"	.0067	84.97	569	14.81	15.11
1-PVC-064-0176	"	.0066	63.73	421	14.85	14.28
AVERAGE		.0075	63.44	476	13.38	12.63
STANDARD DEVIATION		.0007	11.55	85	1.17	1.15

TEST OF 1-PLY PVC FOAM

TABLE 5.8

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
2-PVC-065-0176	Smooth-On EA-40	.0067	67.74	903	14.44	14.55
2-PVC-066-0176	"	.0066	76.59	1007	15.08	14.55
2-PVC-067-0176	"	.0067	78.43	1059	15.32	13.72
2-PVC-068-0176	"	.0065	71.69	939	15.37	14.73
2-PVC-077-0276-RK	"	.0065	72.04	935	14.72	15.40
2-PVC-078-0276-RK	"	.0065	66.96	870	15.53	14.14
2-PVC-069-0176	"	.0060	84.76	1026	15.96	15.38
2-PVC-070-0176	"	.0062	81.77	1022	15.79	15.19
2-PVC-071-0176	"	.0064	83.67	1079	15.49	15.84
2-PVC-072-0176	"	.0067	68.51	911	14.95	15.45
AVERAGE		.0065	75.21	975	15.27	14.90
STANDARD DEVIATION		.0002	6.76	72	.47	.67

TESTS OF 2-PLY PVC FOAM

TABLE 5.9

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
7251	Film Adhesive	.0078	46.23	360	11.74	
7253	"	.0078	50.52	394	12.21	
7254	"	.0072	64.49	464	13.28	
7255	"	.0079	44.29	350	11.68	
1-NOH-041-1075	"	.0080	57.01	456	12.20	11.89
1-NOH-042-1075	"	.0079	59.77	472	12.98	12.87
1-NOH-043-1075	"	.0077	64.69	498	12.82	12.64
1-NOH-044-1075	"	.0078	61.07	476	10.99	12.94
1-NOH-049-1076	"	.0075	74.26	557	13.71	12.96
1-NOH-050-1076	"	.0073	73.94	540	12.58	12.27
1-NOH-051-1076	"	.0070	73.77	516	13.36	13.12
1-NOH-052-1076	"	.0071	66.54	472	13.17	12.36
AVERAGE		.0076	61.38	463	12.56	12.50
STANDARD DEVIATION		.0003	10.38	66	.81	.55

TESTS OF 1-PLY NOMEX HONEYCOMB

TABLE 5.10

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
2-NOH-073-0376	Film Adhesive	.0069	66.51	911	14.58	14.20
2-NOH-074-0376	"	.0065	68.18	886	14.19	14.73
2-NOH-075-0376	"	.0064	69.84	890	15.58	14.48
2-NOH-076-0376	"	.0062	77.84	961	15.53	16.14
2-NOH-079-0476	"	.0061	67.11	812	16.38	15.31
2-NOH-080-0476	"	.0063	81.50	1019	15.54	15.45
2-NOH-081-0476	"	.0065	75.31	972	15.59	15.25
2-NOH-082-0476	"	.0067	67.52	898	14.27	14.90
AVERAGE		.0065	71.73	919	15.21	15.06
STANDARD DEVIATION		.0003	5.71	64	.77	.61

TESTS OF 2-PLY NOMEX HONECOMB

TABLE 5.11

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	ELASTIC MODULUS (msi)
8141	Film Adhesive	.0077	59.20	456	11.99
8142	"	.0081	32.50	263	11.67
8143	"	.0080	63.89	511	11.47
8144	"	.0077	64.64	498	13.05
8145	"	.0076	58.36	444	11.76
AVERAGE		.0078	55.72	434	11.99
STANDARD DEVIATION		.0002	13.27	91	.51

TESTS OF 1-PLY ALUMINUM HONEYCOMB

TABLE 5.12

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
1 HOON BEAM #1	Smooth-On EA-40	.0132	17.72	234	7.41	7.04
1 HOON BEAM #2	"	.0135	12.59	170	6.60	5.72
1 HOON BEAM #3	"	.0129	17.13	221	7.63	6.83
1 HOON BEAM #4	"	.0172	19.42	334	6.37	8.00
1 HOON BEAM #5	"	.0142	15.70	223	6.92	7.22
1 HOON BEAM #6	"	.0148	18.85	279	7.41	7.58
1 HOON BEAM #7	"	.0176	16.65	293	6.08	7.63
1 HOON BEAM #8	"	.0185	17.78	329	6.15	6.15
AVERAGE		.0152	16.98	260	6.82	7.02
STANDARD DEVIATION		.0022	2.13	58	.61	.77

TABLE 5.13

TESTS OF CROSS-PLIED URETHANE FOAM

SPECIMEN NO.	ADHESIVE	PLY THICK (in)	STRESS (ksi)	N (lb/in)	TENSION MODULUS (msi)	COMPR. MODULUS (msi)
1 HOON BEAM # 9	Smooth-On EA-40	.0153	41.96	642	7.33	7.33
1 HOON BEAM #10	"	.0153	36.21	554	7.17	6.78
1 HOON BEAM #11	"	.0143	35.45	507	7.63	7.66
1 HOON BEAM #12	"	.0145	31.45	456	7.14	7.35
1 HOON BEAM #13	"	.0143	32.80	469	8.16	7.55
1 HOON BEAM #14	"	.0144	32.01	461	7.60	7.60
1 HOON BEAM #15	"	.0138	26.52	366	7.66	7.37
1 HOON BEAM #16	"	.0140	36.93	517	7.78	8.10
1 HOON BEAM #17	"	.0145	35.38	513	7.56	7.22
1 HOON BEAM #18	"	.0138	36.96	510	7.53	7.14
1 HOON BEAM #19	"	.0136	30.81	419	7.63	7.49
1 HOON BEAM #20	"	.0142	36.62	520	7.91	6.94
AVERAGE		.0143	34.43	495	7.59	7.38
STANDARD DEVIATION		.0005	3.96	69	.29	.35

TABLE 5.14

TESTS OF CROSS-PLIED PVC FOAM

		DIMENSIONS	MASS	DENSITY	E COMPRESSION	CRUSHING STRENGTH
		L x W x T inches	grams	lbs/ft^3	psi	psi
Blue Styrofoam	1	1.83 x 1.7 x 1.43			1,352	30
	2	1.875 x 1.83 x 1.45	2.48	1.90	1,099	29
	3	2.27 x 1.45 x 1.4	2.21	1.83	1,396	30
	4	1.83 x 1.83 x 1.46	2.38	1.85	1,177	29
	5	1.87 x 1.7 x 1.45	2.23	1.84	1,067	30
White Styrofoam	1	3.0 x 2.875 x 1.7	12.43	3.23	2,200	75
	2	3.0 x 2.72 x 1.78	12.07	3.17	2,487	75
	3	2.85 x 2.225 x 1.75	9.27	3.18	2,829	84
	4	2.725 x 2.47 x 1.75	9.83	3.18	2,262	79
	5	2.7 x 2.0 x 1.75	7.90	3.18	2,107	79
PVC Foam	1	2.5 x 2.65 x .75	8.76	6.71	4,387	113
	2	2.5 x 2.45 x .75	8.31	6.90	4,696	114
	3	2.5 x 2.6 x .75	8.39	6.55	4,835	102
	4	2.5 x 2.45 x .75	8.08	6.71	4,610	103
Nomex Honeycomb DENSE	1	2.4 x 2.0 x 1.45	8.04	4.40	20,065	500
	2	2.45 x 2.1 x 1.45	8.60	4.39	20,048	525
Nomex Honeycomb LIGHT	1	1.75 x 1.6 x 1	1.41	1.92	6,875	112
	2	1.6 x 1.55 x 1	1.25	1.90	6,880	112
	3	2.0 x 1.7 x 1	1.83	2.05	7,162	117
	4	2.0 x 1.7 x 1	1.68	1.88	6,500	112
	5	1.6 x 1.5 x 1			7,375	115
Aluminum Honeycomb LIGHT	1	1.5 x 1.4 x 1	2.48	4.50	45,238	443
	2	1.9 x 1 x 1	2.27	4.55	49,868	484
	3	2.0 x 1.1 x 1	2.67	4.62	46,250	477

TABLE 5.15

PROPERTIES OF CORE MATERIALS

WEIBULL DISTRIBUTION PARAMETERS						
No. of Plies	CORE MATERIAL	No. of Tests	STRESS		N	
			$\hat{\alpha}$	$\hat{\beta}$	$\hat{\alpha}$	$\hat{\beta}$
1	2# Styrofoam	10	2.69	18.8	3.44	140
2	2# Styrofoam	2	14.51	27.2	7.55	397
1	3# Styrofoam	10	7.67	35.3	8.06	267
2	3# Styrofoam	4	44.93	41.0	18.51	616
1	Urethane Foam	8	17.48	33.4	16.31	236
2	Urethane Foam	4	22.69	33.1	14.84	458
1	PVC Foam	16	6.07	68.6	6.94	509
2	PVC Foam	10	13.05	78.2	16.20	1010
1	Nomex Honeycomb	12	6.98	65.6	8.48	489
2	Nomex Honeycomb	8	13.45	74.3	16.82	947
1	Aluminum Honeycomb	5	7.15	60.0	7.14	468
2*	Urethane Foam	8			5.62	282
2*	Urethane Foam	12			7.66	523

*Crossplied 0°/90°.

TABLE 5.16

CORE	CORE DENSITY grams/cc	No. of Plies	av. N lbs/in	σ for N lbs/in	No. of Tests	E_{core}	Crushing Strength psi
Styrofoam 2	.0297	1	126	38	10	1,218	30
Styrofoam 3	.0511	1	251	43	10	2,376	79
Urethane	.0641(1)	1	228	23	8	2,000(1)	75
PVC	.1076	1	476	85	16	4,632	106
Nomex Honeycomb	.0704	1	463	66	12	20,050	512
Aluminum Honeycomb	.0730	1	434	91	5	47,119	468
Styrofoam 2	.0297	2	372	83	2	1,218	
Styrofoam 3	.0511	2	598	45	4	2,376	
Urethane Foam	.0641	2	443	34	4	2,000	
PVC Foam	.1076	2	975	72	10	4,632	
Nomex Honeycomb	.0730	2	919	64	8	20,050	

(1) Manufacturer's nominal values

TABLE 5.17

SUMMARY OF DATA FOR FIGURES 5.7, 5.8, 5.9

	No. of plies	E_{ply} 10^6 psi	E_{core} psi	t_{ply} inches	t_{core} inches	$\frac{E_{ply} E_{core} t_{ply}^3}{12 t_c}$	N lbs/inch
Styrofoam 2	1	12.45	1,218	.00781	.776	775	126
Styrofoam 2	2	13.92	1,218	.0146	.791	5,559	371
Styrofoam 3	1	12.86	2,376	.00769	.80	1,447	277
Styrofoam 3	2	13.44	2,376	.0140	.79	9,243	598
Urethane	1	14.87	2,000	.00708	.776	1,133	228
Urethane	2	14.02	2,000	.01368	.791	7,563	443
PVC	1	12.63	4,632	.00754	.737	2,836	476
PVC	2	14.90	4,632	.01296	.738	16,964	975
Nomex	1	12.50	20,050	.00754	.774	11,567	463
Nomex	2	15.06	20,050	.0129	.784	68,899	919
Aluminum Honeycomb	1	12.07	47,119	.00775	.81	27,172	477

TABLE 5.18

CALCULATION OF STRUCTURAL PARAMETER

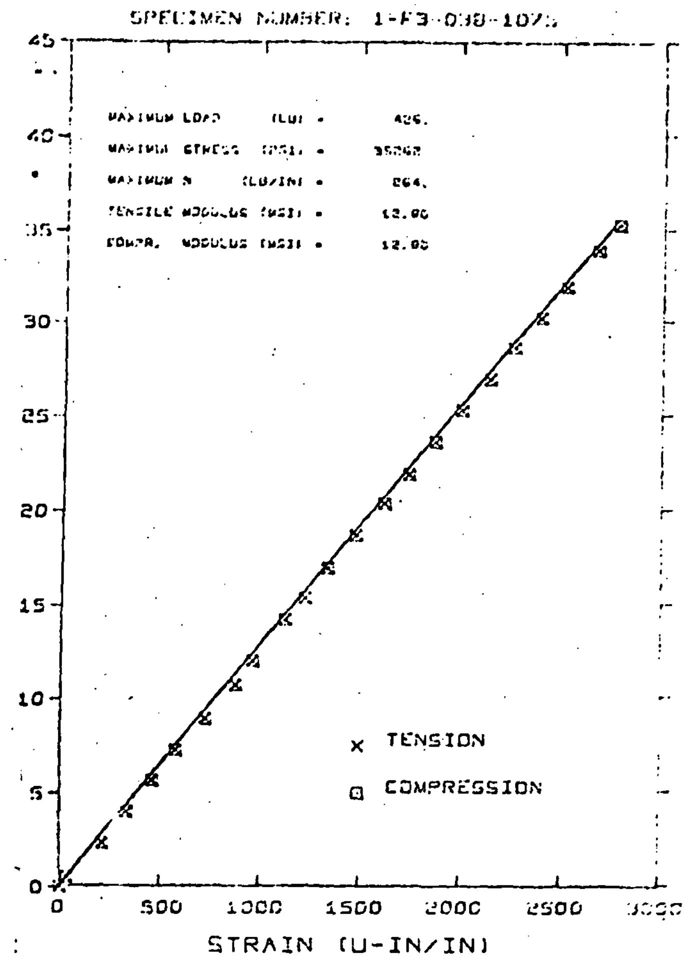
	m	K
Styrofoam 3	.415	13.52
Urethane	.349	19.62
PVC	.400	19.82
Nomex	.384	12.75

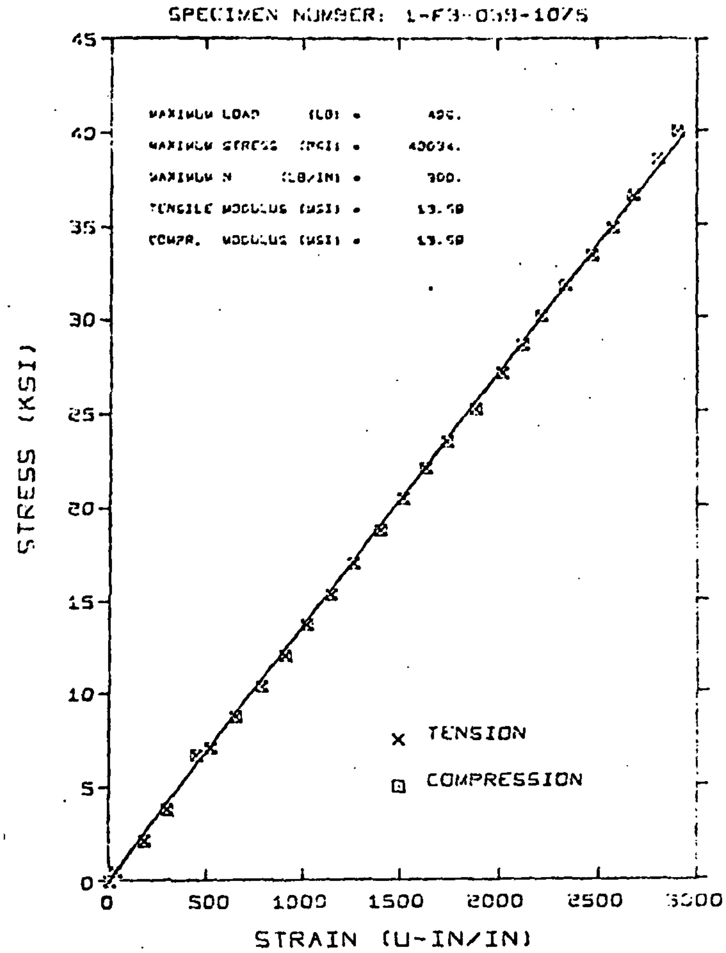
TABLE 5.19

STRUCTURAL PARAMETER CORRELATION CONSTANTS

APPENDIX 5.1

The stress-strain data are shown in this appendix. Figure numbers have not been assigned since each test specimen has its own identification number. As can be seen these are copies of the computer printouts.





-EN NUMBER: 1-F3-038-1075 DATE OF TEST : 08 OCT 75

MATERIAL : 3# WHITE STYROFOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

OF PLYS : 1 PLY THICKNESS : 0.0075

DIMENSIONS: 0.795 X 2.770 X 5.140 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	497.	39.	39.
28.	2318.	222.	222.
48.	3973.	344.	344.
68.	5629.	469.	469.
88.	7284.	589.	589.
106.	8940.	737.	737.
130.	10761.	888.	888.
145.	12032.	973.	973.
172.	14237.	1133.	1133.
186.	15396.	1228.	1228.
205.	16969.	1346.	1346.
226.	18707.	1479.	1479.
246.	20362.	1620.	1620.
265.	21935.	1738.	1738.
286.	23673.	1871.	1871.
306.	25329.	2004.	2004.
326.	26984.	2141.	2141.
346.	28640.	2261.	2261.
366.	30295.	2394.	2394.
386.	31951.	2522.	2522.
410.	33937.	2674.	2674.
426.	35262.	2782.	2782.
426.	35262.******************************		

LOAD (LB) = 425.

STRESS (PSI) = 35262.

N (LB/IN) = 264.

MODULUS (MSI) = 12.80

MODULUS (MSI) = 12.80

SPECIMEN NUMBER: 1-F3-039-1075 DATE OF TEST : 09 OCT 75

CORE MATERIAL : 3# WHITE STYROFOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0075

CORE DIMENSIONS: 0.796 X 2.780 X 5.140 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	494.	36.	36.
26.	2142.	186.	186.
46.	3789.	307.	307.
81.	6672.	458.	458.
86.	7084.	530.	530.
106.	8732.	661.	661.
126.	10379.	793.	793.
146.	12027.	910.	910.
166.	13674.	1024.	1024.
186.	15321.	1143.	1143.
206.	16969.	1257.	1257.
228.	18781.	1402.	1402.
248.	20429.	1519.	1519.
268.	22076.	1633.	1633.
285.	23476.	1743.	1743.
306.	25206.	1883.	1883.
329.	27101.	2017.	2017.
347.	28584.	2117.	2117.
366.	30149.	2215.	2215.
386.	31796.	2332.	2332.
406.	33444.	2474.	2474.
424.	34926.	2578.	2578.
445.	36656.	2682.	2682.
468.	38551.	2804.	2804.
486.	40033.	2903.	2903.
486.	40033.******************************		

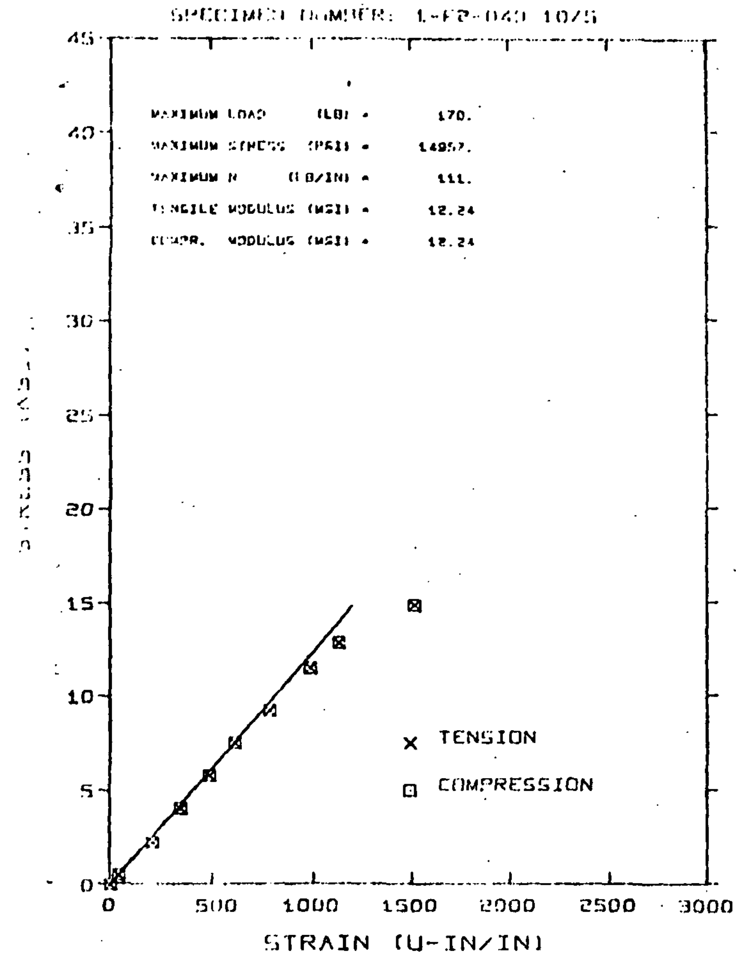
MAXIMUM LOAD (LB) = 486.

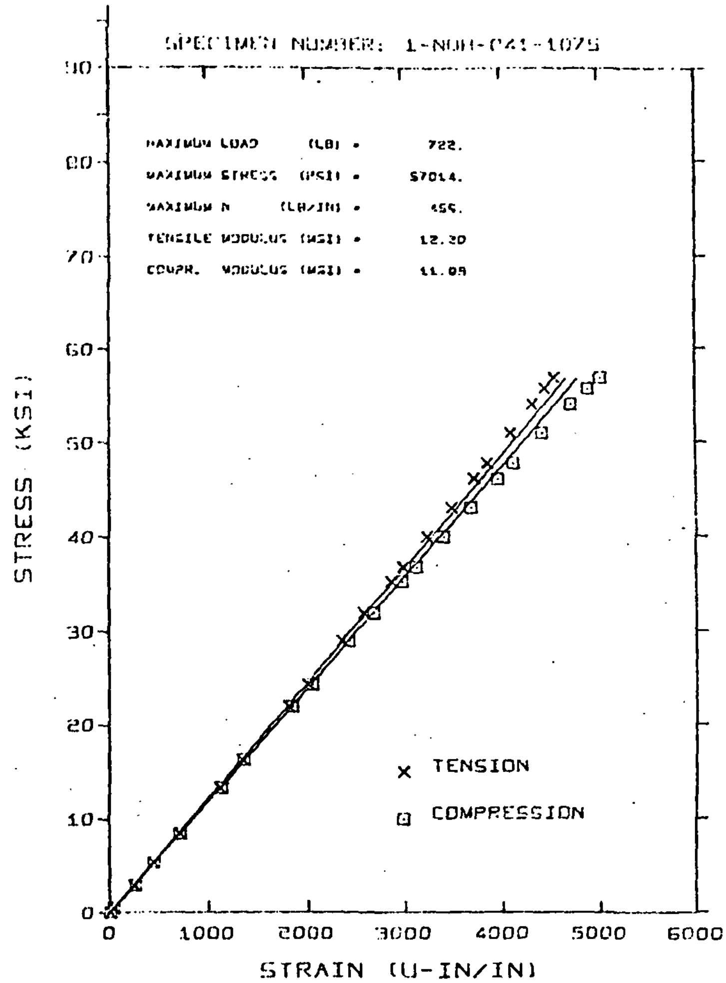
MAXIMUM STRESS (PSI) = 40033.

MAXIMUM N (LB/IN) = 300.

TENSILE MODULUS (MSI) = 13.58

COMPR. MODULUS (MSI) = 13.58





CIMEN NUMBER: 1-F2-040-1075 DATE OF TEST : 08 OCT 75

MATERIAL : 2# BLUE STYROFOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

BER OF PLYS : 1 PLY THICKNESS : 0.0075

E DIMENSIONS: 0.790 X 2.640 X 5.140 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	524.	43.	43.
26.	2272.	213.	213.
46.	4020.	347.	347.
66.	5768.	494.	494.
86.	7516.	620.	620.
106.	9264.	795.	795.
132.	11536.	995.	995.
147.	12847.	1143.	1143.
170.	14857.	1524.	1524.
170.	14857.****************	**************	**********

IMUM LOAD (LB) = 170.

IMUM STRESS (PSI) = 14857.

IMUM N (LB/IN) = 111.

SILE MODULUS (MSI) = 12.24

PR. MODULUS (MSI) = 12.24

SPECIMEN NUMBER: 1-NOH-041-1075 DATE OF TEST : 13 NOV 75

CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0020

CORE DIMENSIONS: 0.773 X 2.797 X 5.172 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	474.	40.	39.
38.	3001.	260.	256.
68.	5370.	460.	458.
107.	8449.	720.	718.
170.	13424.	1136.	1130.
205.	16267.	1374.	1362.
278.	21953.	1861.	1829.
308.	24322.	2062.	2018.
366.	28902.	2448.	2373.
404.	31903.	2696.	2607.
446.	35219.	2991.	2876.
466.	36799.	3129.	2999.
506.	39957.	3405.	3245.
546.	43116.	3688.	3493.
585.	46196.	3963.	3724.
606.	47854.	4113.	3848.
646.	51013.	4417.	4089.
686.	54171.	4717.	4322.
706.	55751.	4893.	4450.
722.	57014.***************	**************	**********

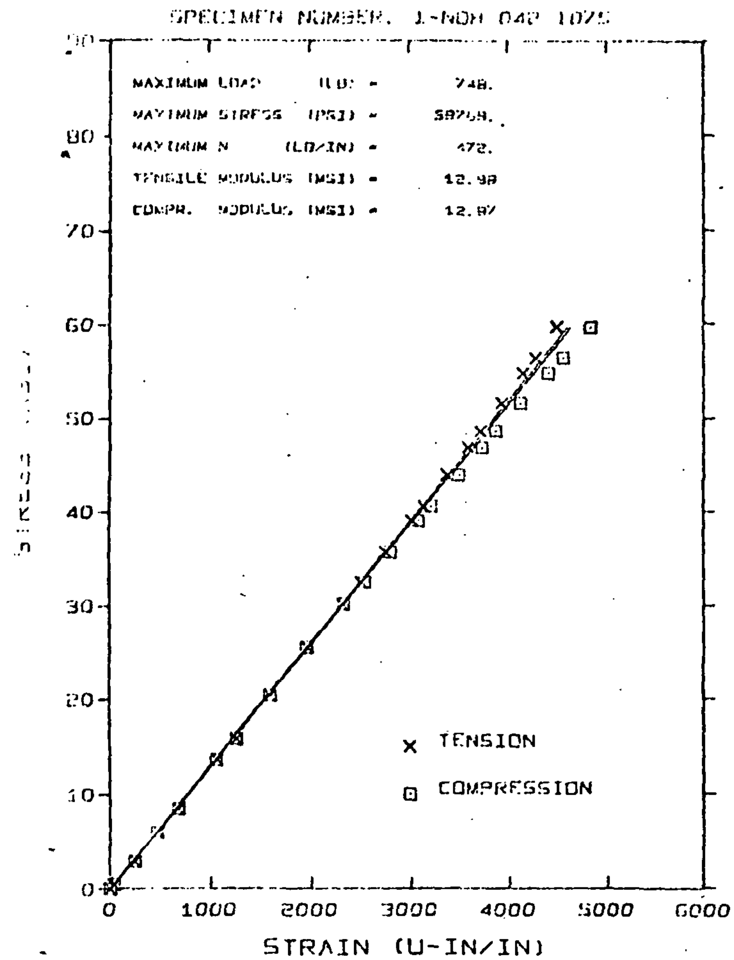
MAXIMUM LOAD (LB) = 722.

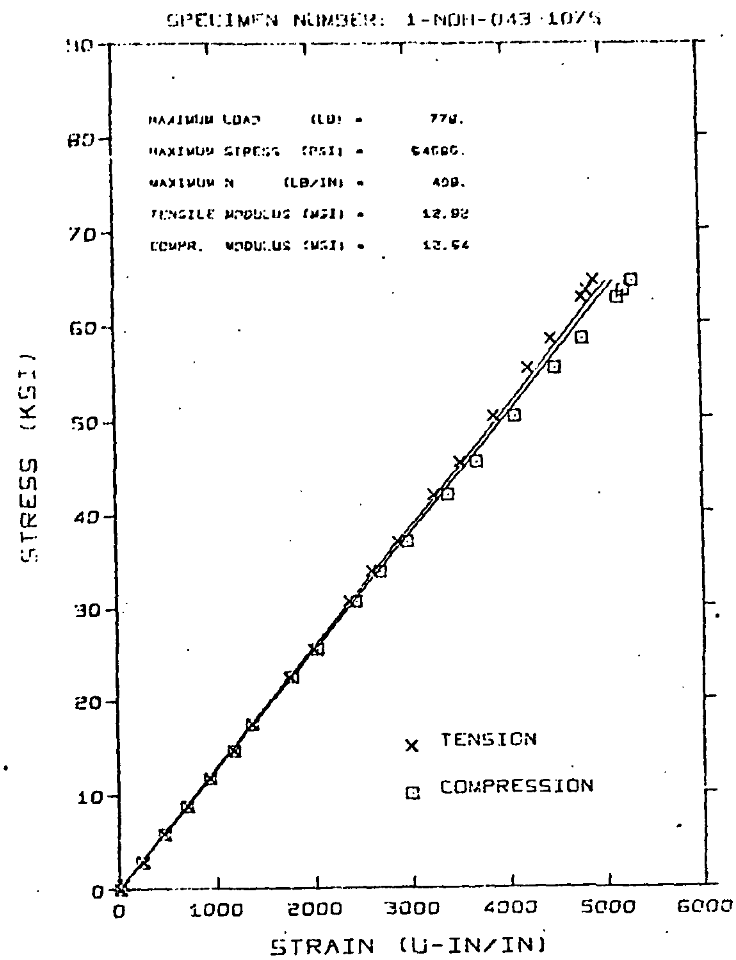
MAXIMUM STRESS (PSI) = 57014.

MAXIMUM N (LB/IN) = 456.

TENSILE MODULUS (MSI) = 12.20

COMPR. MODULUS (MSI) = 11.89





MEN NUMBER: 1-NOH-042-1075 DATE OF TEST : 13 NOV 75
MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE
R OF PLYS : 1 PLY THICKNESS : 0.0079
DIMENSIONS: 0.778 X 2.781 X 5.172 INCHES

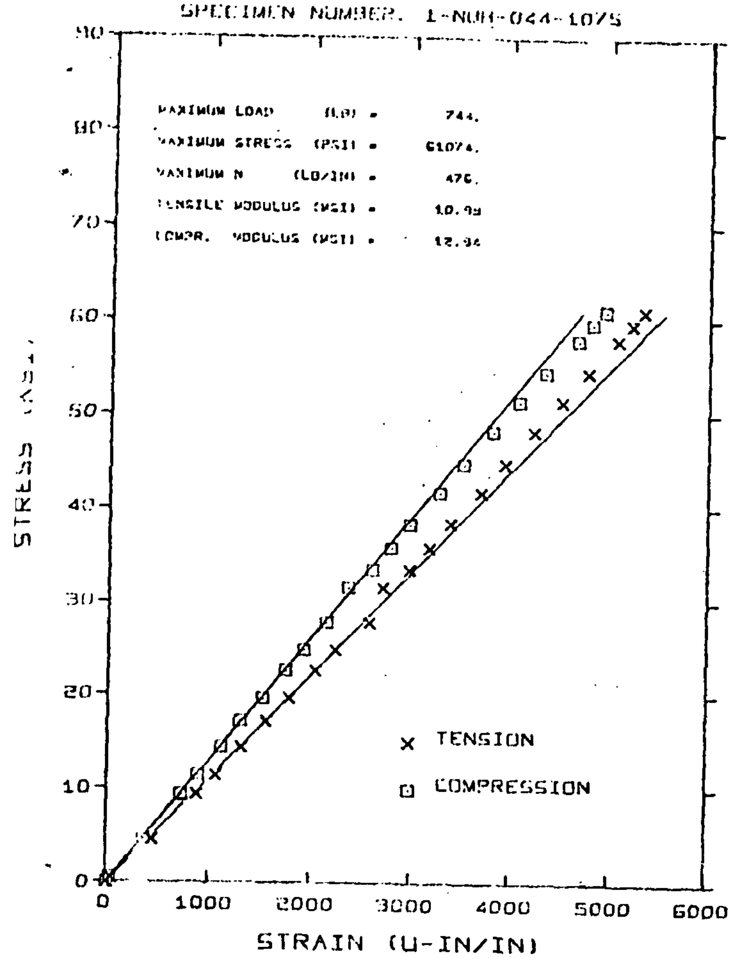
LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	479.	37.	37.
37.	2956.	251.	257.
75.	5993.	470.	480.
106.	8470.	679.	689.
170.	13584.	1071.	1085.
198.	15821.	1268.	1277.
256.	20456.	1607.	1609.
318.	25410.	1973.	1981.
376.	30044.	2345.	2325.
406.	32441.	2550.	2523.
446.	35638.	2810.	2766.
488.	38994.	3088.	3019.
507.	40512.	3217.	3139.
548.	43788.	3486.	3377.
586.	46824.	3730.	3594.
608.	48582.	3871.	3715.
646.	51619.	4128.	3933.
686.	54815.	4398.	4155.
706.	56413.	4565.	4290.
746.	59609.	4835.	4493.
748.	59769.******************************		

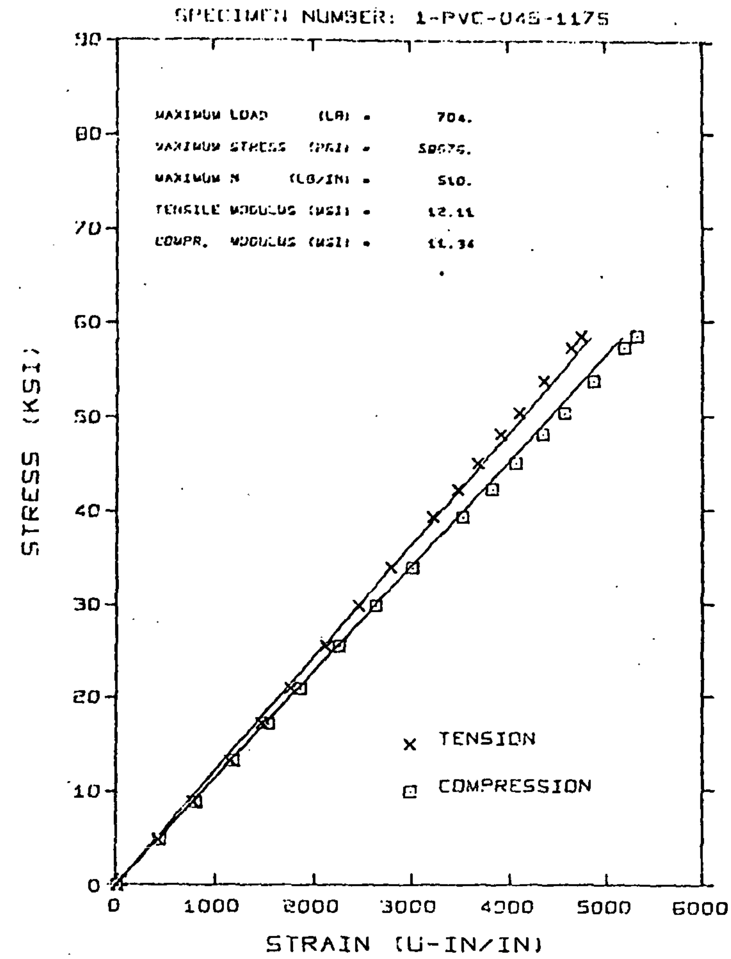
IN LOAD (LB) = 748.
IN STRESS (PSI) = 59769.
IN N (LB/IN) = 472.
E MODULUS (MSI) = 12.98
MODULUS (MSI) = 12.87

SPECIMEN NUMBER: 1-NOH-043-1075 DATE OF TEST : 13 NOV 75
CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE
NUMBER OF PLYS : 1 PLY THICKNESS : 0.0077
CORE DIMENSIONS: 0.772 X 2.766 X 5.156 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	499.	39.	39.
34.	2827.	245.	248.
69.	5737.	463.	472.
105.	8730.	701.	707.
140.	11640.	939.	942.
177.	14717.	1185.	1184.
210.	17460.	1381.	1377.
270.	22449.	1789.	1770.
306.	25442.	2040.	2007.
368.	30597.	2452.	2381.
406.	33757.	2700.	2620.
446.	37082.	2980.	2878.
506.	42071.	3395.	3256.
548.	45563.	3679.	3513.
606.	50385.	4085.	3867.
666.	55374.	4500.	4228.
704.	58533.	4783.	4464.
756.	62857.	5164.	4785.
766.	63688.	5225.	4839.
778.	64686.******************************		

MAXIMUM LOAD (LB) = 778.
MAXIMUM STRESS (PSI) = 64686.
MAXIMUM N (LB/IN) = 498.
TENSILE MODULUS (MSI) = 12.82
COMPR. MODULUS (MSI) = 12.64





ECIMEN NUMBR : 1-NOH-044-1075 DATE OF TEST : 11 NOV 75

RE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

MBER OF PLYS : 1 PLY THICKNESS : 0.0078

RE DIMENSIONS: 0.771 X 2.766 X 5.172 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	493.	38.	45.
56.	4597.	367.	453.
114.	9358.	737.	885.
140.	11492.	903.	1083.
176.	14448.	1124.	1335.
210.	17239.	1323.	1567.
240.	19701.	1534.	1803.
276.	22656.	1765.	2063.
303.	24873.	1942.	2255.
338.	27746.	2170.	2607.
384.	31522.	2383.	2739.
408.	33492.	2623.	2997.
436.	35791.	2804.	3190.
466.	38253.	3005.	3404.
507.	41619.	3288.	3703.
545.	44738.	3528.	3945.
588.	48268.	3810.	4237.
626.	51388.	4078.	4512.
664.	54507.	4345.	4773.
706.	57955.	4668.	5080.
726.	59596.	4813.	5219.
744.	61074.************************************		

IMUM LOAD (LB) = 744.

IMUM STRESS (PSI) = 61074.

IMUM N (LB/IN) = 476.

SILE MODULUS (MSI) = 10.99

PR. MODULUS (MSI) = 12.54

SPECIMEN NUMBER: 1-PVC-045-1175 DATE OF TEST : 9 DEC 75

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0087

CORE DIMENSIONS: 0.680 X 2.765 X 5.125 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	500.	44.	41.
58.	4834.	438.	431.
106.	8835.	815.	795.
159.	13252.	1199.	1158.
206.	17169.	1551.	1485.
252.	21003.	1874.	1781.
306.	25504.	2262.	2132.
358.	29838.	2655.	2474.
408.	34005.	3027.	2807.
472.	39340.	3528.	3232.
508.	42340.	3824.	3484.
541.	45090.	4070.	3689.
578.	48174.	4347.	3917.
607.	50591.	4569.	4104.
646.	53847.	4872.	4357.
689.	57426.	5197.	4641.
704.	58676.************************************		

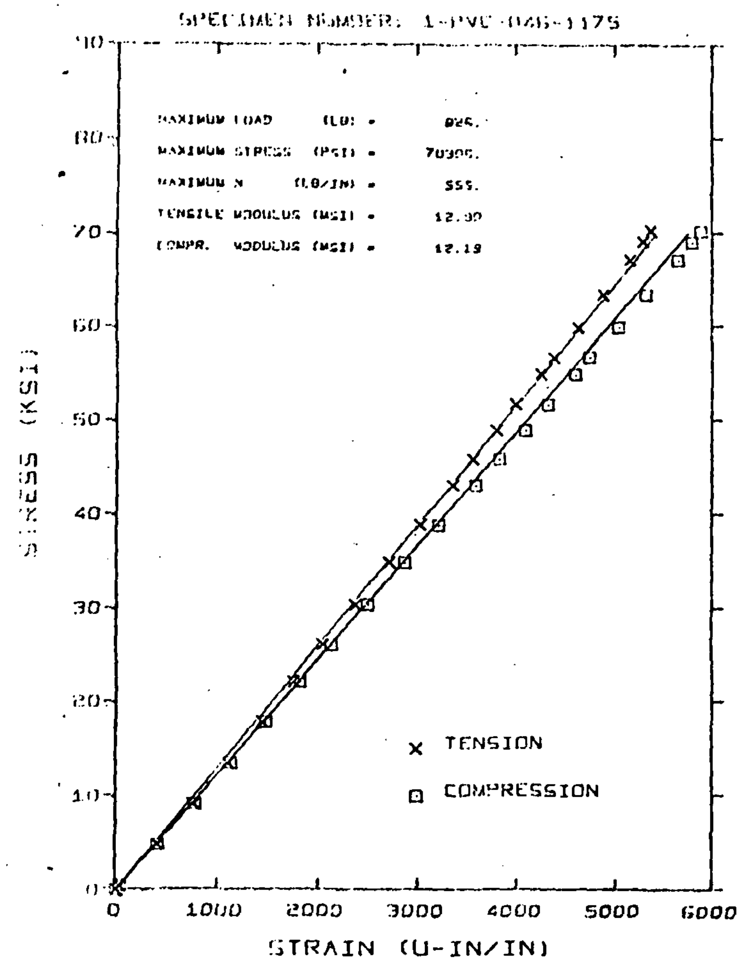
MAXIMUM LOAD (LB) = 704.

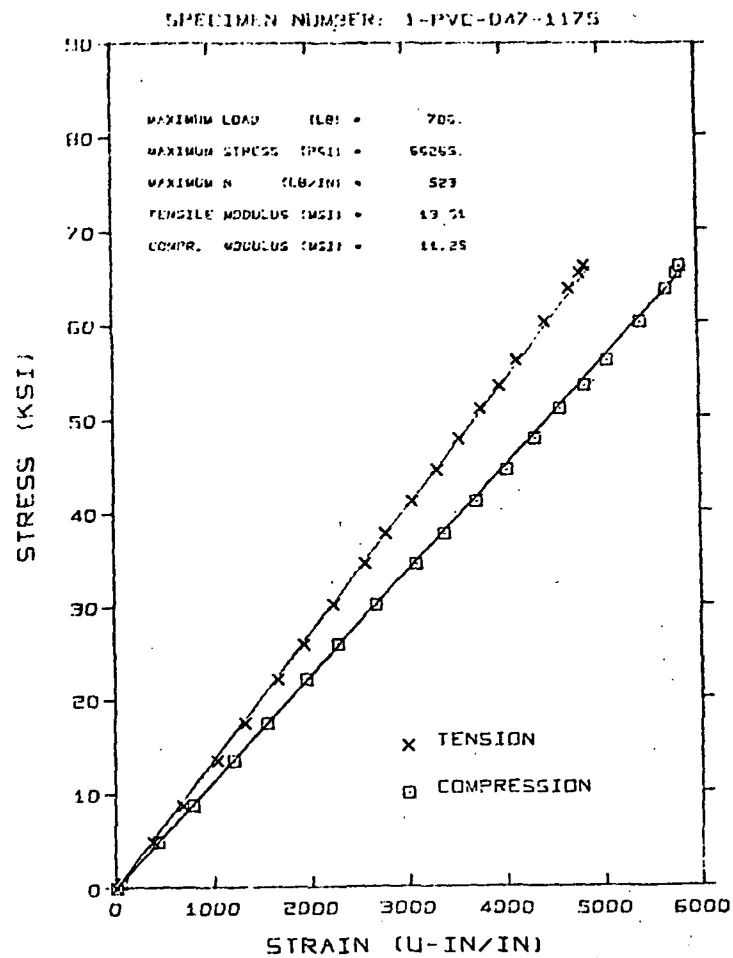
MAXIMUM STRESS (PSI) = 58676.

MAXIMUM N (LB/IN) = 510.

TENSILE MODULUS (MSI) = 12.11

COMPR. MODULUS (MSI) = 11.34





FCIMEN NUMBER: 1-PVC-046-1175 DATE OF TEST : 9 DEC 75

RE MATERIAL : RIGID PVC FOAM TYPE CF ADHESIVE: SMOOTH-ON EA-40

MBER OF PLYS : 1 PLY THICKNESS : 0.0079

RE DIMENSIONS: 0.732 X 2.773 X 5.000 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	511.	42.	40.
58.	4937.	421.	415.
107.	9107.	781.	769.
158.	13440.	1135.	1113.
210.	17874.	1490.	1453.
260.	22130.	1026.	1770.
306.	26046.	2154.	2069.
357.	30386.	2507.	2387.
409.	34812.	2876.	2724.
456.	38813.	3218.	3035.
506.	43069.	3591.	3359.
540.	45963.	3832.	3567.
576.	49027.	4097.	3803.
608.	51751.	4321.	3998.
646.	54985.	4594.	4243.
667.	56772.	4746.	4378.
706.	60092.	5044.	4636.
746.	63497.	5327.	4887.
790.	67242.	5647.	5163.
812.	69114.	5795.	5291.
826.	70306.**************************		

IMUM LOAD (LB) = 826.

IMUM STRESS (PSI) = 70306.

IMUM N (LB/IN) = 555.

SILE MODULUS (MSI) = 12.90

PR. MODULUS (MSI) = 12.19

SPECIMEN NUMBER: 1-PVC-047-1175 DATE OF TEST : 9 DEC 75

CORE MATERIAL : RIGID PVC FOAM TYPE CF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0079

CORE DIMENSIONS: 0.741 X 2.766 X 5.133 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	506.	45.	37.
58.	4890.	437.	381.
104.	8768.	794.	686.
160.	13489.	1216.	1044.
207.	17451.	1566.	1336.
263.	22173.	1962.	1662.
306.	25798.	2297.	1938.
357.	30097.	2689.	2244.
409.	34481.	3100.	2575.
447.	37685.	3386.	2801.
488.	41141.	3705.	3056.
528.	44514.	4070.	3306.
568.	47886.	4312.	3541.
605.	51005.	4576.	3751.
635.	53535.	4826.	3946.
667.	56232.	5062.	4130.
715.	60279.	5412.	4426.
756.	63736.	5682.	4674.
777.	65506.	5780.	4784.
786.	66265.**************************		

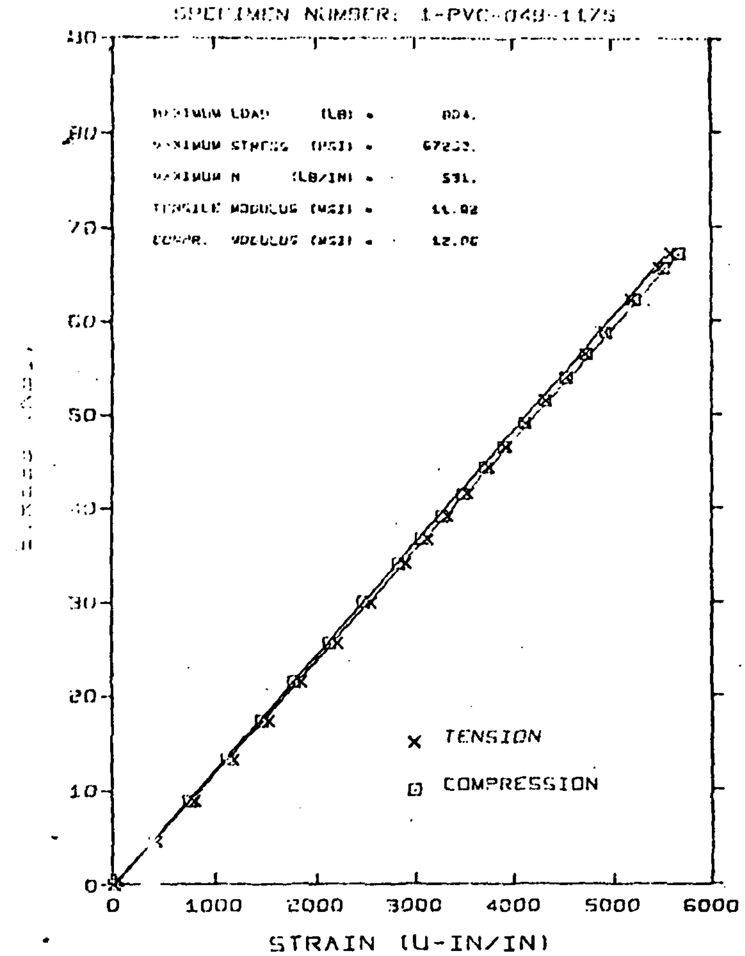
MAXIMUM LOAD (LB) = 786.

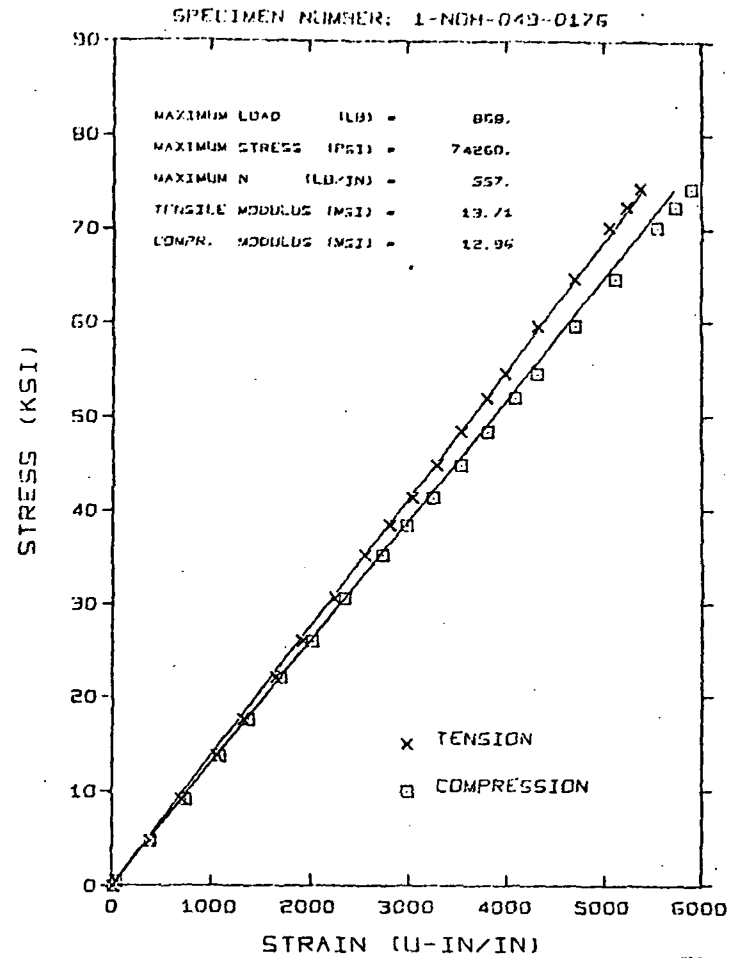
MAXIMUM STRESS (PSI) = 66265.

MAXIMUM N (LB/IN) = 523.

TENSILE MODULUS (MSI) = 13.51

COMPR. MODULUS (MSI) = 11.25





ECIMEN NUMBER: 1-PVC-048-1175 DATE OF TEST : 10 DEC 75

RE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

MBER OF PLYS : 1 PLY THICKNESS : 0.0079

DIMENSIONS: 0.745 X 2.773 X 5.070 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	502.	42.	42.
56.	4684.	406.	430.
106.	8867.	750.	804.
159.	13300.	1126.	1186.
208.	17399.	1464.	1536.
256.	21414.	1790.	1859.
306.	25596.	2132.	2214.
358.	29946.	2400.	2551.
408.	34128.	2846.	2915.
438.	36637.	3074.	3133.
468.	39147.	3278.	3332.
497.	41572.	3487.	3534.
531.	44416.	3723.	3758.
557.	46591.	3907.	3933.
587.	49101.	4111.	4124.
617.	51610.	4325.	4331.
646.	54036.	4536.	4534.
676.	56545.	4738.	4725.
704.	58887.	4946.	4928.
746.	62401.	5233.	5201.
786.	65746.	5518.	5481.
804.	67252.*************************************		

IMUM LOAD (LB) = 804.

IMUM STRESS (PSI) = 67252.

IMUM N (LB/IN) = 531.

SILE MODULUS (MSI) = 11.82

PR. MODULUS (MSI) = 12.08

SPECIMEN NUMBER: 1-NOH-049-0176 DATE OF TEST : 03 FEB 76

CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0075

CORE DIMENSIONS: 0.776 X 2.745 X 5.104 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	513.	40.	37.
56.	4791.	380.	387.
106.	9069.	750.	707.
161.	13774.	1050.	1067.
206.	17674.	1380.	1337.
258.	22073.	1720.	1667.
304.	26008.	2030.	1937.
357.	30543.	2370.	2257.
412.	35248.	2750.	2577.
449.	38413.	2990.	2317.
484.	41408.	3250.	3047.
525.	44915.	3530.	3287.
566.	48423.	3800.	3537.
608.	52016.	4080.	3787.
638.	54583.	4310.	3987.
697.	59631.	4700.	4317.
756.	64678.	5110.	4687.
820.	70154.	5550.	5057.
846.	72378.	5740.	5227.
868.	74260.*************************************		

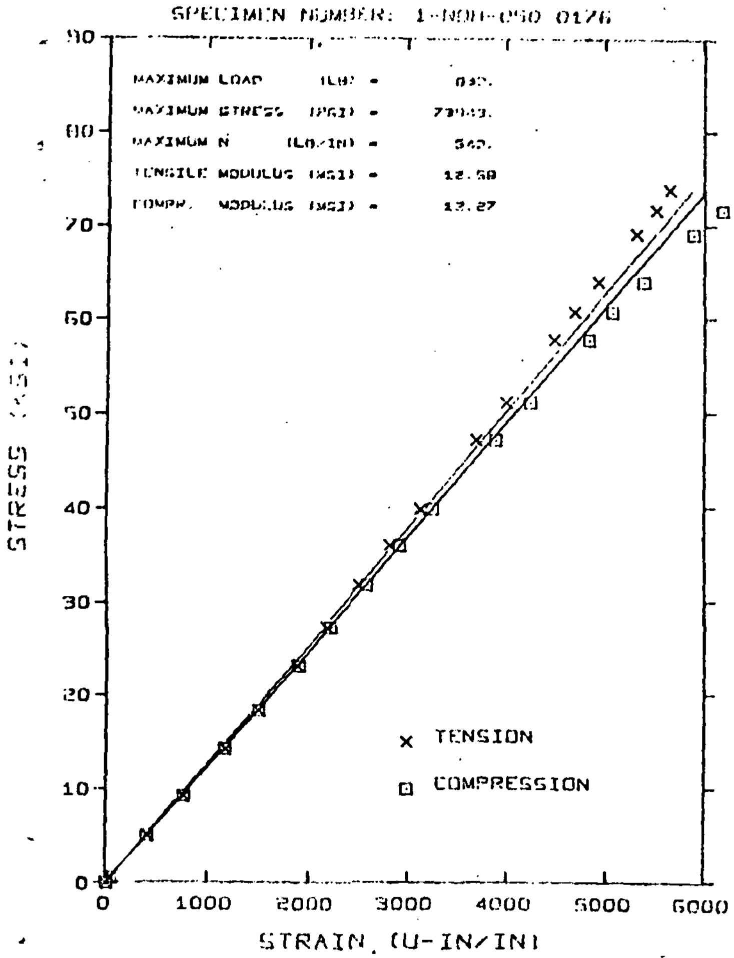
MAXIMUM LOAD (LB) = 868.

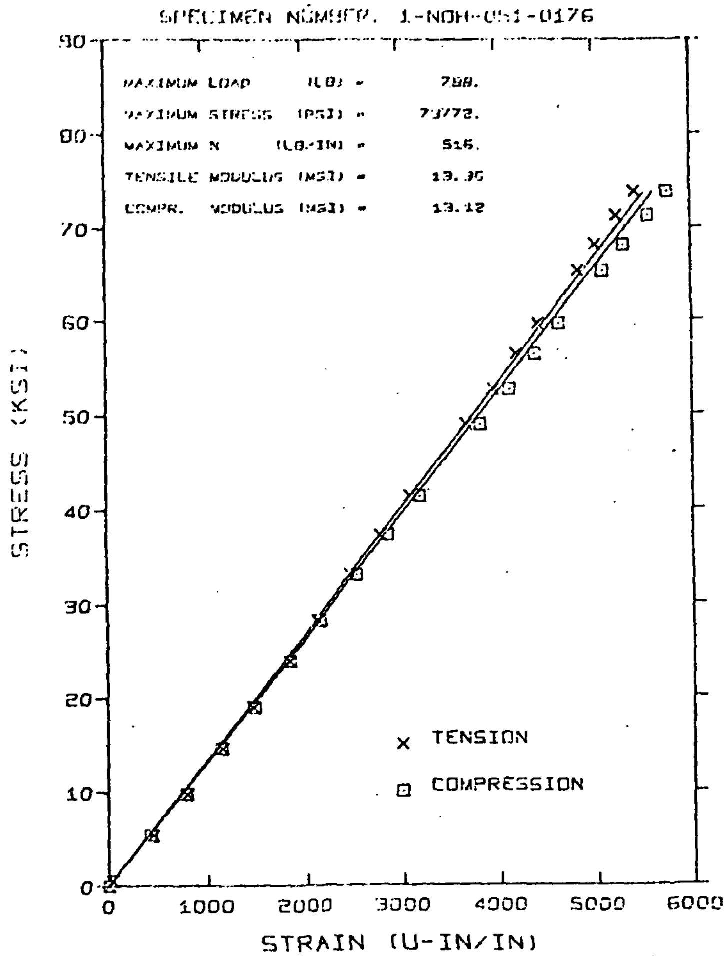
MAXIMUM STRESS (PSI) = 74260.

MAXIMUM N (LB/IN) = 557.

TENSILE MODULUS (MSI) = 13.71

COMPR. MODULUS (MSI) = 12.56





SPECIMEN NUMBER: 1-NOH-050-0176 DATE OF TEST : 03 FEB 76
CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE
NUMBER OF PLYS : 1 PLY THICKNESS : 0.0073
CORE DIMENSIONS: 0.771 X 2.725 X 5.134 INCHES

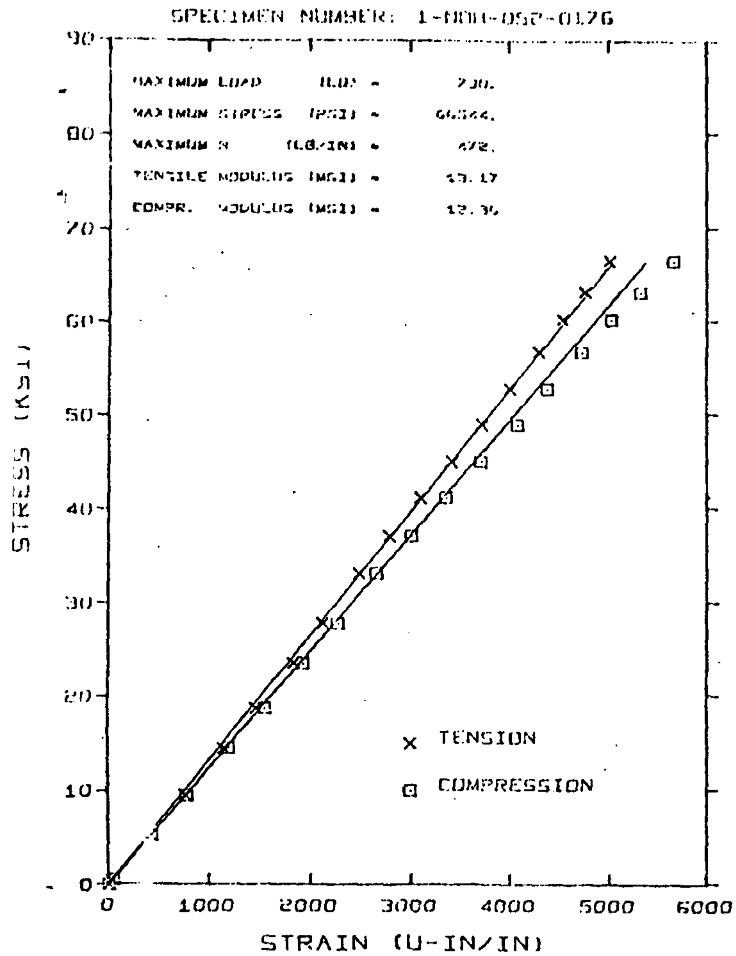
LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	535.	44.	42.
56.	4989.	404.	422.
104.	9265.	764.	772.
160.	14254.	1174.	1192.
206.	18352.	1514.	1512.
260.	23163.	1914.	1892.
306.	27261.	2234.	2192.
356.	31715.	2594.	2522.
404.	35992.	2934.	2832.
448.	39911.	3254.	3132.
530.	47217.	3854.	3692.
574.	51137.	4234.	3992.
649.	57818.	4824.	4472.
682.	60758.	5064.	4682.
718.	63965.	5384.	4932.
776.	69132.	5854.	5312.
806.	71805.	6184.	5502.
830.	73943.******************************		

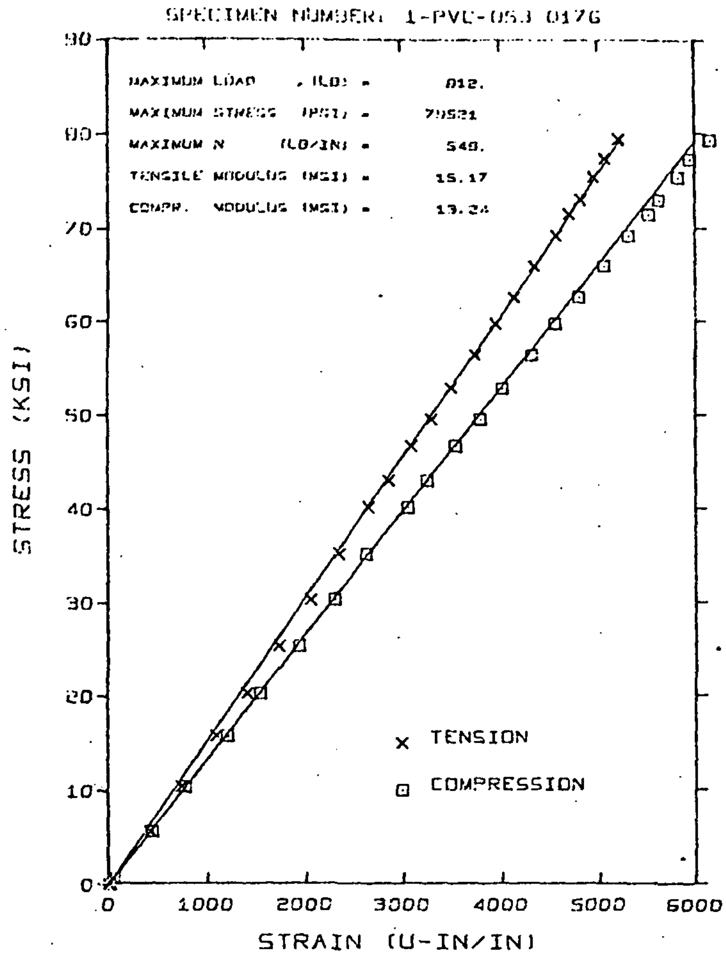
MAXIMUM LOAD (LB) = 830.
MAXIMUM STRESS (PSI) = 73943.
MAXIMUM N (LB/IN) = 540.
TENSILE MODULUS (MSI) = 12.58
COMPR. MODULUS (MSI) = 12.27

SPECIMEN NUMBER: 1-NOH-051-0176 DATE OF TEST : 03 FEB 76
CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE
NUMBER OF PLYS : 1 PLY THICKNESS : 0.0070
CORE DIMENSIONS: 0.773 X 2.734 X 5.073 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	555.	42.	42.
58.	5362.	432.	452.
106.	9799.	792.	802.
158.	14606.	1152.	1162.
206.	19044.	1482.	1482.
258.	23851.	1852.	1852.
304.	28104.	2162.	2142.
358.	33096.	2542.	2482.
404.	37348.	2872.	2792.
448.	41416.	3192.	3102.
530.	48996.	3812.	3672.
570.	52694.	4112.	3952.
610.	56392.	4362.	4192.
646.	59720.	4632.	4422.
707.	65359.	5082.	4842.
737.	68133.	5302.	5012.
770.	71183.	5552.	5232.
798.	73772.******************************		

MAXIMUM LOAD (LB) = 798.
MAXIMUM STRESS (PSI) = 73772.
MAXIMUM N (LB/IN) = 516.
TENSILE MODULUS (MSI) = 13.36
COMPR. MODULUS (MSI) = 13.12





MEN NUMBER: 1-NOH-052-0176 DATE OF TEST : 03 FEB 76

MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

OF PLYS : 1 PLY THICKNESS : 0.0071

DIMENSIONS: 0.775 X 2.727 X 5.098 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	547.	44.	42.
58.	5287.	434.	432.
105.	9571.	784.	772.
160.	14585.	1154.	1152.
206.	18778.	1554.	1482.
258.	23518.	1934.	1842.
304.	27711.	2274.	2142.
362.	32998.	2664.	2502.
406.	37009.	3014.	2802.
452.	41202.	3354.	3112.
494.	45031.	3704.	3422.
538.	49042.	4074.	3722.
580.	52870.	4384.	4012.
624.	56881.	4724.	4292.
662.	60345.	5024.	4532.
694.	63262.	5324.	4762.
730.	66544.******************************		

MUM LOAD (LB) = 730.

MUM STRESS (PSI) = 66544.

IMUM N (LB/IN) = 472.

SILE MODULUS (MSI) = 13.17

PR. MODULUS (MSI) = 12.36

SPECIMEN NUMBER: 1-PVC-053-0176 DATE OF TEST : 20 JAN 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0065

CORE DIMENSIONS: 0.744 X 2.719 X 5.128 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	588.	44.	39.
58.	5680.	444.	419.
106.	10381.	784.	749.
161.	15767.	1214.	1099.
207.	20272.	1544.	1419.
258.	25266.	1944.	1739.
308.	30163.	2304.	2069.
359.	35157.	2634.	2349.
410.	40152.	3064.	2669.
438.	42894.	3254.	2869.
476.	46615.	3544.	3099.
506.	49553.	3754.	3299.
540.	52883.	4024.	3509.
576.	56409.	4324.	3739.
610.	59738.	4554.	3949.
640.	62676.	4794.	4139.
674.	66006.	5064.	4349.
706.	69140.	5314.	4569.
730.	71490.	5514.	4709.
746.	73057.	5624.	4819.
770.	75407.	5834.	4959.
790.	77366.	5954.	5079.
812.	79520.	6154.	5219.
812.	79520.******************************		

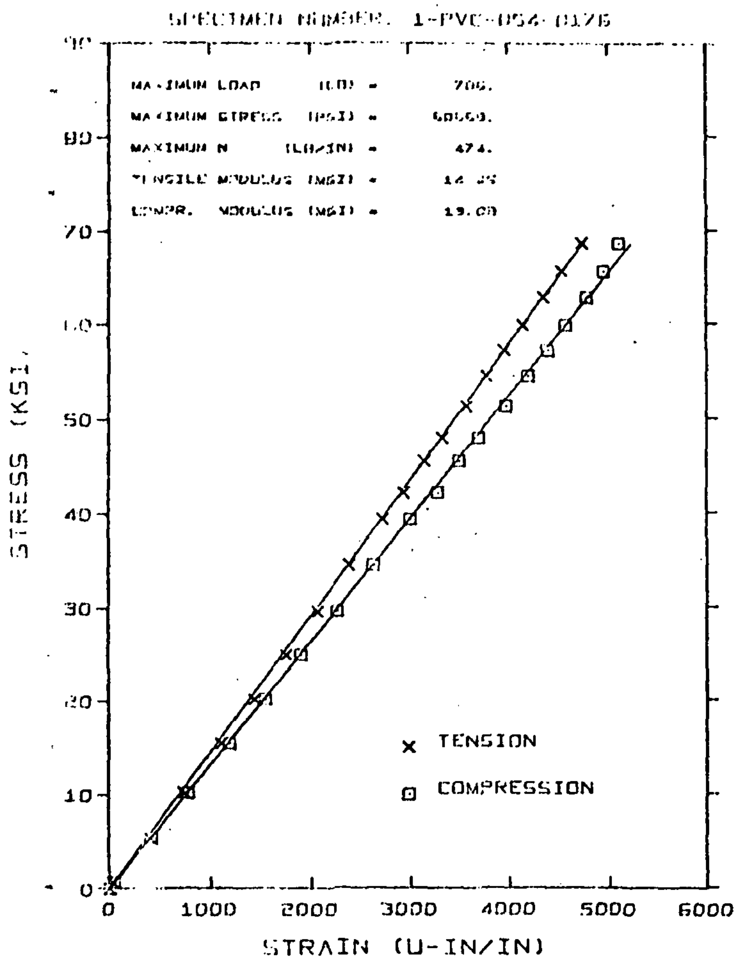
MAXIMUM LOAD (LB) = 812.

MAXIMUM STRESS (PSI) = 79520.

MAXIMUM N (LB/IN) = 549.

TENSILE MODULUS (MSI) = 15.17

COMPR. MODULUS (MSI) = 13.24



ECIMEN NUMBER: 1-PVC-054-0176 DATE OF TEST : 20 JAN 76

IE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

BER OF PLYS : 1 PLY THICKNESS : 0.0065

IE DIMENSIONS: 0.745 X 2.734 X 5.094 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	584.	45.	40.
56.	5447.	415.	410.
105.	10213.	785.	740.
158.	15368.	1195.	1110.
208.	20231.	1565.	1450.
256.	24900.	1925.	1770.
304.	29569.	2285.	2090.
354.	34432.	2635.	2400.
404.	39295.	3015.	2730.
434.	42213.	3285.	2950.
468.	45520.	3505.	3150.
493.	47952.	3695.	3330.
528.	51356.	3975.	3580.
560.	54468.	4205.	3700.
588.	57192.	4395.	3960.
616.	59915.	4575.	4150.
646.	62833.	4785.	4350.
676.	65751.	4955.	4540.
706.	68669.	5115.	4740.
706.	68665.********************************		

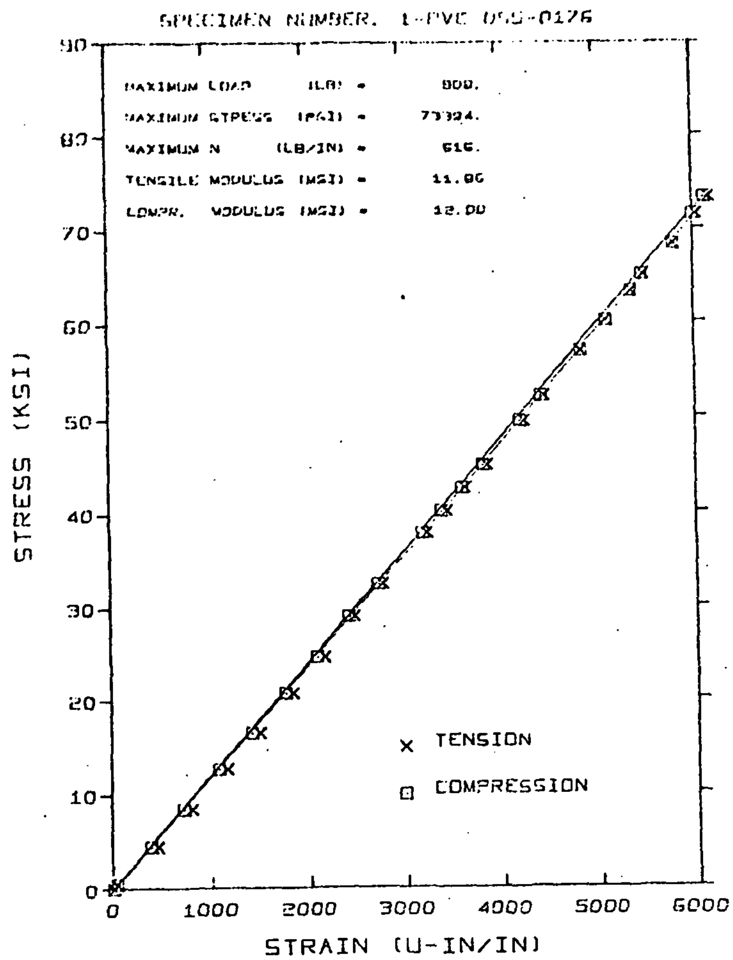
IMUM LOAD (LB) = 706.

IMUM STRESS (PSI) = 68665.

IMUM N (LB/IN) = 474.

SILE MODULUS (MSI) = 14.45

PR. MODULUS (MSI) = 13.09



SPECIMEN NUMBER: 1-PVC-055-0176 DATE OF TEST : 20 JAN 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0064

CORE DIMENSIONS: 0.736 X 2.730 X 5.125 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	485.	40.	41.
56.	4526.	400.	471.
105.	8486.	730.	811.
158.	12769.	1090.	1171.
206.	16649.	1430.	1511.
258.	20851.	1770.	1851.
306.	24731.	2100.	2181.
360.	29095.	2430.	2501.
403.	32570.	2730.	2781.
470.	37985.	3190.	3241.
498.	40248.	3330.	3441.
528.	42673.	3600.	3641.
558.	45097.	3820.	3861.
616.	49785.	4200.	4251.
648.	52371.	4410.	4451.
706.	57058.	4840.	4841.
746.	60291.	5100.	5101.
784.	63362.	5350.	5361.
806.	65140.	5470.	5491.
846.	68373.	5790.	5801.
886.	71606.	6000.	6041.
908.	73384.********************************		

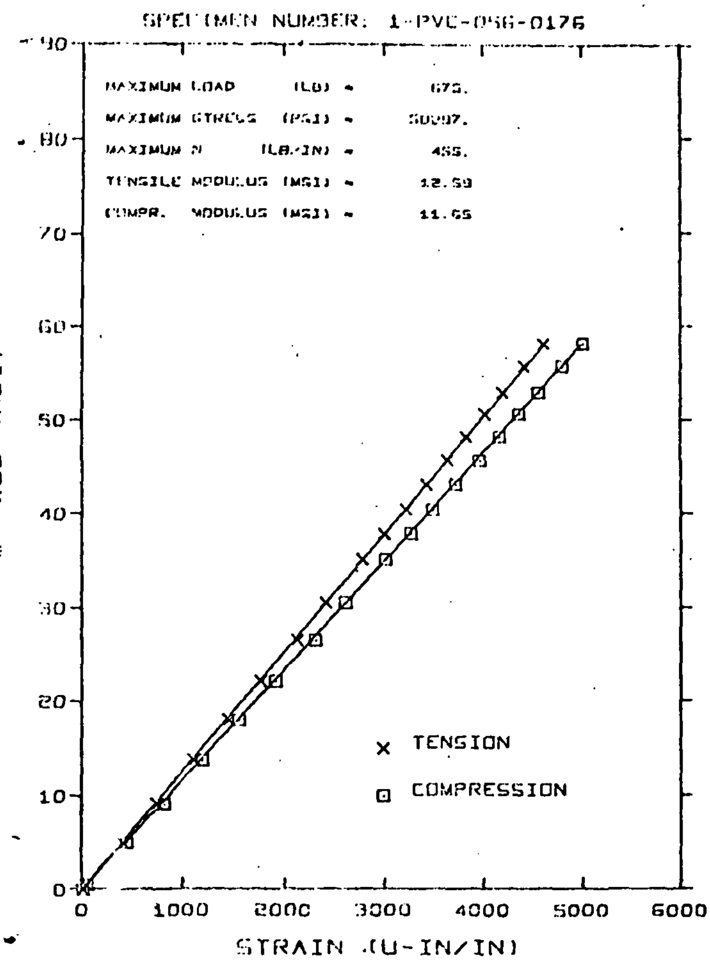
MAXIMUM LOAD (LB) = 908.

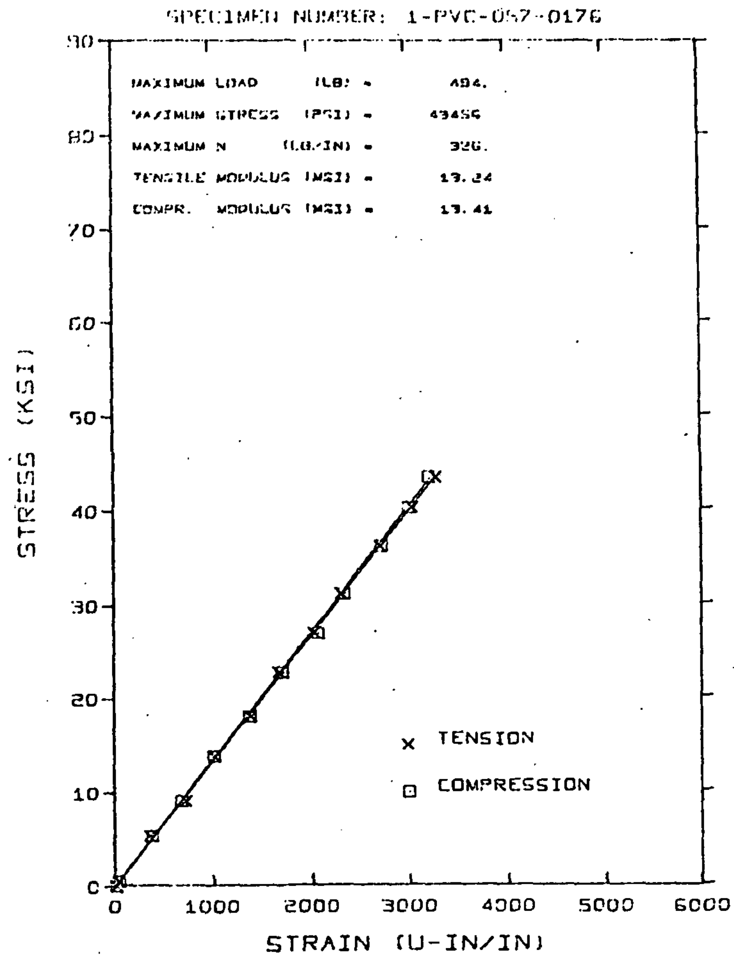
MAXIMUM STRESS (PSI) = 73384.

MAXIMUM N (LB/IN) = 616.

TENSILE MODULUS (MSI) = 11.86

COMPR. MODULUS (MSI) = 12.00





CIMEN NUMBER: 1-PVC-056-0176 DATE OF TEST : 20 JAN 76

MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

BER OF PLYS : 1 PLY THICKNESS : 0.0078

DIMENSIONS: 0.743 X 2.727 X 5.063 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	518.	44.	41.
58.	5009.	444.	411.
106.	9155.	814.	741.
160.	13819.	1204.	1121.
208.	17964.	1564.	1461.
256.	22110.	1924.	1781.
306.	26428.	2314.	2131.
353.	30487.	2614.	2421.
406.	35065.	3014.	2781.
437.	37742.	3264.	3001.
468.	40419.	3484.	3211.
499.	43097.	3724.	3421.
529.	45688.	3964.	3641.
558.	48192.	4164.	3831.
586.	50611.	4364.	4021.
614.	53029.	4554.	4201.
646.	55793.	4794.	4421.
675.	58297.******************************		

IMUM LOAD (LB) = 675.

IMUM STRESS (PSI) = 58297.

IMUM N (LB/IN) = 455.

SILE MODULUS (MSI) = 12.59

PR. MODULUS (MSI) = 11.65

SPECIMEN NUMBER: 1-PVC-057-0176 DATE OF TEST : 27 JAN 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0075

CORE DIMENSIONS: 0.739 X 2.802 X 5.168 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	528.	39.	40.
62.	5454.	379.	360.
104.	9149.	689.	730.
158.	13899.	1019.	1020.
206.	18121.	1379.	1390.
258.	22695.	1719.	1680.
306.	26918.	2079.	2040.
354.	31140.	2349.	2320.
410.	36066.	2739.	2730.
458.	40289.	3039.	3050.
494.	43456.******************************		

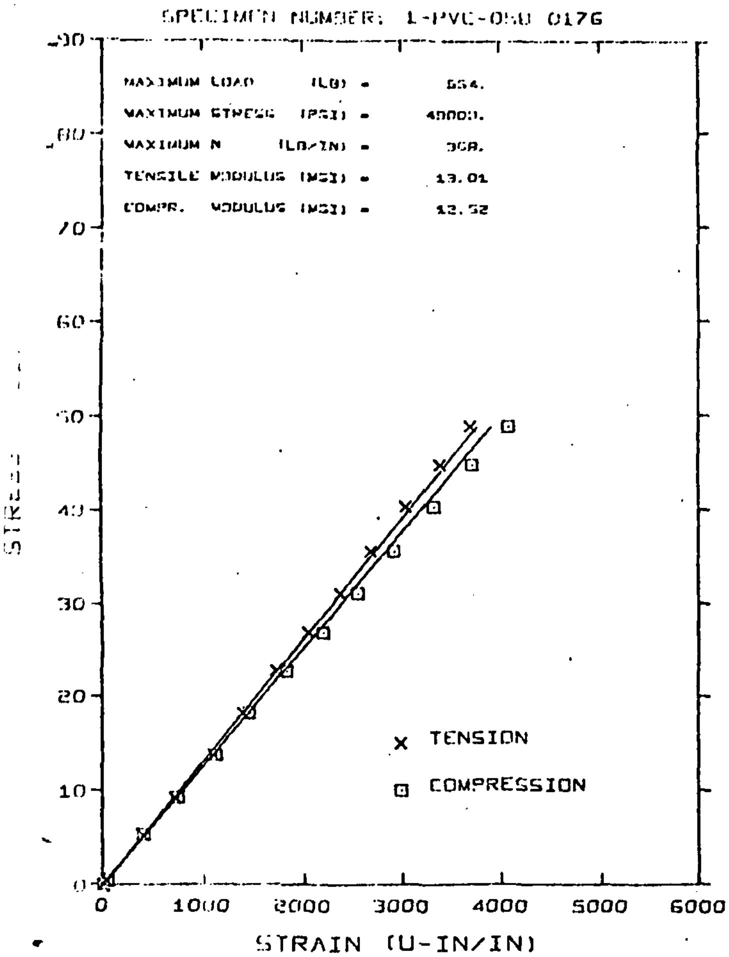
MAXIMUM LOAD (LB) = 494.

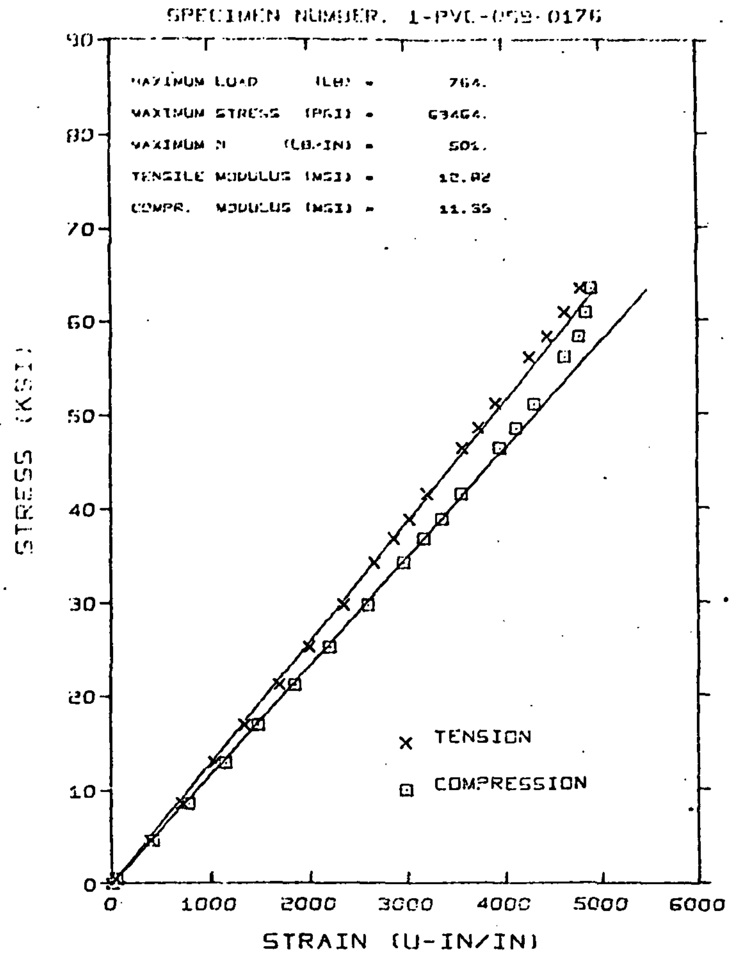
MAXIMUM STRESS (PSI) = 43456.

MAXIMUM N (LB/IN) = 326.

TENSILE MODULUS (MSI) = 13.24

COMPR. MODULUS (MSI) = 13.41





MEN NUMBER: 1 PVC-058-0176 DATE CF TEST : 27 JAN 76

MATERIAL : R GID PVC FOAM TYPE OF ADHFSIVE: SMCOTH-CN EA-40

OF PLYS : 1 PLY THICKNESS : 0.0075

DIMENSIONS: 0.736 X 2.798 X 5.132 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	531.	42.	41.
61.	5395.	412.	401.
104.	9199.	742.	721.
156.	13798.	1132.	1101.
206.	18220.	1462.	1401.
258.	22820.	1842.	1741.
304.	26888.	2202.	2061.
352.	31134.	2562.	2391.
402.	35556.	2922.	2701.
457.	40421.	3322.	3051.
508.	44932.	3722.	3391.
554.	49000.******************************		

UM LOAD (LB) = 554.

UM STRESS (PSI) = 49000.

UM N (LB/IN) = 368.

E MODULUS (MSI) = 13.01

MODULUS (MSI) = 12.52

SPECIMEN NUMBER: 1-PVC-059-0176 DATE CF TEST : 27 JAN 76

CCRE MATERIAL : RIGID PVC FOAM TYPE CF ADHESIVE: SMOCTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0075

CCRE DIMENSIONS: 0.740 X 2.811 X 5.145 INCHES

LOAD (PCUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	498.	43.	39.
56.	4657.	473.	399.
104.	8639.	783.	719.
156.	12959.	1153.	1049.
204.	16946.	1483.	1359.
256.	21265.	1863.	1699.
304.	25253.	2213.	2009.
358.	29738.	2603.	2349.
411.	34141.	2973.	2679.
442.	36716.	3183.	2879.
468.	38876.	3363.	3039.
500.	41534.	3563.	3219.
558.	46352.	3963.	3579.
585.	48595.	4123.	3739.
616.	51170.	4323.	3929.
676.	56154.	4633.	4269.
703.	58397.	4773.	4449.
734.	60977.	4843.	4629.
764.	63464.******************************		

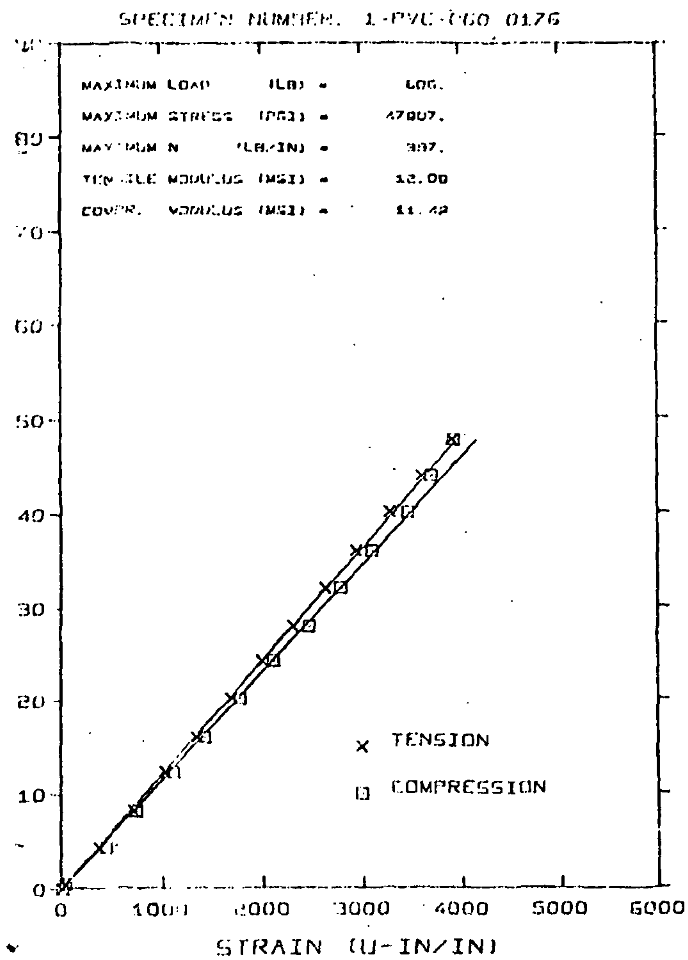
MAXIMUM LOAD (LB) = 764.

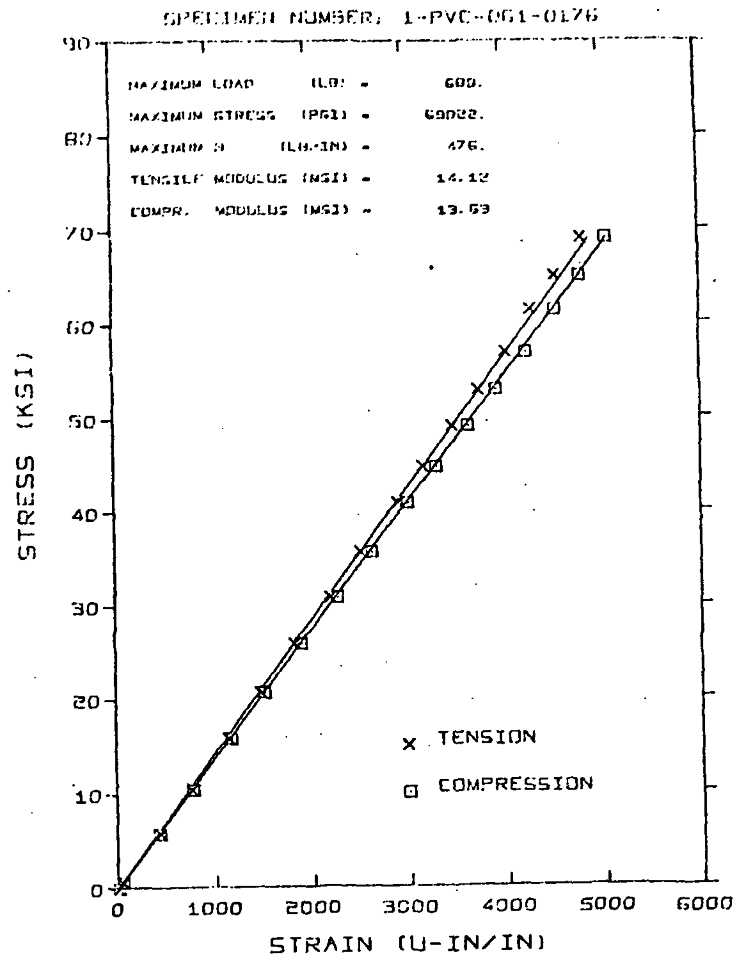
MAXIMUM STRESS (PSI) = 63464.

MAXIMUM N (LB/IN) = 501.

TENSILE MODULUS (MSI) = 12.82

COMPR. MODULUS (MSI) = 11.55





EN NUMBER: 1 PVC-060-0176 DATE OF TEST : 27 JAN 76
ATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40
OF PLYS : 1 PLY THICKNESS : 0.0063
IMENSIONS: 0.744 X 2.800 X 5.142 INCHES

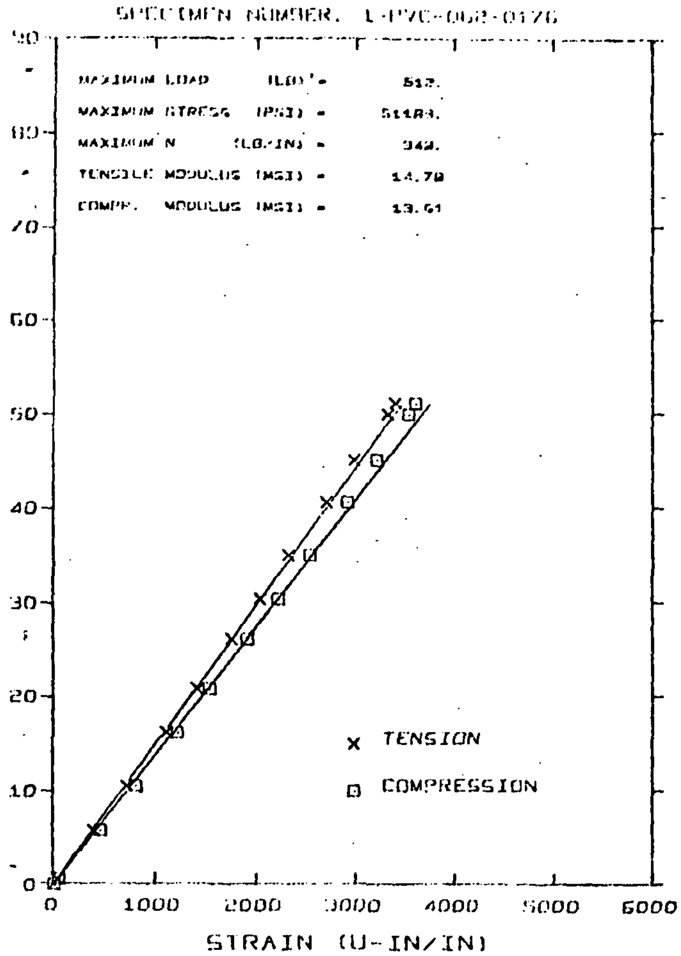
LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	473.	41.	39.
56.	4418.	441.	389.
104.	8205.	741.	719.
156.	12107.	1111.	1039.
204.	16094.	1431.	1359.
256.	20196.	1781.	1689.
306.	24140.	2111.	1999.
354.	27927.	2471.	2319.
406.	32029.	2781.	2639.
456.	35974.	3051.	2939.
508.	40076.	3451.	3279.
558.	44021.	3691.	3599.
606.	47807.******************************		

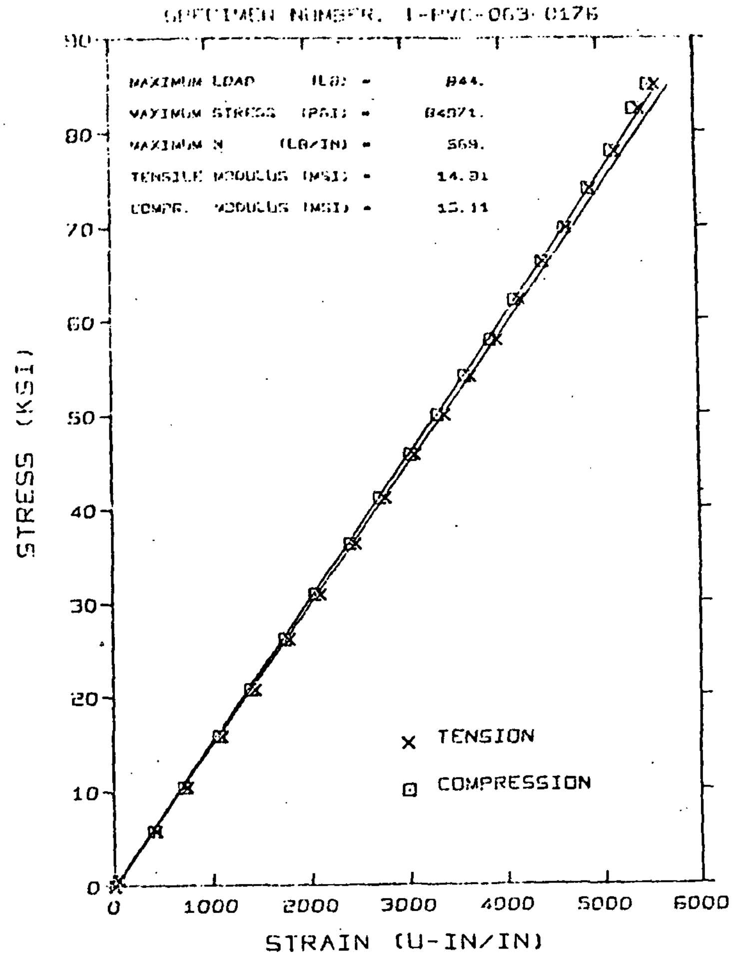
M LOAD (LB) = 606.
M STRESS (PSI) = 47807.
M N (LB/IN) = 397.
E MODULUS (MSI) = 12.08
. MODULUS (MSI) = 11.48

SPECIMEN NUMBER: 1-PVC-061-0176 DATE OF TEST : 12 FEB 76
CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40
NUMBER OF PLYS : 1 PLY THICKNESS : 0.0065
CORE DIMENSIONS: 0.739 X 2.672 X 5.140 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	602.	44.	43.
58.	5819.	434.	443.
104.	10433.	784.	773.
157.	15751.	1174.	1153.
206.	20666.	1524.	1483.
258.	25883.	1904.	1853.
306.	30699.	2284.	2203.
355.	35614.	2644.	2523.
408.	40931.	3014.	2913.
446.	44744.	3304.	3163.
490.	49158.	3624.	3463.
528.	52970.	3914.	3733.
568.	56983.	4224.	4023.
612.	61397.	4524.	4273.
648.	65009.	4774.	4523.
688.	69022.	5064.***************	

MAXIMUM LOAD (LB) = 688.
MAXIMUM STRESS (PSI) = 69022.
MAXIMUM N (LB/IN) = 476.
TENSILE MODULUS (MSI) = 14.12
COMPR. MODULUS (MSI) = 13.63





CN NUMBER: 1-PVC-062-0176 DATE OF TEST : 12 FEB 76

MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

OF PLYS : 1 PLY THICKNESS : 0.0068

DIMENSIONS: 0.741 X 2.713 X 5.198 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	600.	44.	41.
58.	5799.	464.	411.
105.	10498.	814.	731.
162.	16196.	1224.	1111.
208.	20795.	1544.	1431.
261.	26094.	1924.	1761.
304.	30393.	2234.	2051.
350.	34992.	2544.	2331.
407.	40691.	2914.	2711.
451.	45090.	3214.	2991.
500.	49989.	3524.	3321.
512.	51189.*******************************		

M LOAD (LB) = 512.

M STRESS (PSI) = 51189.

M N (LB/IN) = 348.

MODULUS (MSI) = 14.78

MODULUS (MSI) = 13.61

SPECIMEN NUMBER: 1-PVC-063-0176 DATE OF TEST : 12 FEB 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0067

CORE DIMENSIONS: 0.742 X 2.734 X 5.123 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	604.	40.	41.
58.	5839.	410.	431.
104.	10470.	720.	751.
157.	15806.	1080.	1111.
206.	20739.	1410.	1451.
259.	26075.	1750.	1801.
306.	30807.	2070.	2121.
360.	36244.	2420.	2481.
409.	41177.	2740.	2791.
454.	45707.	3050.	3101.
497.	50036.	3330.	3391.
538.	54164.	3600.	3661.
576.	57990.	3870.	3931.
618.	62218.	4120.	4171.
658.	66245.	4400.	4421.
694.	69870.	4630.	4661.
734.	73897.	4890.	4911.
774.	77924.	5140.	5181.
818.	82354.	5380.	5441.
844.	84971.*******************************		

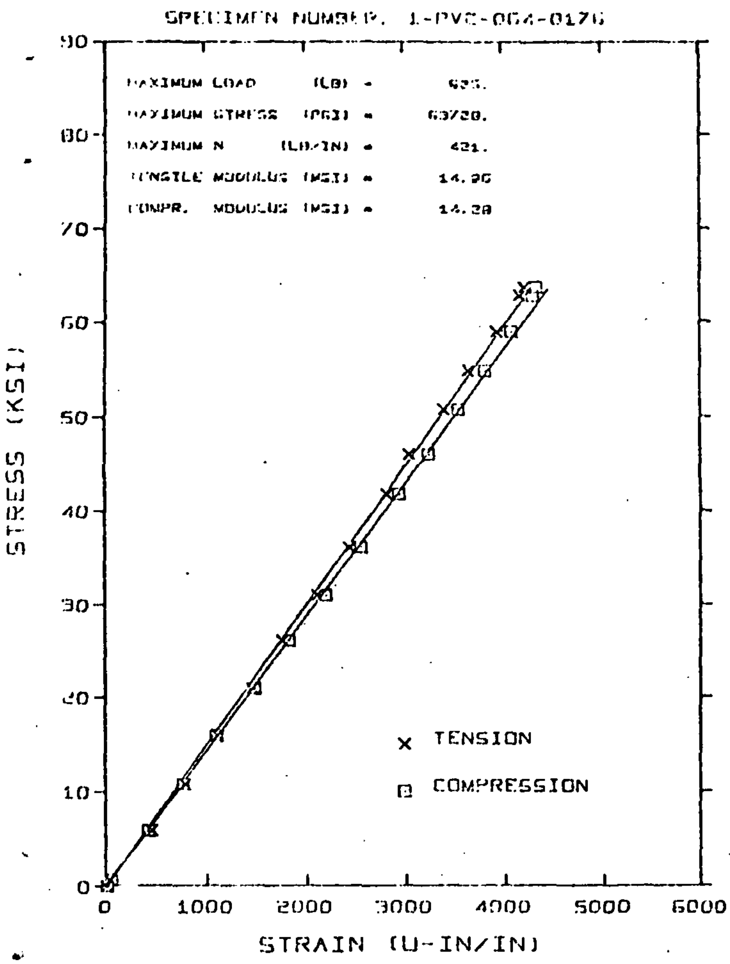
MAXIMUM LOAD (LB) = 844.

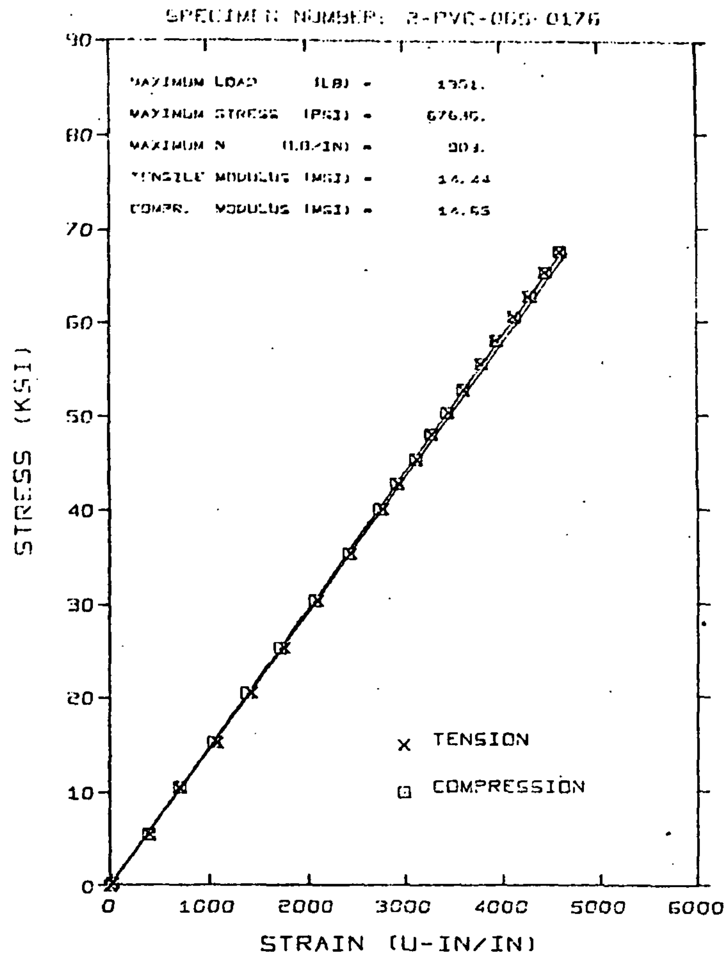
MAXIMUM STRESS (PSI) = 84971.

MAXIMUM N (LB/IN) = 569.

TENSILE MODULUS (MSI) = 14.81

COMPR. MODULUS (MSI) = 15.11





IMEN NUMBER: 1-PVC-064-0176 DATE OF TEST : 12 FEB 76

MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SHOOTH-ON EA-40

MBER OF PLYS : 1 PLY THICKNESS : 0.0066

RE DIMENSIONS: 0.742 X 2.740 X 5.172 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	612.	43.	41.
58.	5914.	423.	461.
106.	10808.	773.	791.
156.	15907.	1103.	1121.
206.	21005.	1493.	1461.
256.	26103.	1833.	1771.
304.	30997.	2203.	2121.
354.	36096.	2553.	2451.
410.	41806.	2943.	2821.
452.	46088.	3243.	3051.
498.	50779.	3543.	3401.
538.	54857.	3813.	3651.
579.	59038.	4083.	3931.
617.	62912.	4293.	4161.
625.	63778.******************************		

AXIMUM LOAD (LB) = 625.

AXIMUM STRESS (PSI) = 63728.

AXIMUM N (LB/IN) = 421.

ENSILE MODULUS (MSI) = 14.86

OMPR. MODULUS (MSI) = 14.78

SPECIMEN NUMBER: 2-PVC-065-0176 DATE OF TEST : 19 FEB 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMCCTH-ON EA-40

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0133

CORE DIMENSIONS: 0.735 X 2.758 X 5.166 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	300.	21.	21.
111.	5557.	401.	411.
211.	10563.	711.	711.
306.	15320.	1051.	1091.
411.	20576.	1391.	1441.
506.	25332.	1731.	1781.
605.	30339.	2071.	2111.
706.	35345.	2431.	2461.
801.	40101.	2751.	2781.
856.	42855.	2931.	2951.
906.	45358.	3121.	3131.
961.	48111.	3281.	3291.
1006.	50364.	3431.	3451.
1056.	52667.	3601.	3611.
1111.	55621.	3791.	3781.
1161.	58124.	3951.	3941.
1211.	60627.	4131.	4111.
1256.	62880.	4291.	4271.
1306.	65383.	4451.	4441.
1351.	67636.******************************		

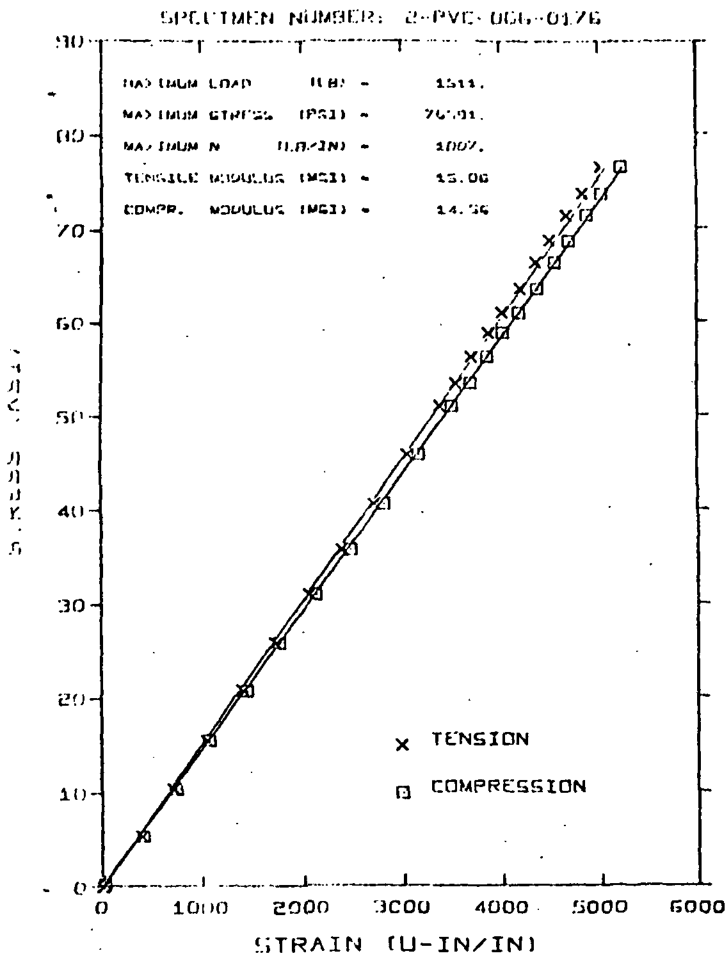
MAXIMUM LOAD (LB) = 1351.

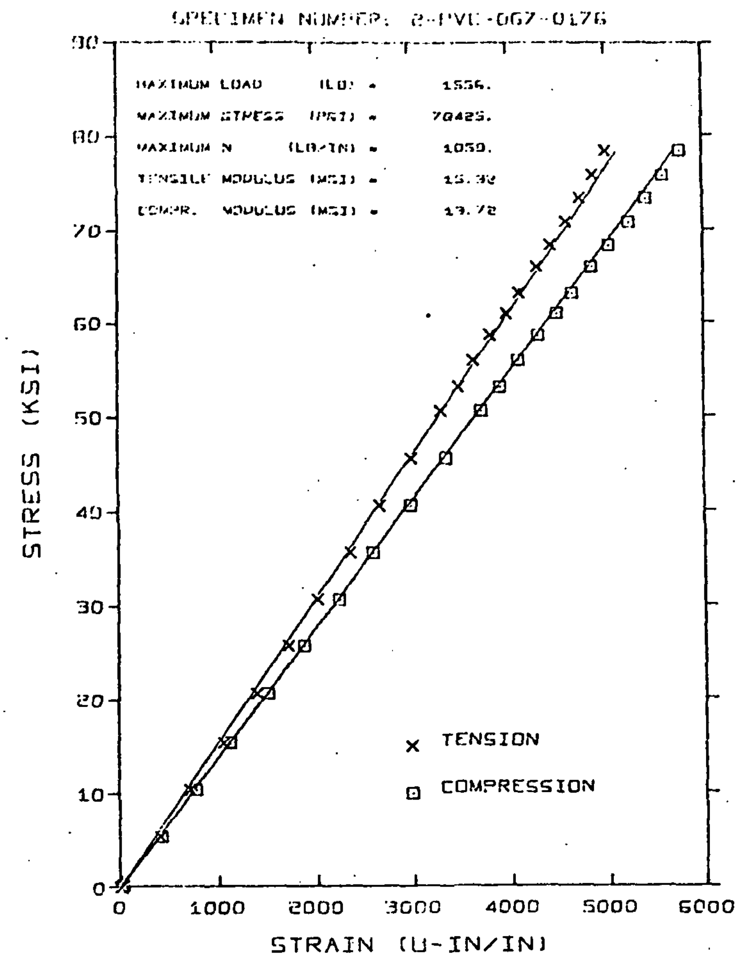
MAXIMUM STRESS (PSI) = 67636.

MAXIMUM N (LB/IN) = 903.

TENSILE MODULUS (MSI) = 14.44

COMPR. MODULUS (MSI) = 14.65





MEN NUMBER: -PVC-066-0176 DATE OF TEST : 19 FEB 76

MATERIAL : IGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

OF PLYS : PLY THICKNESS : 0.0131

DIMENSIONS: 0.740 X 2.750 X 5.145 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	304.	21.	20.
106.	5373.	411.	400.
206.	10442.	741.	720.
306.	15511.	1081.	1060.
411.	20833.	1451.	1420.
511.	25902.	1781.	1740.
611.	30971.	2131.	2070.
706.	35786.	2481.	2400.
801.	40602.	2821.	2720.
906.	45924.	3171.	3060.
1006.	50993.	3531.	3380.
1056.	53527.	3691.	3550.
1111.	56315.	3661.	3710.
1161.	58850.	4021.	3870.
1206.	61131.	4191.	4020.
1256.	63665.	4371.	4200.
1311.	66453.	4551.	4350.
1356.	68734.	4651.	4500.
1411.	71522.	4871.	4670.
1456.	73804.	5031.	4830.
1511.	76591.********************************		

UM LOAD (LB) = 1511.

UM STRESS (PSI) = 76551.

UM N (LB/IN) = 1007.

MODULUS (MSI) = 15.08

MODULUS (MSI) = 14.56

SPECIMEN NUMBER: 2-PVC-067-0176 DATE OF TEST : 19 FEB 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0135

CORE DIMENSIONS: 0.736 X 2.706 X 5.142 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	302.	22.	20.
106.	5343.	422.	410.
206.	10383.	782.	720.
306.	15423.	1132.	1070.
411.	20715.	1512.	1410.
511.	25755.	1882.	1730.
606.	30543.	2242.	2030.
706.	35584.	2602.	2360.
806.	40624.	2982.	2680.
906.	45664.	3352.	3000.
1006.	50704.	3702.	3300.
1056.	53224.	3902.	3480.
1111.	55996.	4092.	3640.
1166.	58768.	4292.	3810.
1211.	61037.	4482.	3970.
1256.	63305.	4642.	4100.
1311.	66077.	4852.	4230.
1356.	68345.	5032.	4430.
1406.	70865.	5232.	4580.
1456.	73385.	5412.	4730.
1506.	75905.	5592.	4870.
1556.	78425.********************************		

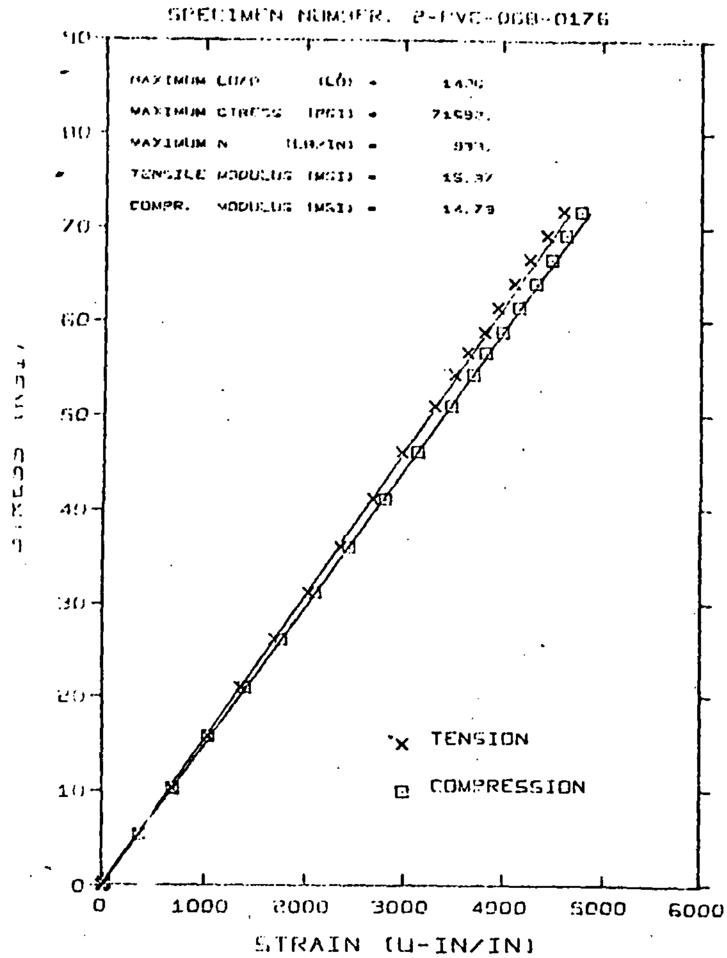
MAXIMUM LOAD (LB) = 1556.

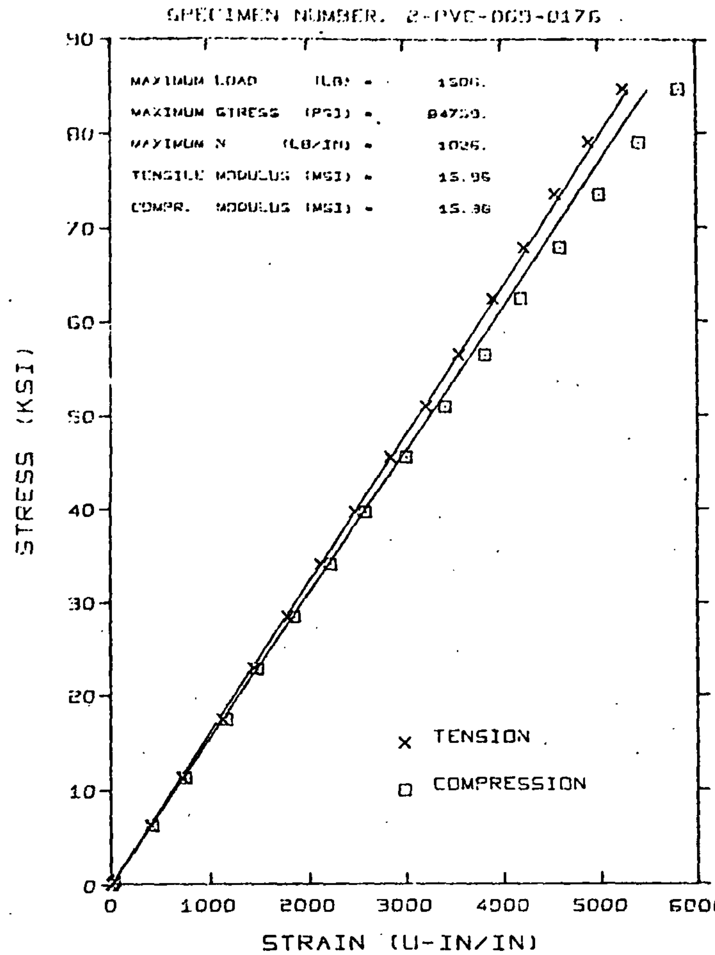
MAXIMUM STRESS (PSI) = 78425.

MAXIMUM N (LB/IN) = 1059.

TENSILE MODULUS (MSI) = 15.32

COMPR. MODULUS (MSI) = 13.72





MEN NUMBER: -PVC-068-0176   DATE OF TEST : 19 FEB 76

MATERIAL : IGID PVC FOAM   TYPE OF ADHESIVE: SMOOTH-ON EA-40

N OF PLYS :   PLY THICKNESS : 0.0131

DIMENSIONS: 0.740 X 2.744 X 5.181 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	306.	21.	20.
106.	5405.	371.	370.
201.	10249.	691.	709.
311.	15858.	1041.	1040.
411.	20957.	1401.	1370.
511.	26056.	1761.	1700.
611.	31155.	2131.	2040.
706.	35999.	2451.	2360.
806.	41098.	2811.	2690.
906.	46197.	3131.	2900.
1001.	51041.	3471.	3300.
1066.	54356.	3691.	3510.
1111.	56650.	3821.	3640.
1156.	58945.	3981.	3800.
1206.	61494.	4151.	3940.
1256.	64044.	4321.	4110.
1306.	66593.	4471.	4260.
1356.	69143.	4621.	4430.
1406.	71692.**************************		

M LOAD (LB) = 1406.

M STRESS (PSI) = 71692.

M N (LB/IN) = 939.

MODULUS (PSI) = 15.37

MODULUS (MSI) = 14.73

SPECIMEN NUMBER: 2-PVC-069-0176   DATE OF TEST : 13 APR 76

CORE MATERIAL : RIGID PVC FOAM   TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 2   PLY THICKNESS : 0.0121

CORE DIMENSIONS: 0.739 X 2.703 X 5.167 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	338.	22.	21.
111.	6247.	422.	411.
201.	11312.	752.	731.
311.	17503.	1172.	1141.
406.	22855.	1492.	1451.
505.	28478.	1862.	1801.
606.	34106.	2232.	2141.
706.	39734.	2602.	2491.
811.	45644.	3012.	2861.
906.	50990.	3412.	3221.
1006.	56619.	3812.	3551.
1111.	62528.	4192.	3901.
1206.	67875.	4592.	4221.
1306.	73503.	5002.	4551.
1406.	79131.	5412.	4901.
1506.	84759.******************************		

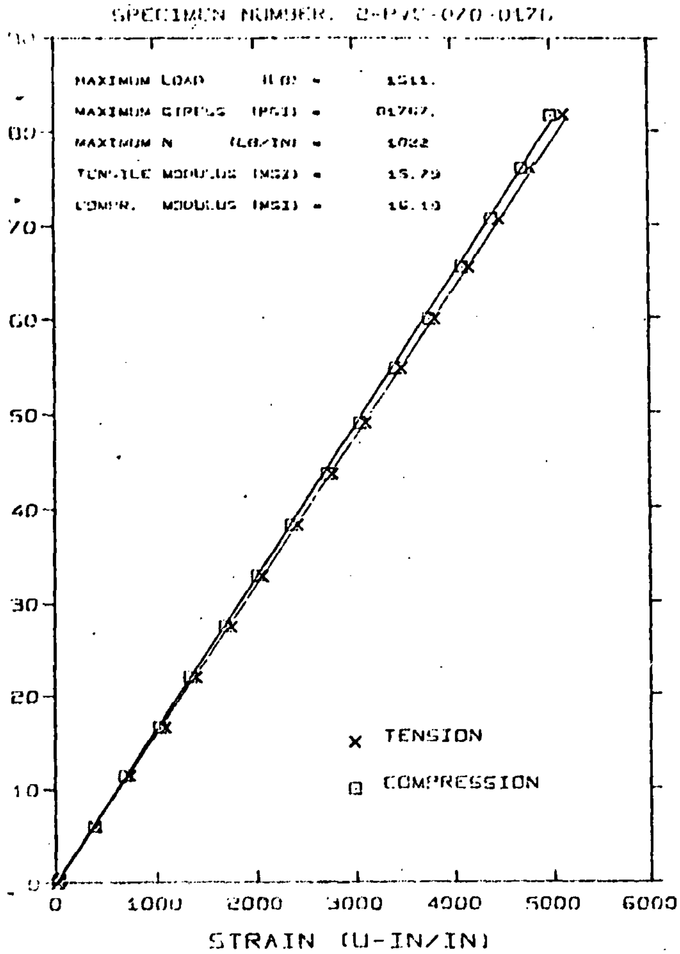
MAXIMUM LOAD (LB) = 1506.

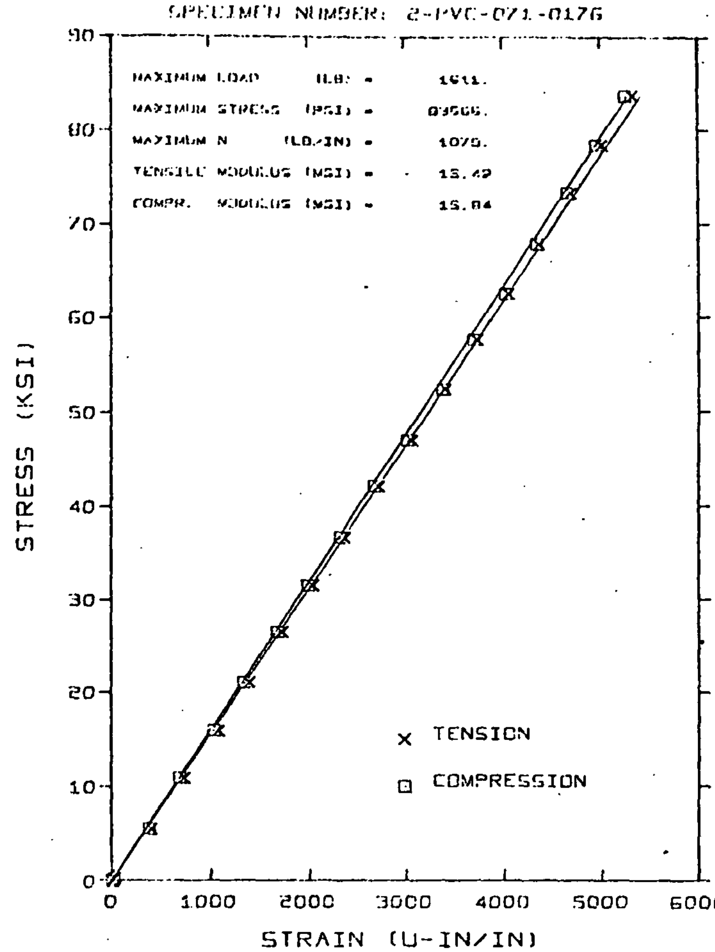
MAXIMUM STRESS (PSI) = 84759.

MAXIMUM N (LB/IN) = 1026.

TENSILE MODULUS (MSI) = 15.96

COMPR. MODULUS (MSI) = 15.38





MEN NUMBER: 2-PVC-07 -0176 DATE OF TEST : 13 APR 76

MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

R OF PLYS : 2 PLY THICKNESS : 0.0125

DIMENSIONS: (.734 X 2.734 X 5.164 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	325.	20.	21.
111.	6017.	383.	401.
211.	11418.	700.	741.
306.	16559.	1040.	1101.
406.	21971.	1361.	1421.
506.	27382.	1700.	1761.
606.	32794.	2033.	2081.
706.	38205.	2370.	2431.
806.	43616.	2730.	2781.
906.	49028.	3061.	3121.
1011.	54710.	3470.	3481.
1109.	60013.	3760.	3811.
1211.	65533.	4097.	4161.
1306.	70674.	4390.	4481.
1406.	76085.	4700.	4791.
1511.	81767.	5000.	5131.
1511.	81767.******************************		

UM LOAD (LB) = 1511.

UM STRESS (PSI) = 81767.

UM N (LB/IN) = 1022.

LE MODULUS (MSI) = 15.79

. MODULUS (MSI) = 16.19

SPECIMEN NUMBER: 2-PVC-071-0176 DATE OF TEST : 13 APR 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0129

CORE DIMENSIONS: 0.737 X 2.745 X 5.165 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	312.	20.	20.
106.	5505.	387.	410.
211.	10958.	700.	740.
306.	15892.	1050.	1090.
406.	21085.	1350.	1400.
511.	26538.	1690.	1740.
606.	31472.	2020.	2050.
706.	36666.	2330.	2390.
811.	42119.	2697.	2740.
906.	47052.	3030.	3070.
1011.	52506.	3380.	3410.
1111.	57699.	3700.	3730.
1206.	62633.	4020.	4050.
1306.	67826.	4340.	4370.
1411.	73279.	4660.	4690.
1511.	78473.	4960.	5010.
1611.	83666.	5250.***************	

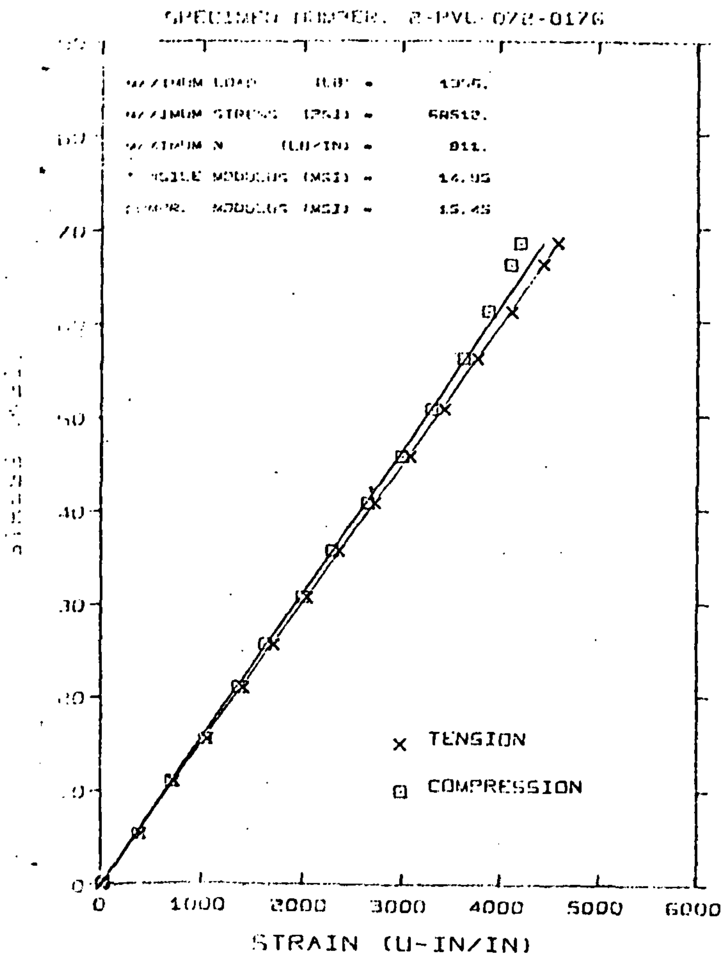
MAXIMUM LOAD (LB) = 1611.

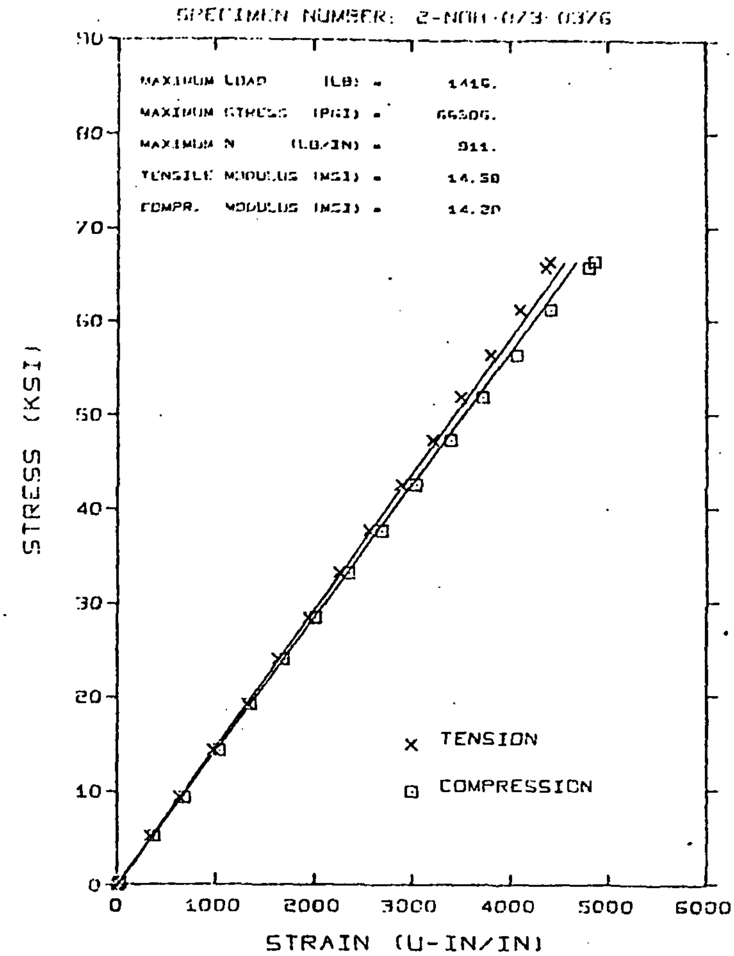
MAXIMUM STRESS (PSI) = 83666.

MAXIMUM N (LB/IN) = 1079.

TENSILE MODULUS (MSI) = 15.48

COMPR. MODULUS (MSI) = 15.84





CIMEN NUMBER: 2-PVC-072-0176 DATE OF TEST : 13 APR 76

E MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

BER OF PLYS : 2 PLY THICKNESS : 0.0133

DIMENSIONS: 0.735 X 2.744 X 5.158 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	303.	20.	20.
106.	5356.	370.	390.
216.	10913.	710.	730.
306.	15461.	1040.	1070.
416.	21019.	1309.	1430.
506.	25566.	1650.	1730.
606.	30618.	2009.	2050.
706.	35671.	2311.	2380.
806.	40723.	2660.	2740.
906.	45776.	3009.	3080.
1006.	50829.	33[illegible].	3430.
1111.	56134.	3620.	3770.
1211.	61186.	3885.	4110.
1311.	66239.	4100.	4440.
1356.	68512.******************************		

IMUM LOAD (LB) = 1356.

IMUM STRESS (PSI) = 68512.

IMUM N (LB/IN) = 911.

SILE MODULUS (MSI) = 14.95

PR. MODULUS (MSI) = 15.45

SPECIMEN NUMBER: 2-NOH-073-0376 DATE OF TEST : 30 MAR 76

CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0137

CORE DIMENSIONS: 0.777 X 2.711 X 5.164 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	282.	20.	19.
111.	5213.	370.	339.
201.	9445.	690.	639.
306.	14372.	1040.	989.
411.	19304.	1360.	1329.
511.	240[illegible]0.	1695.	1639.
606.	28462.	2020.	1959.
706.	33159.	235[illegible].	2259.
801.	37621.	2700.	2569.
906.	42553.	3040.	2989.
1008.	47343.	338[illegible].	3199.
1106.	51946.	3710.	3489.
1203.	56502.	4060.	3789.
1308.	61342.	4410.	4089.
1401.	65801.	4800.	4359.
1416.	665[illegible]6.******************************		

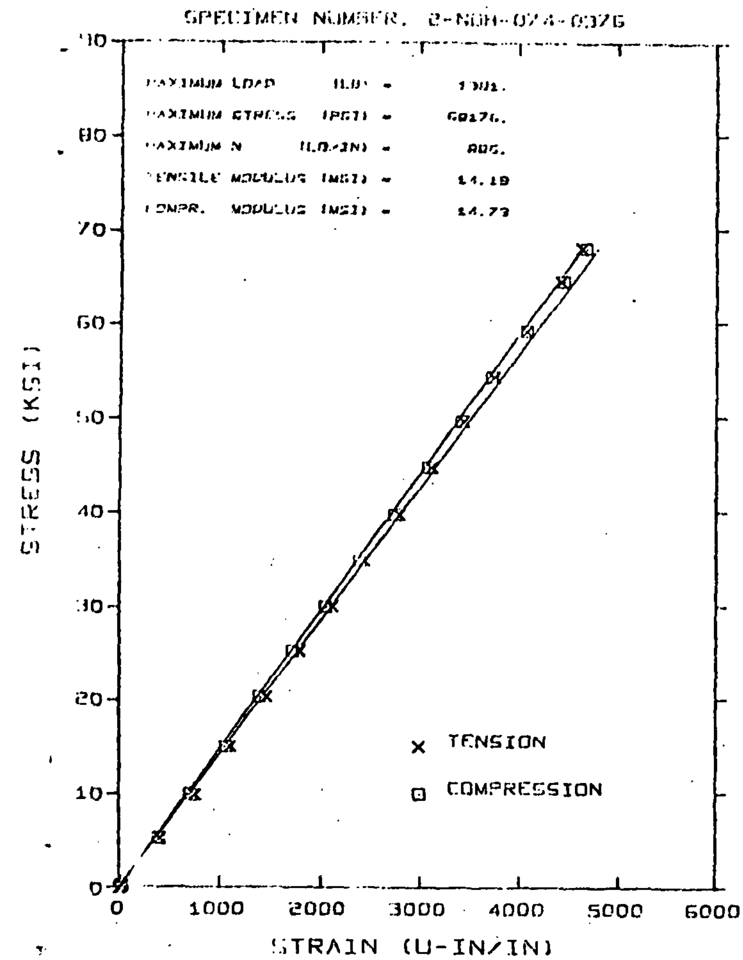
MAXIMUM LOAD (LB) = 1416.

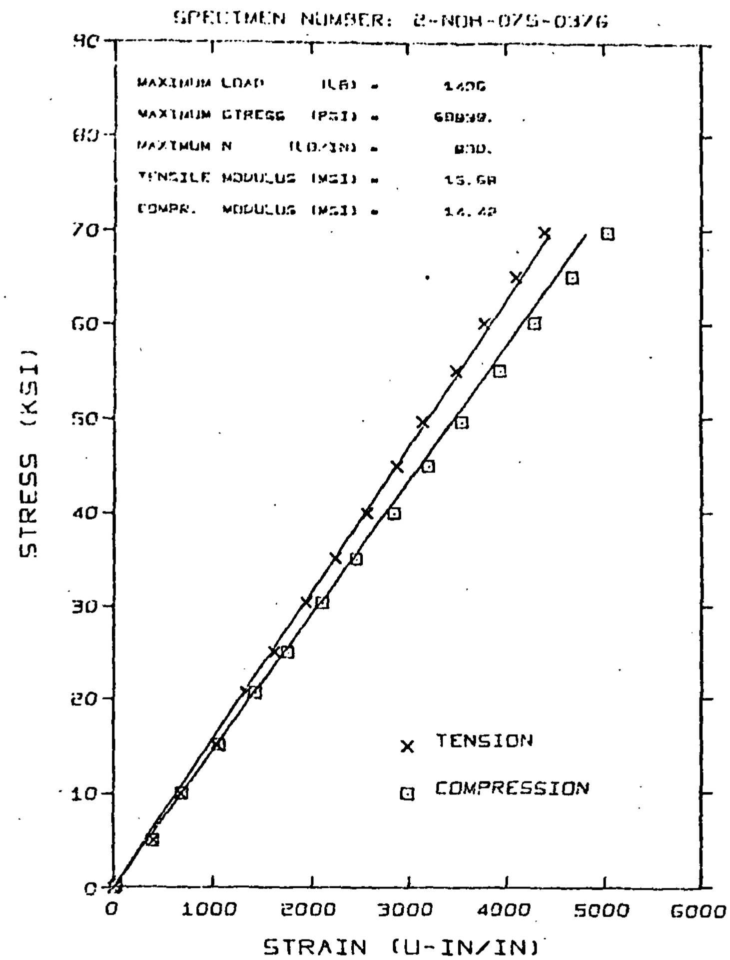
MAXIMUM STRESS (PSI) = 66506.

MAXIMUM N (LB/IN) = 911.

TENSILE MODULUS (MSI) = 14.58

COMPR. MODULUS (MSI) = 14.23





N NUMBER: 2-NOH-074-0376   DATE OF TEST : 30 MAR 76

TERIAL : 44 NOMEX HONEYCOMB   TYPE OF ADHESIVE: FILM ADHESIVE

OF PLYS : 2   PLY THICKNESS : 0.0130

IMENSIONS: 0.779 X 2.714 X 5.094 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	296.	21.	21.
106.	5233.	390.	411.
201.	9923.	710.	751.
306.	15106.	1070.	1111.
411.	20290.	1400.	1471.
511.	25227.	1730.	1801.
608.	30015.	2050.	2121.
706.	34853.	[illegible]	2451.
806.	39795.	2750.	2791.
906.	44726.	3080.	3121.
1006.	49663.	342[illegible]	3441.
1101.	54353.	3730.	3751.
1201.	59290.	4080.	4001.
1308.	64572.	4440.	4411.
1381.	68176.******************************		

MUM LOAD (LB) = 1391.

MUM STRESS (PSI) = 68176.

MUM N (LB/IN) = 886.

SILE MODULUS (MSI) = 14.19

R. MODULUS (MSI) = 14.73

SPECIMEN NUMBER: 2-NOH-075-0376   DATE OF TEST : 30 MAR 76

CORE MATERIAL : 40 NOMEX HONEYCOMB   TYPE OF ADHESIVE: FILM ADHESIVE

NUMBER OF PLYS : 2   PLY THICKNESS : 0.0127

CORE DIMENSIONS: 0.795 X 2.695 X 5.125 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	298.	21.	19.
101.	5017.	391.	409.
201.	9984.	791.	689.
306.	15199.	1071.	1039.
416.	20663.	1441.	1349.
506.	25134.	1761.	1629.
611.	30349.	2111.	1959.
706.	35068.	2461.	2239.
806.	40035.	2851.	2579.
906.	45002.	3191.	2879.
1003.	49820.	3541.	3149.
1111.	55185.	3921.	3479.
1211.	60152.	4281.	3769.
1311.	65119.	4671.	4089.
1406.	69837.******************************		

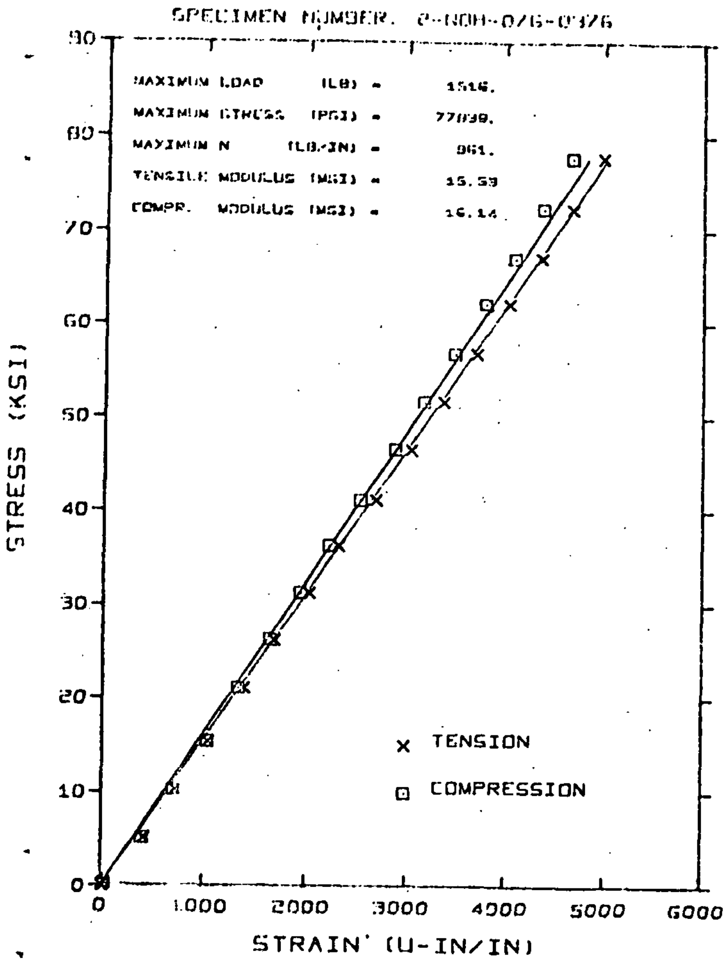
MAXIMUM LOAD (LB) = 1406.

MAXIMUM STRESS (PSI) = 69837.

MAXIMUM N (LB/IN) = 890.

TENSILE MODULUS (MSI) = 15.68

COMPR. MODULUS (MSI) = 14.48



ECIMEN NUMBER: 2-NOH-376-0376 DATE OF TEST : 30 MAR 76

RE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

BER OF PLYS : 2 PLY THICKNESS : 0.0124

E DIMENSIONS: 0.800 X 2.680 X 5.109 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	308.	19.	20.
101.	5186.	399.	420.
201.	10320.	709.	730.
301.	15455.	1039.	1060.
411.	21103.	1349.	1400.
511.	26237.	1659.	1710.
609.	31269.	1949.	2040.
706.	36249.	2229.	2330.
801.	41127.	2549.	2700.
906.	46518.	2879.	3050.
1006.	51653.	3169.	3375.
1106.	56787.	3479.	3710.
1211.	62178.	3789.	4030.
1306.	67056.	4079.	4360.
1411.	72447.	4369.	4670.
1516.	77838.******************************		

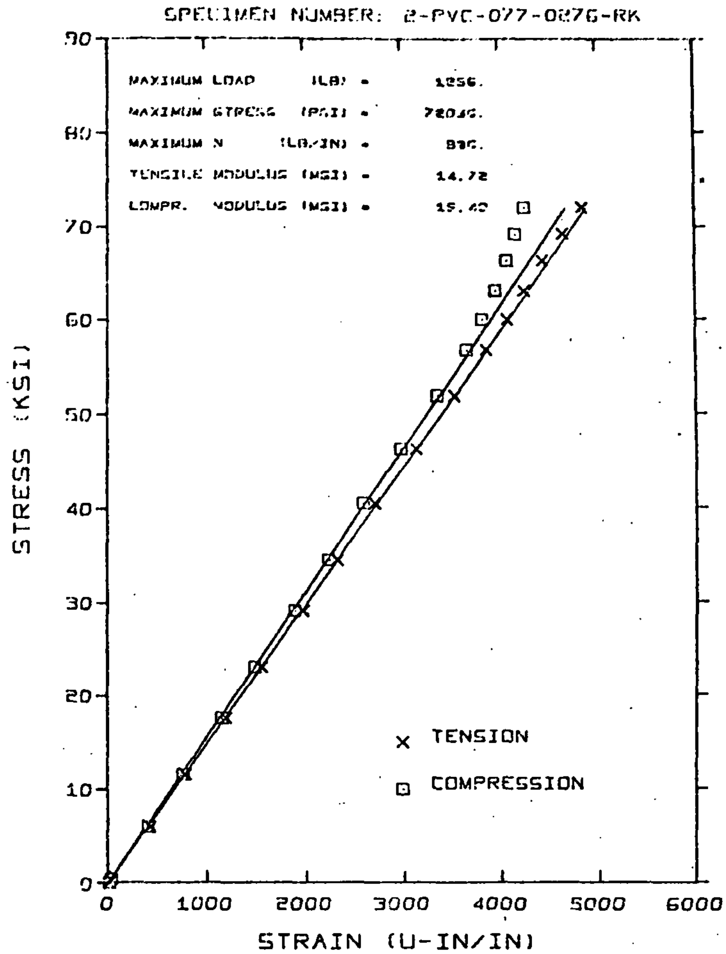
IMUM LOAD (LB) = 1516.

IMUM STRESS (PSI) = 77838.

IMUM N (LB/IN) = 961.

ILE MODULUS (MSI) = 15.59

R. MODULUS (PSI) = 16.14



SPECIMEN NUMBER: 2-PVC-077-0276-RK DATE OF TEST : 18 MAR 76

CORE MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0133

CORE DIMENSIONS: 0.744 X 2.445 X 4.650 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	344.	22.	23.
105.	6022.	412.	433.
201.	11528.	762.	793.
306.	17550.	1162.	1213.
401.	22999.	1522.	1573.
507.	29078.	1902.	1993.
601.	34470.	2252.	2353.
706.	40492.	2612.	2733.
806.	46227.	2992.	3143.
906.	51962.	3342.	3523.
991.	56837.	3642.	3853.
1046.	59992.	3802.	4063.
1101.	63146.	3942.	4253.
1156.	66301.	4062.	4443.
1206.	69169.	4152.	4643.
1256.	72036.******************************		

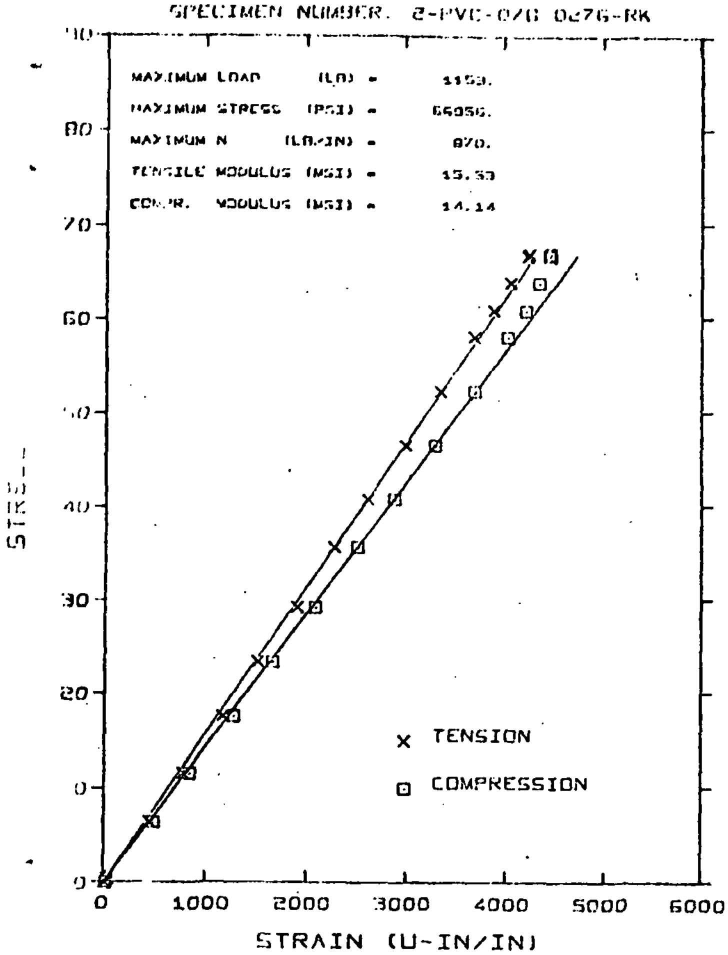
MAXIMUM LOAD (LB) = 1256.

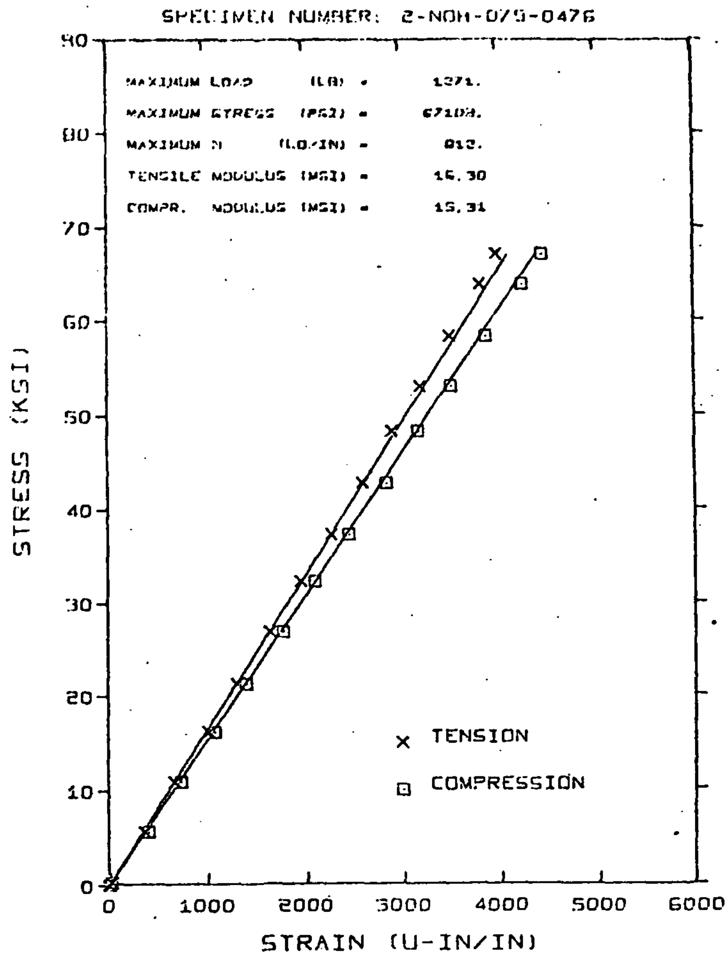
MAXIMUM STRESS (PSI) = 72036.

MAXIMUM N (LB/IN) = 936.

TENSILE MODULUS (MSI) = 14.72

COMPR. MODULUS (MSI) = 15.40





.CIMEN NUMBER: ?-PVC-C78-C276-RK DATE OF TEST : 18 MAR 76

(E MATERIAL : RIGID PVC FOAM TYPE OF ADHESIVE: SMOOTH-ON EA-40

IBER PLYS : 2 PLY THICKNESS : 0.0130

(E DIMENSIONS: 0.741 X 2.437 X 4.978 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	347.	25.	22.
111.	6413.	495.	452.
201.	11612.	855.	792.
306.	17678.	1295.	1192.
406.	23455.	1675.	1532.
506.	29232.	2105.	1922.
616.	35587.	2525.	2292.
706.	40786.	2895.	2632.
806.	46563.	3305.	3012.
906.	52340.	3695.	3362.
1006.	58117.	4035.	3692.
1056.	61006.	4215.	3892.
1106.	63895.	4345.	4052.
1156.	66783.	4455.	4232.
1159.	66956.******************************		

IMUM LOAD (LB) = 1159.

IMUM STRESS (PSI) = 66956.

IMUM N (LB/IN) = 870.

SILE MODULUS (MSI) = 15.53

PR. MODULUS (MSI) = 14.14

SPECIMEN NUMBER: 2-NOH-079-0476 DATE OF TEST : 06 MAY 76

CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0121

CORE DIMENSIONS: 0.783 X 2.716 X 5.594 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	317.	21.	19.
106.	5597.	391.	359.
206.	10877.	731.	669.
308.	16262.	1081.	1019.
404.	21331.	1401.	1309.
509.	26975.	1771.	1649.
611.	32261.	2131.	1959.
706.	37277.	2461.	2279.
811.	42821.	2841.	2599.
916.	48365.	3171.	2939.
1006.	53117.	3501.	3189.
1106.	58397.	3861.	3489.
1211.	63941.	4231.	3799.
1271.	67109.******************************		

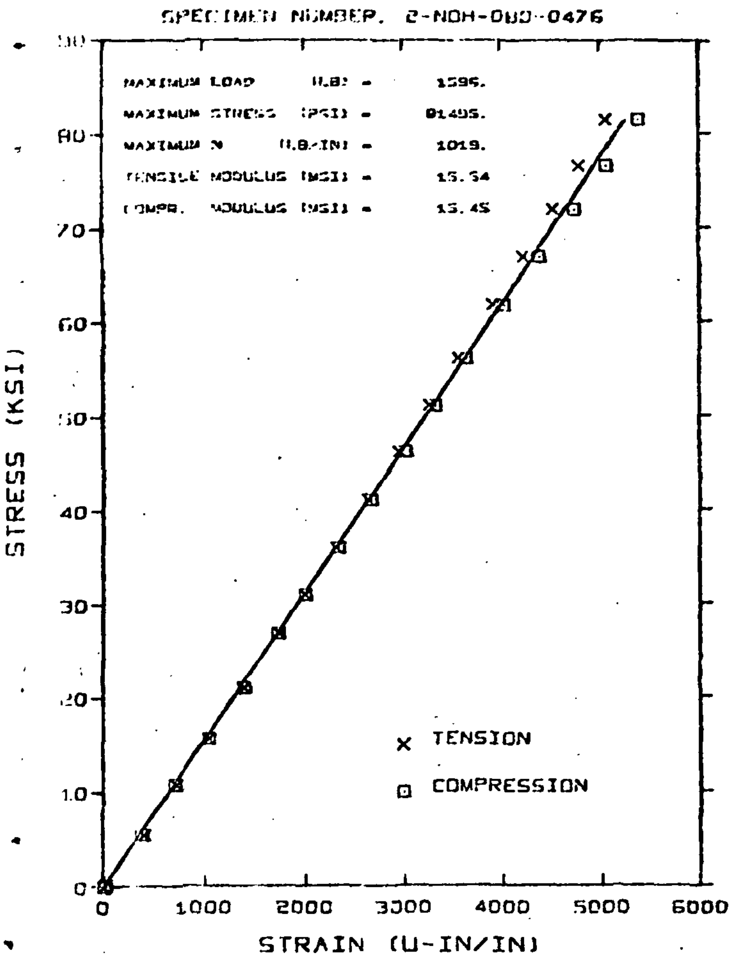
MAXIMUM LOAD (LB) = 1271.

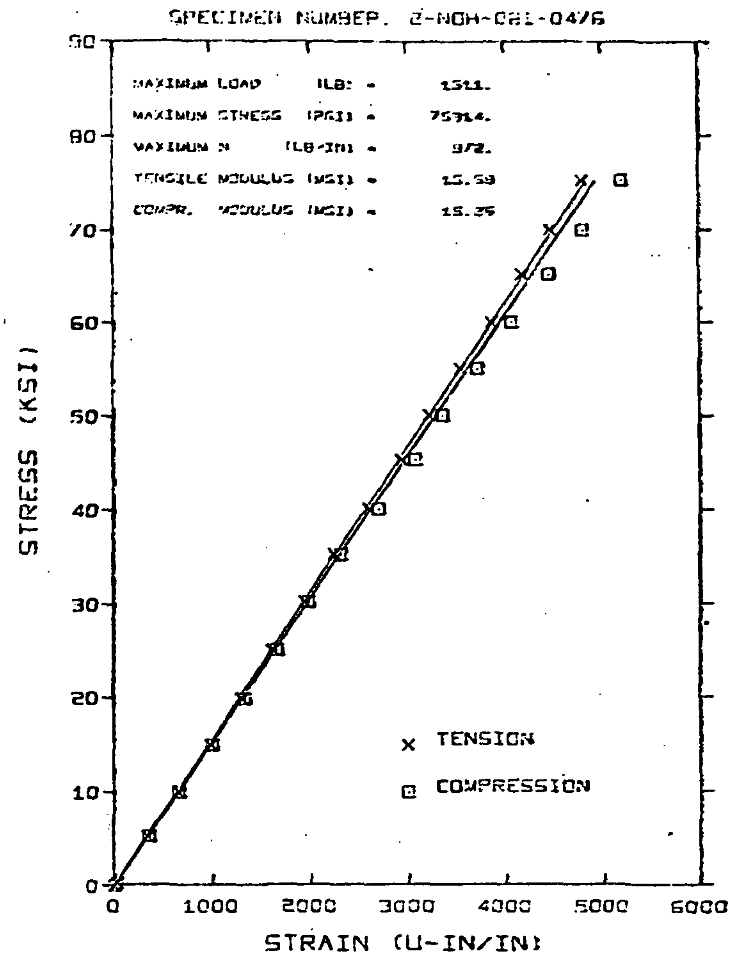
MAXIMUM STRESS (PSI) = 67109.

MAXIMUM N (LB/IN) = 812.

TENSILE MODULUS (MSI) = 16.38

COMPR. MODULUS (MSI) = 15.31





CIMEN NUMBER: 2-NOH-080-0476 DATE OF TEST : 06 MAY 76
RE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE
MBER OF PLYS : 2 PLY THICKNESS : 0.0125
RE DIMENSIONS: 0.782 X 2.722 X 5.065 INCHES

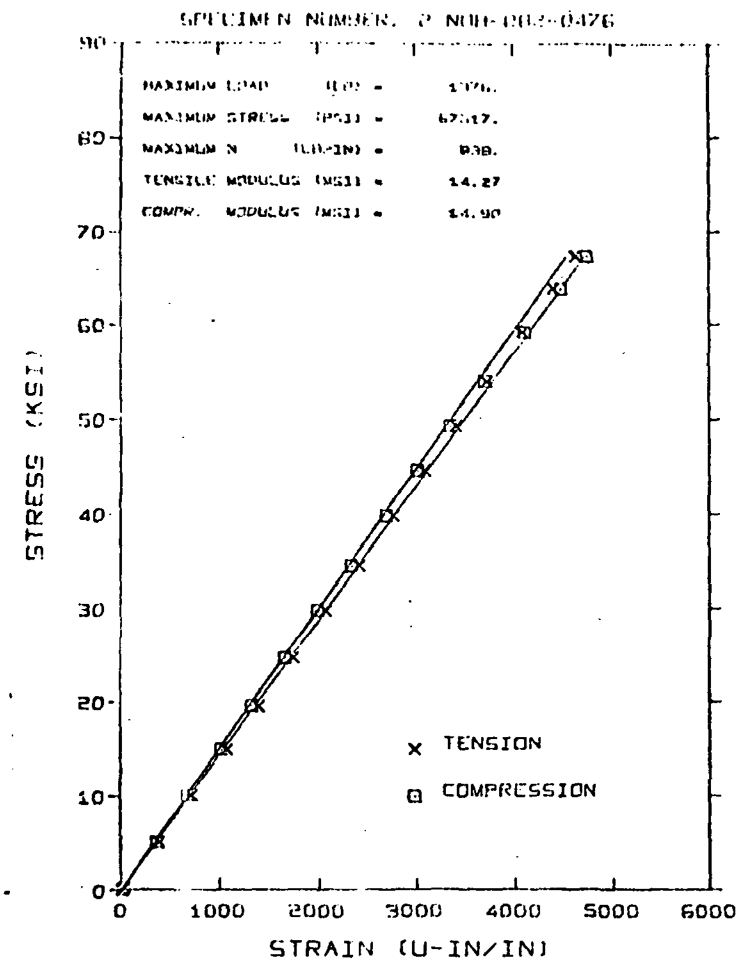
LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	306.	2[illegible].	20.
108.	5515.	391.	410.
211.	10774.	71[illegible].	720.
306.	15625.	10[illegible].	1050.
414.	21140.	1400.	1410.
526.	26859.	174[illegible].	1750.
606.	30943.	2020.	2020.
706.	36[illegible].	235[illegible].	2330.
806.	41156.	268[illegible].	2650.
906.	46262.	3020.	2970.
1001.	51113.	333[illegible].	3279.
1101.	56219.	3640.	3560.
1211.	61836.	4020.	3910.
1311.	66942.	438[illegible].	4220.
1409.	71946.	4740.	4530.
1501.	76644.	5061.	479[illegible].
1596.	81495.********************************		

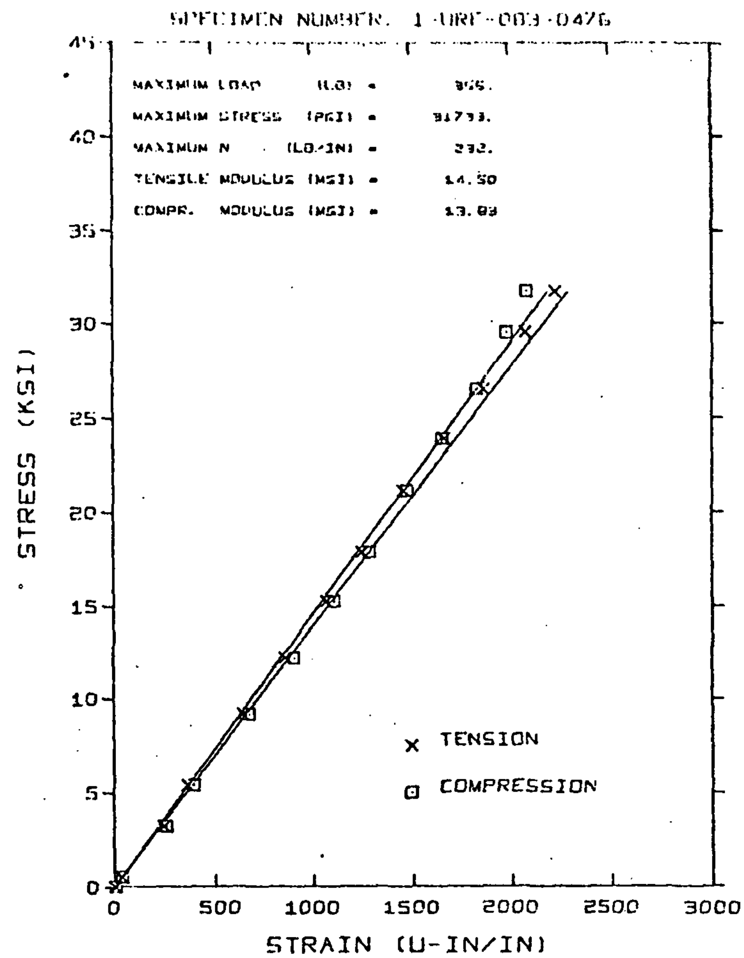
AXIMUM UAD (LB) = 1596.
XIMUM TRESS (PSI) = 81495.
XIMUM (LB/IN) = 1019.
NSILE MODULUS (MSI) = 15.54
MPR. MODULUS (MSI) = 15.45

SPECIMEN NUMBER: 2-NOH-081-0476 DATE OF TEST : 06 MAY 76
CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE
NUMBER OF PLYS : 2 PLY THICKNESS : 0.0129
CORE DIMENSIONS: 0.778 X 2.713 X 5.117 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	299.	20.	19.
106.	5283.	36[illegible].	349.
202.	10068.	660.	659.
301.	15[illegible]3.	10[illegible].	979.
401.	19987.	133[illegible].	1309.
503.	25071.	1660.	1619.
606.	30205.	198[illegible].	1939.
706.	35189.	2320.	2259.
806.	40174.	27[illegible].	2599.
911.	45407.	3070.	2939.
1006.	50143.	3350.	3219.
1106.	55127.	3710.	3539.
1206.	60111.	4060.	3849.
1310.	65295.	4440.	4159.
1406.	70[illegible]80.	48[illegible].	4459.
1511.	75313.********************************		

MAXIMUM LOAD (LB) = 1511.
MAXIMUM STRESS (PSI) = 75313.
MAXIMUM N (LB/IN) = 972.
TENSILE MODULUS (MSI) = 15.59
COMPR. MODULUS (MSI) = 15.26





SPECIMEN NUMBER: 2-NOH-082-0476 DATE OF TEST : 06 MAY 76

CORE MATERIAL : 4# NOMEX HONEYCOMB TYPE OF ADHESIVE: FILM ADHESIVE

NUMBER OF PLYS : 2 PLY THICKNESS : 0.[illegible]133

CORE DIMENSIONS: 0.778 X 2.673 X 5.078 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	294.	2[illegible].	21.
106.	5201.	36[illegible].	381.
206.	10108.	680.	731.
306.	15[illegible]15.	103[illegible].	1091.
401.	19676.	1340.	1411.
507.	24877.	1683.	1761.
609.	29882.	2013.	2091.
706.	34642.	2350.	2431.
811.	39794.	2713.	2781.
908.	44554.	3070.	3101.
1007.	49411.	3363.	3421.
1104.	54171.	3713.	3731.
1210.	59372.	4103.	4081.
1306.	64083.	448[illegible].	4401.
1376.	67517.******************************		

MAXIMUM LOAD (LB) = 1376.

MAXIMUM STRESS (PSI) = 67517.

MAXIMUM N (LB/IN) = 893.

TENSILE MODULUS (MSI) = 14.27

COMPR. MODULUS (MSI) = 14.90

SPECIMEN NUMBER: 1-URE-083-0476 DATE OF TEST : 21 MAY 76

CORE MATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0073

CORE DIMENSIONS: 0.782 X 2.762 X 5.152 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	520.	38.	36.
37.	3258.	258.	246.
62.	5376.	398.	366.
106.	9191.	678.	646.
141.	12225.	9[illegible]8.	866.
176.	15260.	1108.	1076.
206.	17861.	1288.	1256.
244.	21156.	1478.	1456.
276.	23930.	1659.	1666.
306.	26531.	1828.	1866.
341.	29566.	1978.	2076.
366.	31733.******************************		

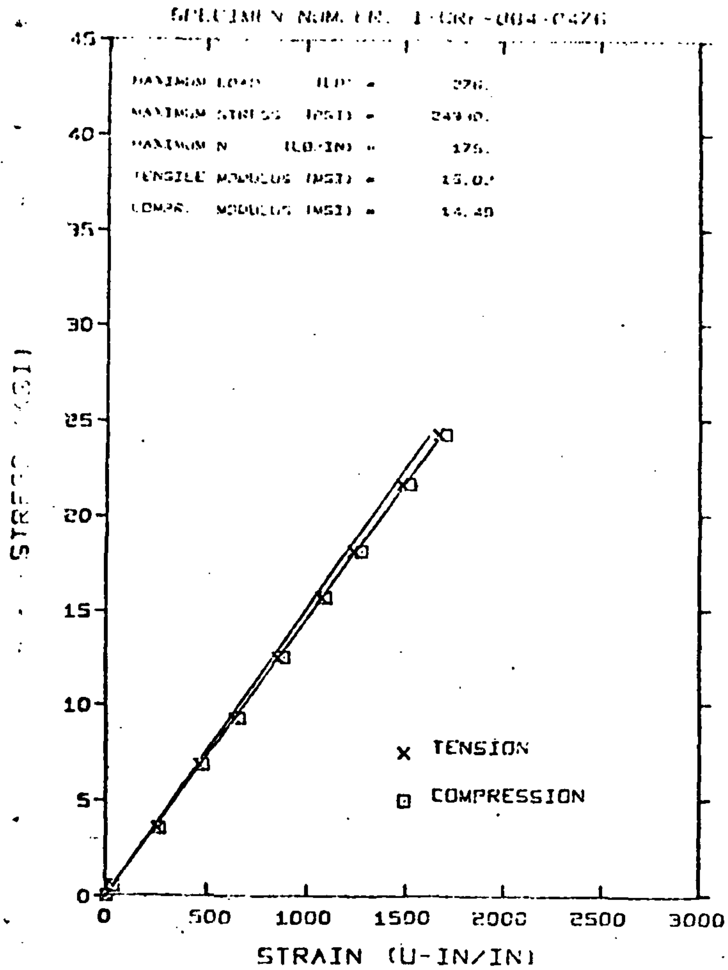
MAXIMUM LOAD (LB) = 366.

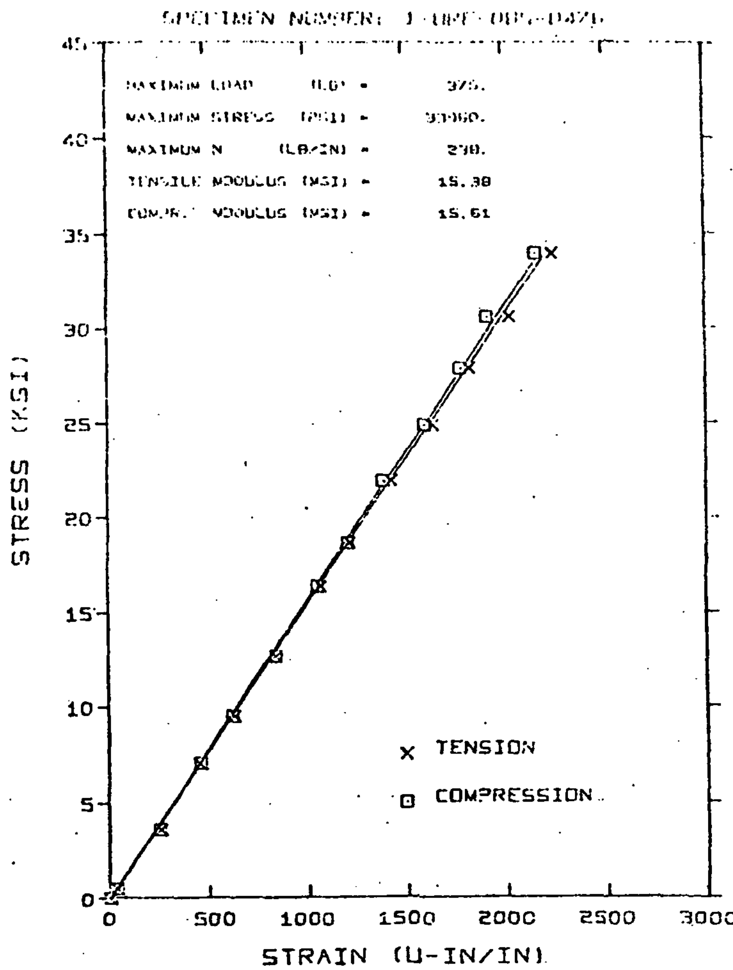
MAXIMUM STRESS (PSI) = 31733.

MAXIMUM N (LB/IN) = 232.

TENSILE MODULUS (MSI) = 14.50

COMPR. MODULUS (MSI) = 13.83





SPECIMEN NUMBER: 1-URE-084-0476　　DATE OF TEST : 21 MAY 76

CORE MATERIAL : CRP URETHANE 9006-4　　TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1　　PLY THICKNESS : 0.0072

CORE DIMENSIONS: 0.780 X 2.761 X 5.169 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	529.	36.	35.
40.	3526.	266.	255.
78.	6876.	486.	465.
106.	9344.	666.	645.
142.	12518.	896.	865.
178.	15691.	11[illegible]6.	1095.
206.	18159.	1286.	1245.
246.	21685.	1526.	1485.
276.	24330.	******	******

MAXIMUM LOAD (LB) = 276.

MAXIMUM STRESS (PSI) = 24330.

MAXIMUM N (LB/IN) = 175.

TENSILE MODULUS (MSI) = 15.02

COMPR. MODULUS (MSI) = 14.49

SPECIMEN NUMBER: 1-URE-085-0476　　DATE OF TEST : 21 MAY 76

CORE MATERIAL : CRP URETHANE 9006-4　　TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1　　PLY THICKNESS : 0.0070

CORE DIMENSIONS: 0.781 X 2.764 X 5.155 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	543.	35.	35.
40.	3622.	255.	255.
78.	7064.	465.	455.
105.	9509.	625.	635.
140.	12678.	845.	849.
180.	16301.	1055.	1075.
206.	18655.	1215.	1225.
242.	21916.	1395.	1435.
275.	24934.	1595.	1635.
308.	27893.	1775.	1825.
338.	30609.	1915.	2025.
375.	33960.	2155.	2235.
375.	33960.	******	******

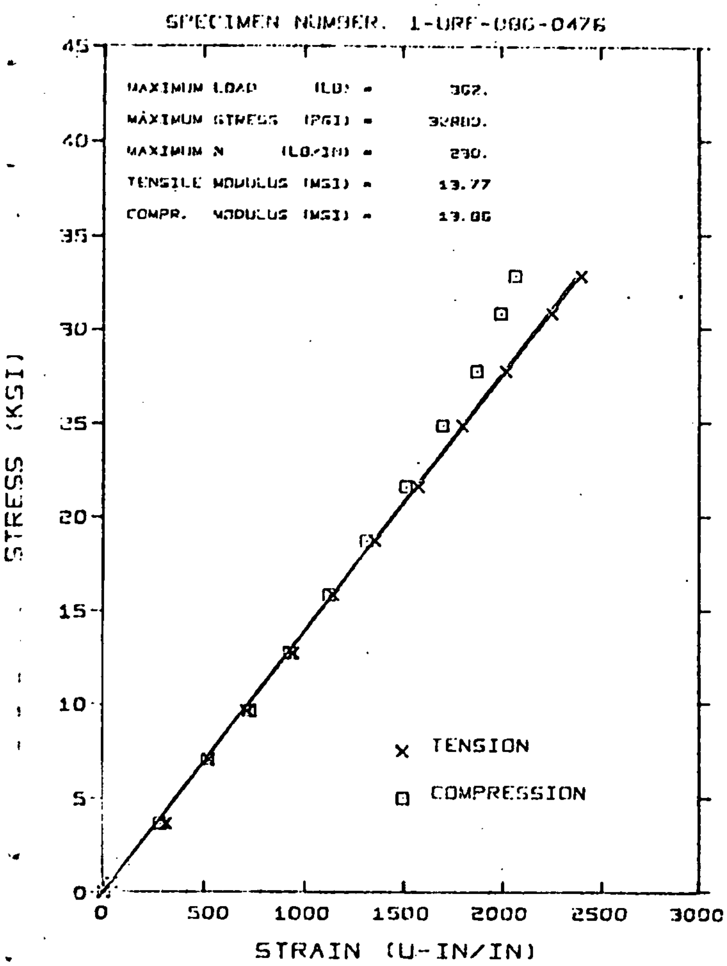
MAXIMUM LOAD (LB) = 375.

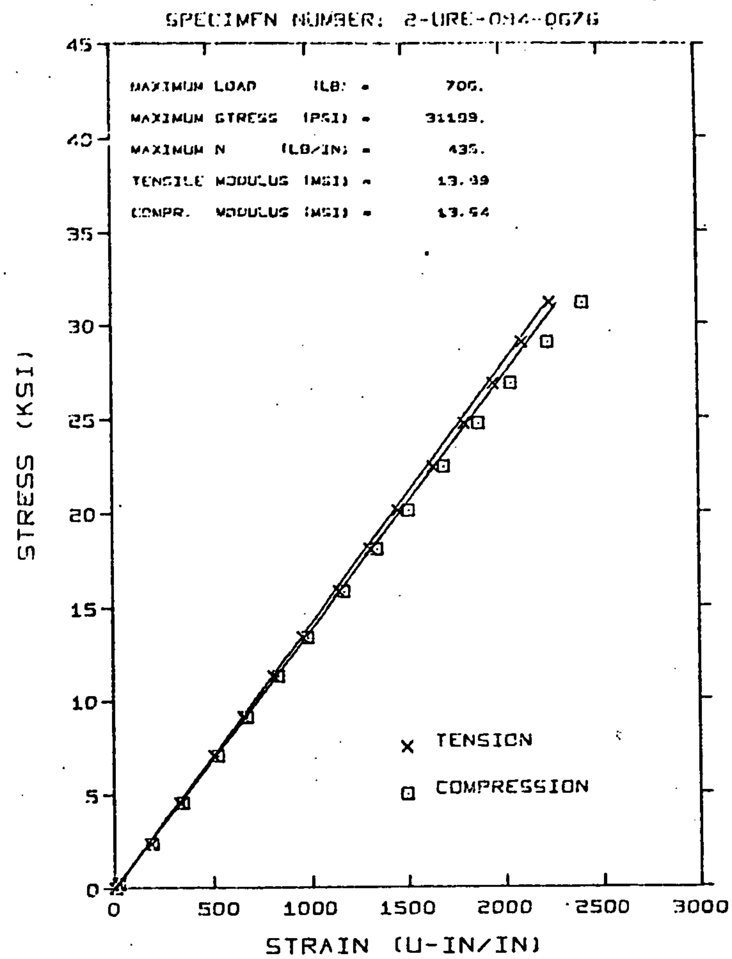
MAXIMUM STRESS (PSI) = 33960.

MAXIMUM N (LB/IN) = 238.

TENSILE MODULUS (MSI) = 15.38

COMPR. MODULUS (MSI) = 15.61





CIMEN NUMBER: 1-URE-086-0476 DATE OF TEST : 21 MAY 76

MATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

BER OF PLYS : 1 PLY THICKNESS : 0.0070

DIMENSIONS: 0.781 X 2.753 X 5.148 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	545.	39.	40.
40.	3633.	279.	310.
78.	7085.	519.	530.
106.	9628.	729.	720.
140.	12716.	929.	953.
174.	15804.	1129.	1150.
206.	18711.	1319.	1360.
238.	21617.	15 9.	1583.
274.	24887.	1699.	1800.
306.	27794.	1869.	2023.
340.	30882.	1987.	2250.
362.	32880.	******	******

MUM LOAD (LB) = 362.

MUM STRESS (PSI) = 32880.

MUM N (LB/IN) = 230.

ILE MODULUS (MSI) = 13.77

R. MODULUS (MSI) = 13.86

SPECIMEN NUMBER: 2-URE-094-0676 DATE OF TEST : 28 JUN 76

CORE MATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0140

CORE DIMENSIONS: 0.786 X 2.797 X 5.185 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	265.	19.	19.
54.	2386.	189.	189.
104.	4596.	349.	339.
160.	7:71.	529.	509.
206.	9103.	679.	659.
256.	11313.	839.	819.
302.	13346.	989.	969.
358.	15820.	1179.	1159.
409.	18074.	1349.	1319.
456.	20151.	15.9.	1459.
508.	22449.	1699.	1639.
560.	24747.	1869.	1799.
608.	26868.	2039.	1949.
658.	29078.	2229.	2099.
706.	31199.	******	******

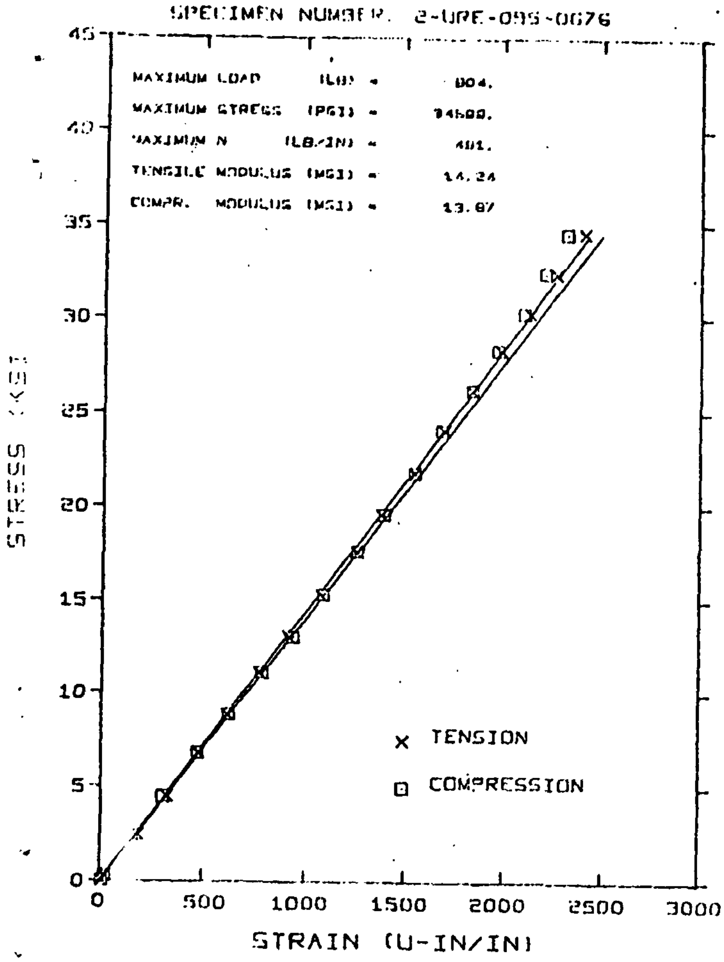
MAXIMUM LOAD (LB) = 706.

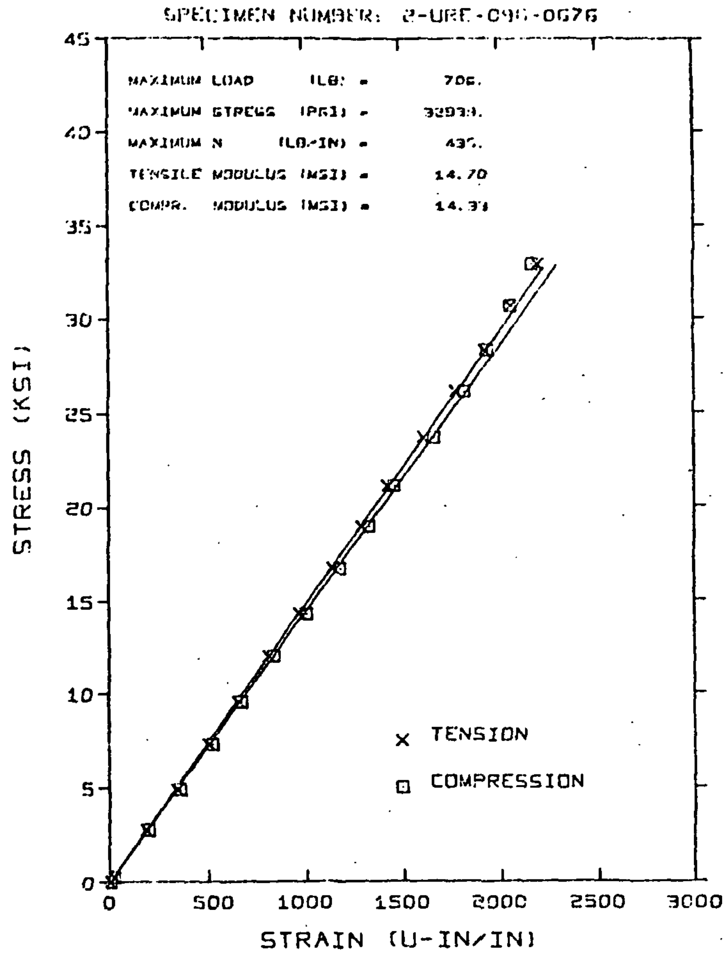
MAXIMUM STRESS (PSI) = 31199.

MAXIMUM N (LB/IN) = 435.

TENSILE MODULUS (MSI) = 13.99

COMPR. MODULUS (MSI) = 13.54





IMEN NUMBER: -URE-095-0676 DATE OF TEST : 28 JUN 76

MATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

ER OF PLYS : 2 PLY THICKNESS : 0.0142

DIMENSIONS: 0.795 X 2.792 X 5.266 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	258.	19.	18.
58.	2495.	159.	188.
105.	4517.	309.	328.
159.	6840.	479.	408.
206.	8862.	639.	628.
258.	11099.	799.	788.
304.	13078.	949.	928.
356.	15315.	1099.	1088.
410.	17638.	1269.	1250.
456.	19617.	1399.	1388.
508.	21854.	1549.	1548.
560.	24091.	1689.	1698.
609.	26199.	1839.	1838.
659.	28350.	1969.	1988.
706.	30372.	2099.	2128.
755.	32480.	22 9.	2268.
804.	34588.	********************	********************

MUM LOAD (LB) = 804.

MUM STRESS (PSI) = 34588.

MUM N (LB/IN) = 491.

ILE MODULUS (MSI) = 14.74

R. MODULUS (MSI) = 13.87

SPECIMEN NUMBER: 2-URE-096-0676 DATE OF TEST : 28 JUN 76

CORE MATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 2 PLY THICKNESS : 0.0132

CORE DIMENSIONS: 0.793 X 2.789 X 5.209 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	279.	19.	19.
60.	2791.	199.	189.
105.	4885.	359.	349.
158.	7351.	529.	509.
206.	9584.	679.	669.
258.	12003.	839.	819.
307.	14283.	1029.	979.
359.	16702.	1179.	1149.
408.	18982.	1329.	1299.
454.	21122.	1459.	1429.
510.	23727.	1659.	1609.
562.	26147.	18 9.	1769.
610.	28380.	1929.	1919.
660.	30706.	2049.	2059.
708.	32939.	********************	********************

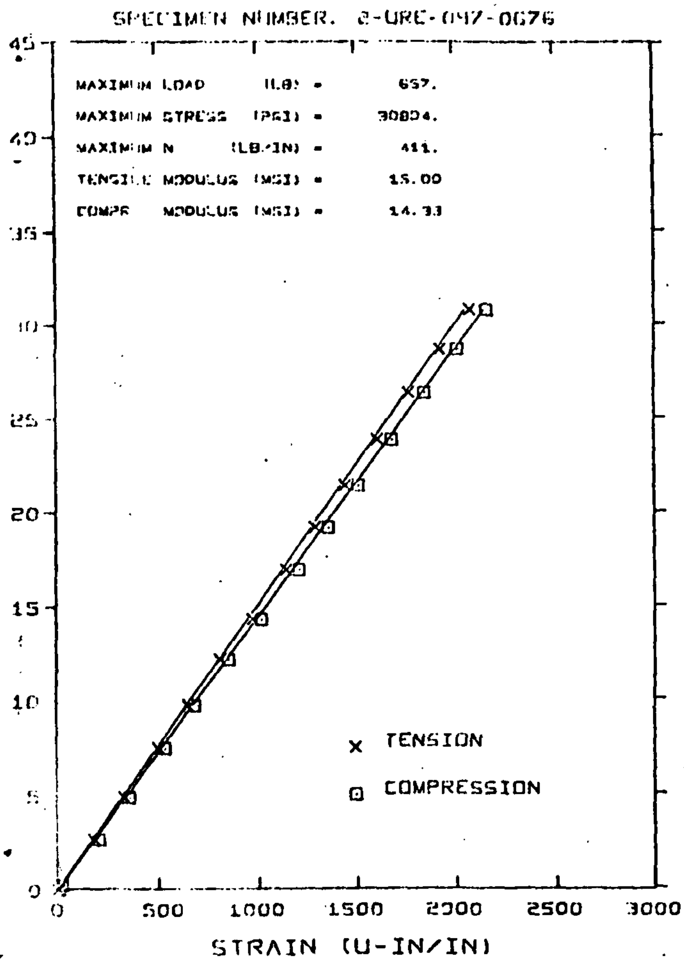
MAXIMUM LOAD (LB) = 708.

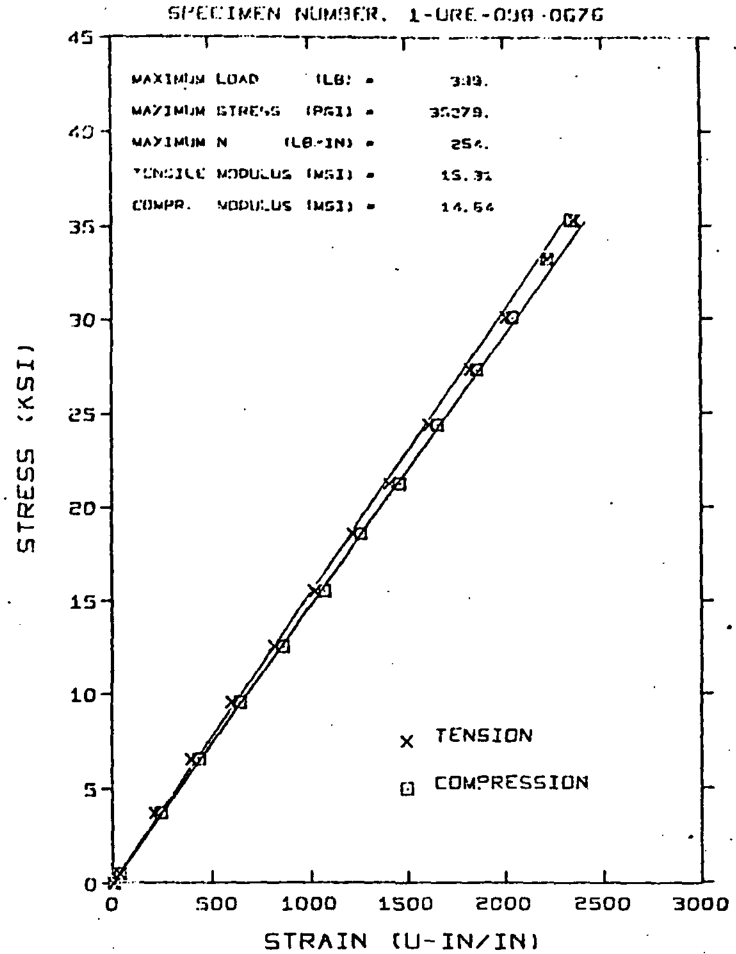
MAXIMUM STRESS (PSI) = 32939.

MAXIMUM N (LB/IN) = 435.

TENSILE MODULUS (MSI) = 14.70

COMPR. MODULUS (MSI) = 14.33





IMEN NUMBER: 2-URE-097-0676   DATE OF TEST : 28 JUN 76
MATERIAL : CRP URETHANE 9006-4   TYPE OF ADHESIVE: SMOOTH-ON EA-40
ER OF PLYS : 2   PLY THICKNESS : 0.0133
DIMENSIONS: 0.791 X 2.742 X 5.138 INCHES

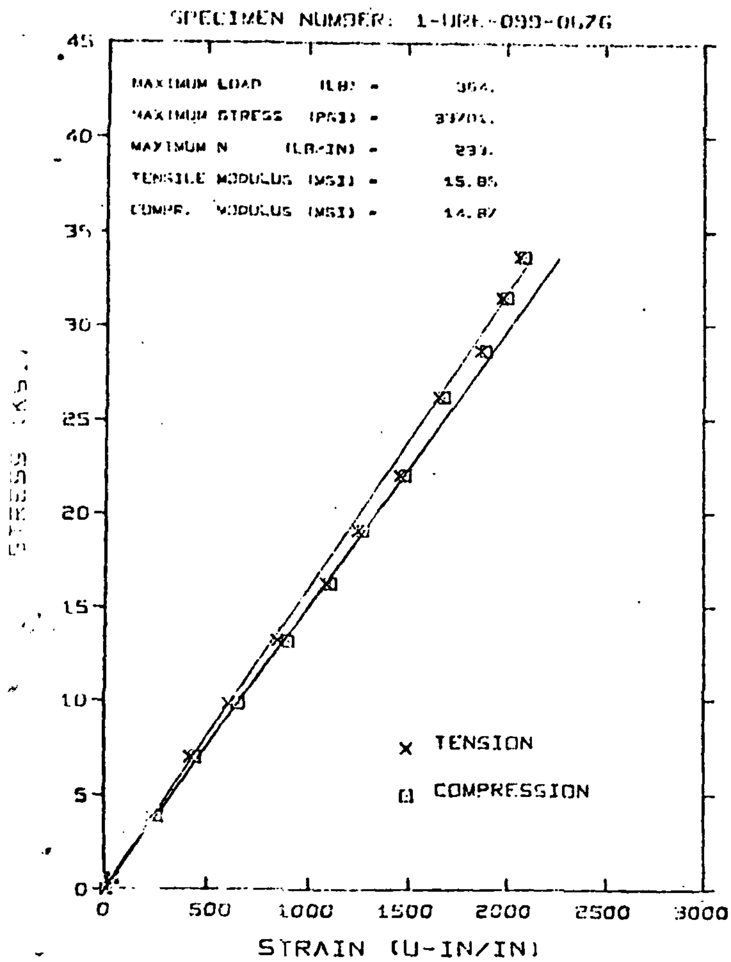
LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	281.	20.	19.
56.	2626.	210.	189.
104.	4876.	360.	339.
159.	7455.	540.	509.
207.	9715.	690.	659.
259.	12144.	860.	819.
305.	14300.	1020.	979.
360.	16879.	1210.	1149.
409.	19177.	1360.	1299.
457.	21427.	1510.	1449.
508.	23018.	1680.	1609.
562.	26350.	1850.	1769.
611.	28648.	2010.	1929.
657.	30804.******************************		

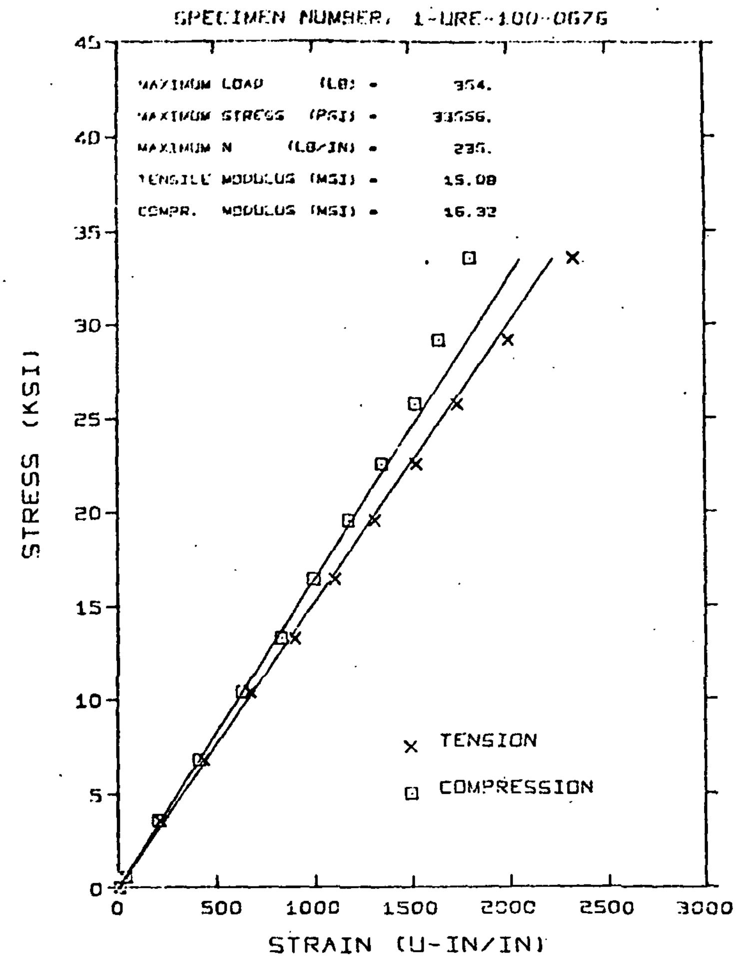
MUM LOAD (LB) = 657.
MUM STRESS (PSI) = 30804.
MUM N (LB/IN) = 411.
ILE MODULUS (MSI) = 15.00
R. MODULUS (MSI) = 14.33

SPECIMEN NUMBER: 1-URE-098-0676   DATE OF TEST : 27 JUL 76
CORE MATERIAL : CRP URETHANE 9006-4   TYPE OF ADHESIVE: SMOOTH-ON EA-40
NUMBER OF PLYS : 1   PLY THICKNESS : 0.0072
CORE DIMENSIONS: 0.782 X 2.745 X 5.180 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	531.	36.	35.
42.	3714.	246.	215.
74.	6543.	436.	405.
108.	9549.	646.	605.
142.	12555.	866.	825.
175.	15473.	1076.	1025.
210.	18568.	1266.	1225.
241.	21309.	1466.	1415.
276.	24403.	1656.	1615.
310.	27410.	1856.	1825.
341.	30151.	2036.	2005.
376.	33245.	2216.	2215.
399.	35279.******************************		

MAXIMUM LOAD (LB) = 399.
MAXIMUM STRESS (PSI) = 35279.
MAXIMUM N (LB/IN) = 254.
TENSILE MODULUS (MSI) = 15.31
COMPR. MODULUS (MSI) = 14.64





EN NUMBER: 1-URE-C99-?676 DATE OF TEST : 27 JUL 76

ATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

OF PLYS : 1 PLY THICKNESS : 0.0069

IMENSIONS: 0.779 X ?.749 X 5.180 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	556.	37.	35.
42.	3889.	257.	235.
76.	7C?7.	447.	425.
106.	9814.	667.	615.
142.	13147.	9?7.	855.
176.	16295.	1117.	1095.
206.	19?73.	1277.	1255.
238.	22?35.	1487.	1465.
283.	26?92.	1677.	1655.
310.	28?52.	1887.	1865.
340.	31479.	1997.	1975.
364.	337?1.*******************		

M LOAD (LB) = 364.

M STRESS (PSI) = 33701.

M N (LB/IN) = 233.

E MODULUS (MSI) = 15.85

MODULUS (MSI) = 14.87

SPECIMEN NUMBER: 1-URE-100-0676 DATE OF TEST : 27 JUL 76

CORE MATERIAL : CRP URETHANE 9?26-4 TYPE OF ADHESIVE: SMOOTH-ON EA-4?

NUMBER OF PLYS : 1 PLY THICKNESS : 0.?070

CORE DIMENSIONS: ?.749 X 2.751 X 5.158 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	569.	35.	38.
38.	3602.	2?5.	218.
72.	6825.	415.	438.
110.	10427.	635.	678.
140.	13271.	835.	908.
173.	16399.	10?5.	1108.
206.	19527.	1185.	1318.
238.	22560.	1355.	1528.
272.	25783.	1525.	1738.
308.	29196.	1645.	1998.
354.	33556.*******************		

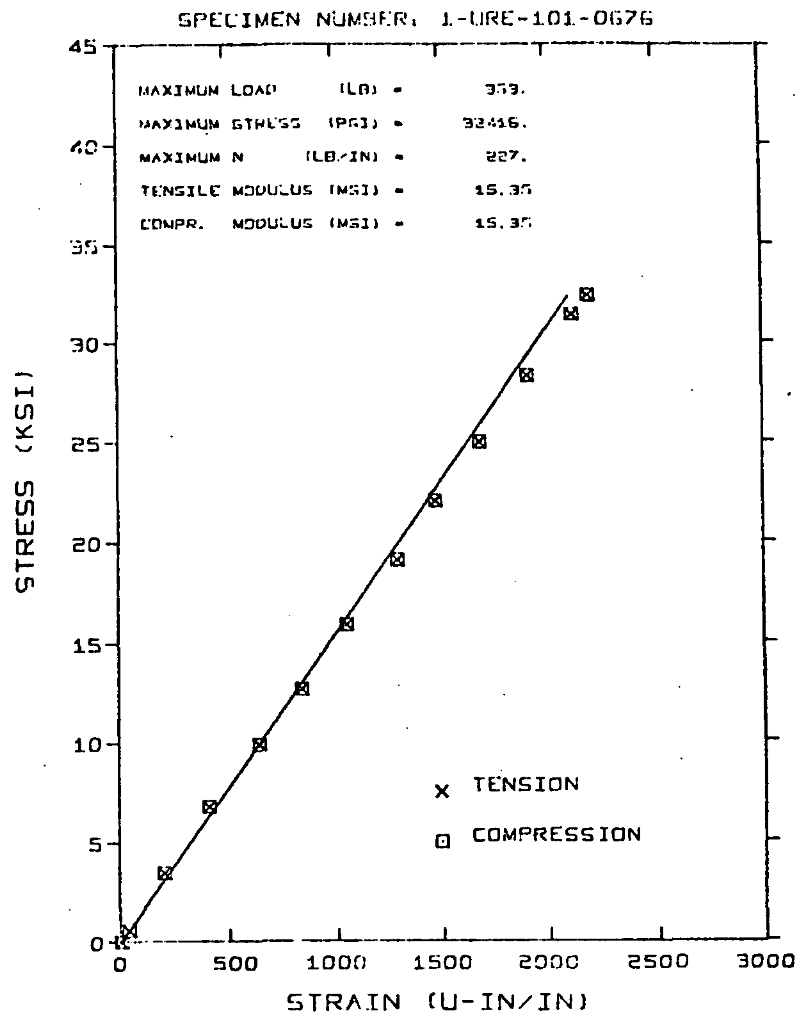
MAXIMUM LOAD (LB) = 354.

MAXIMUM STRESS (PSI) = 33556.

MAXIMUM N (LB/IN) = 235.

TENSILE MODULUS (MSI) = 15.08

COMPR. MODULUS (MSI) = 16.32



SPECIMEN NUMBER: 1-URE-101-0676 DATE OF TEST : 27 JUL 76

CORE MATERIAL : CRP URETHANE 9006-4 TYPE OF ADHESIVE: SMOOTH-ON EA-40

NUMBER OF PLYS : 1 PLY THICKNESS : 0.0070

CORE DIMENSIONS: 0.779 X 2.731 X 5.195 INCHES

LOAD (POUNDS)	STRESS (PSI)	COMPRESSIVE STRAIN (U-IN/IN)	TENSILE STRAIN (U-IN/IN)
0.	0.	0.	0.
6.	551.	36.	36.
38.	3490.	206.	206.
74.	6795.	416.	416.
108.	9918.	646.	646.
138.	12672.	846.	846.
173.	15886.	1056.	1056.
208.	19101.	1296.	1296.
240.	22039.	1476.	1476.
272.	24979.	1686.	1686.
309.	28375.	1916.	1916.
342.	31436.	2126.	2126.
353.	32416.		

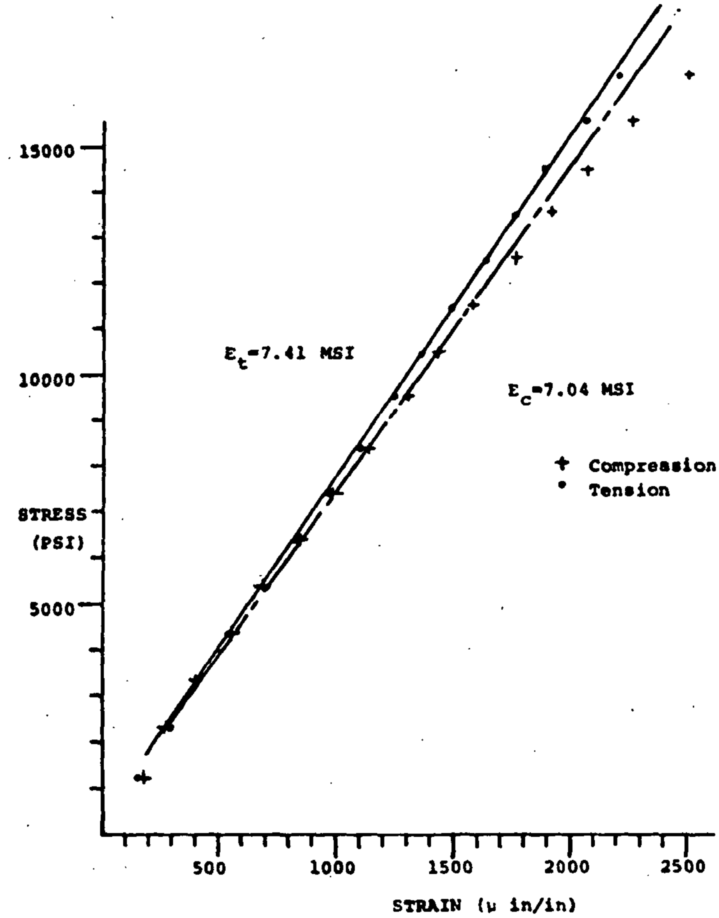
MAXIMUM LOAD (LB) = 353.

MAXIMUM STRESS (PSI) = 32416.

MAXIMUM N (LB/IN) = 227.

TENSILE MODULUS (MSI) = 15.35

COMPR. MODULUS (MSI) = 15.35



SPECIMEN NUMBER: 1-FOOM BEAM #1

DATE OF TEST : 15 DEC 75

CORE MATERIAL : CPR URETHANE 9306-3

CORE DIMENSIONS: 0.767 X 2.620 X 5.100 INCHES

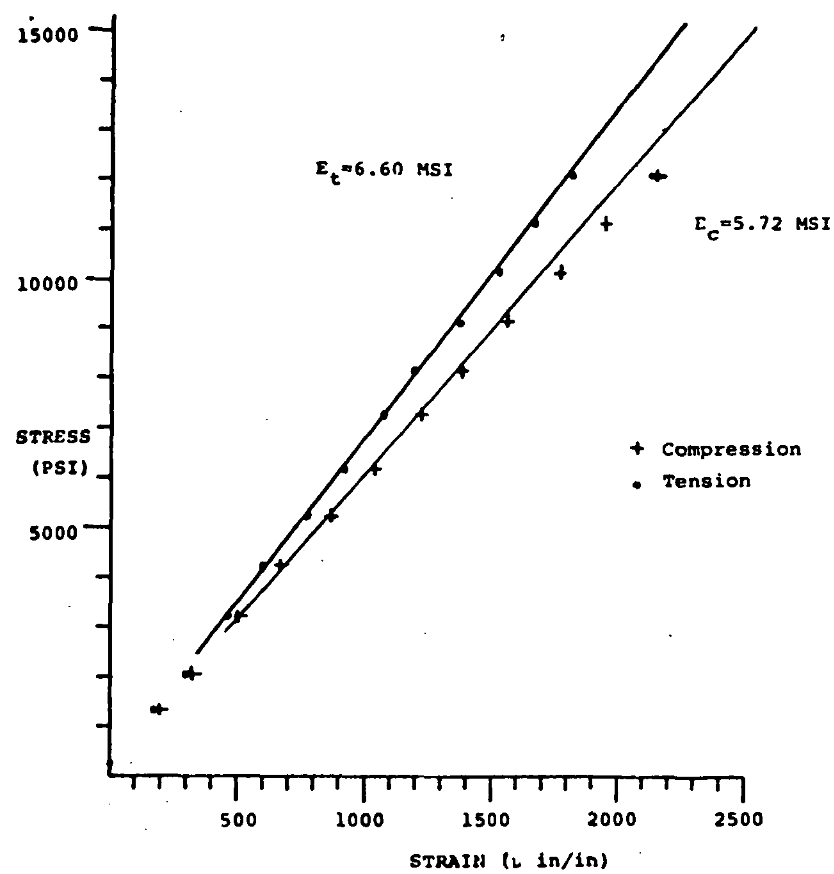
PLY THICKNESS : 0.0132 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	307.	0.	0.
26.	1330.	161.	162.
46.	2352.	286.	276.
66.	3375.	416.	412.
86.	4399.	549.	552.
106.	5421.	699.	696.
126.	6444.	841.	852.
146.	7466.	973.	997.
166.	8489.	1136.	1138.
189.	9610.	1252.	1304.
206.	10535.	1361.	1431.
225.	11536.	1499.	1588.
246.	12580.	1637.	1765.
266.	13603.	1769.	1919.
285.	14575.	1892.	2089.
306.	15649.	2076.	2261.
326.	16671.	2218.	2513.
346.	17694.	******************	******************

MAXIMUM LOAD = 346. POUNDS

MAXIMUM STRESS = 17694. PSI

MAXIMUM M = 230. LB/IN



SPECIMEN NUMBER: 1-INCH BEAM #2

DATE OF TEST : 15 DEC 75

CORE MATERIAL : CPR URETHANE [illegible]6-4

CORE DIMENSIONS: [illegible].771 X [illegible].65[illegible] X [illegible].1[illegible] INCHES

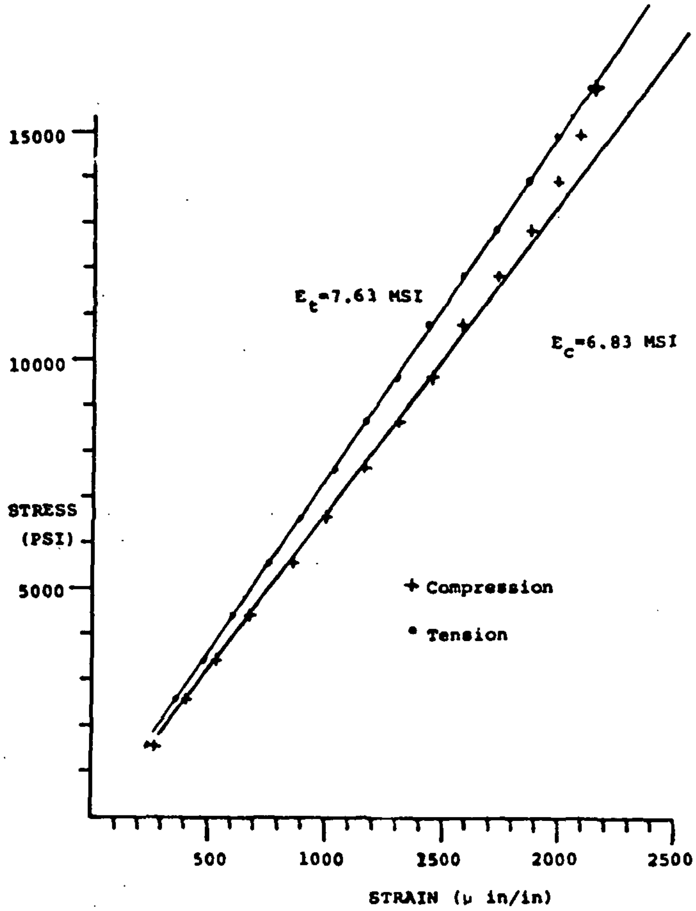
PLY THICKNESS : [illegible].[illegible]135 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	205.	[illegible].	[illegible].
27.	[illegible].	13[illegible].	194.
47.	2[illegible]65.	302.	335.
66.	[illegible]45.	465.	5[illegible].
86.	4224.	595.	665.
106.	52[illegible]2.	766.	[illegible]6[illegible].
126.	[illegible].	915.	1[illegible]42.
149.	7277.	1[illegible]62.	1224.
166.	8162.	110[illegible].	1389.
186.	[illegible].	1362.	1562.
206.	10129.	15[illegible].	1765.
226.	1111[illegible].	16[illegible].	1940.
246.	12[illegible]35.	1819.	[illegible]15[illegible].
256.	12597.	********	********

MAXIMUM LOAD = 256. POUNDS

MAXIMUM STRESS = 12597. PSI

MAXIMUM M = [illegible]. IN/IN



SPECIMEN NUMBER: [illegible]

DATE OF TEST : 17 DEC 75

CORE MATERIAL : [illegible] URETHANE [illegible]

CORE DIMENSIONS: 0.755 X 2.620 X 5.100 INCHES

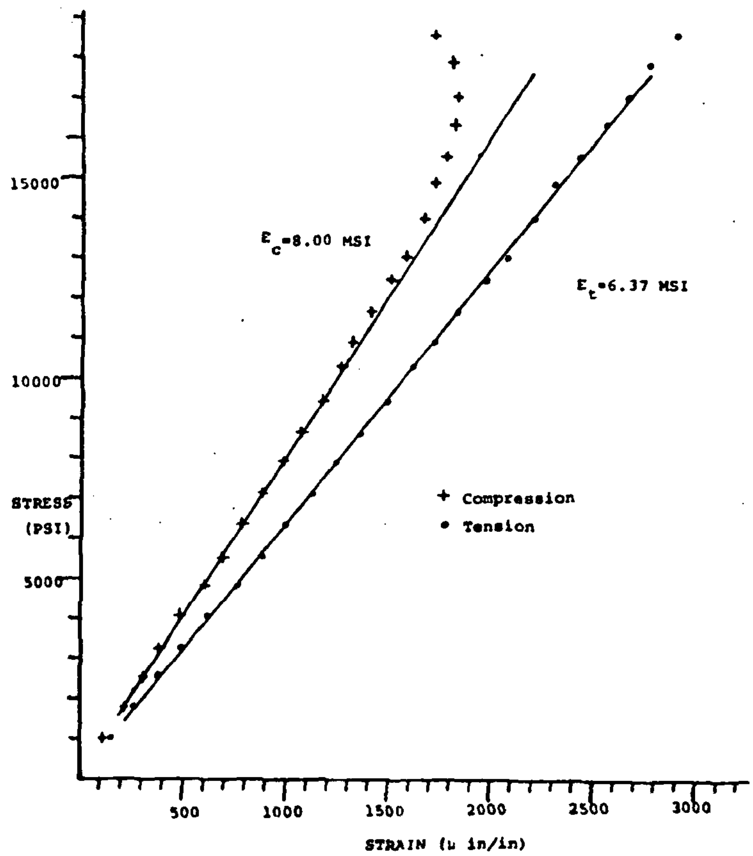
PLY THICKNESS : 0.0120 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	315.	0.	0.
30.	1575.	245.	270.
50.	2598.	371.	409.
66.	3460.	493.	541.
88.	4479.	627.	678.
105.	5563.	769.	863.
125.	6611.	895.	1003.
146.	7663.	1042.	1159.
165.	8712.	1172.	1310.
185.	9730.	1319.	1455.
206.	10812.	1441.	1596.
226.	11861.	1590.	1743.
244.	12836.	1724.	1873.
266.	13961.	1860.	1995.
285.	14958.	1994.	2070.
305.	16008.	2115.	2155.
326.	17110.	******************	******************

MAXIMUM LOAD = 326. POUNDS

MAXIMUM STRESS = 17110. PSI

MAXIMUM W = 221. LB/IN



SPECIMEN NUMBER: [illegible]

DATE OF TEST : 15 DEC 75

CORE MATERIAL : CPR URETHANE [illegible]

CORE DIMENSIONS: 0.772 X 2.65[illegible] X [illegible] INCHES

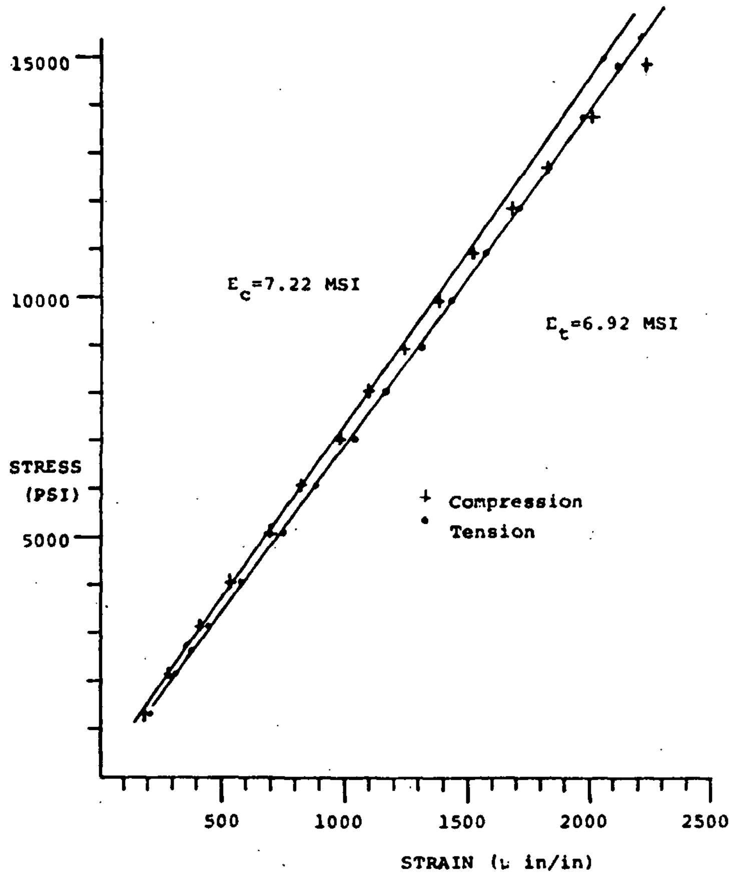
PLY THICKNESS : 0.[illegible]172 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	[illegible]	0.	0.
27.	1016.	153.	119.
47.	19[illegible].	272.	216.
69.	2627.	[illegible]	318.
85.	[illegible]	[illegible]	399.
106.	[illegible]	635.	496.
126.	[illegible]	765.	603.
146.	[illegible]	899.	696.
165.	6367.	[illegible]	789.
185.	[illegible]	1127.	899.
207.	[illegible]	1259.	99[illegible].
226.	[illegible]	[illegible]	1077.
246.	[illegible]	[illegible]	1169.
269.	10318.	1628.	126[illegible].
285.	[illegible]	17[illegible].	13[illegible].
306.	11737.	[illegible]	[illegible]
326.	[illegible]	[illegible]	1511.
346.	[illegible]	[illegible]	1593.
367.	[illegible]	2311.	1676.
386.	[illegible]	[illegible]	1739.
[illegible]	[illegible]	[illegible]	1793.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17875.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
506.	[illegible]		

MAXIMUM LOAD = 506. POUNDS

MAXIMUM STRESS = 19[illegible]. PSI

MAXIMUM [illegible] = [illegible]



SPECIMEN NUMBER: 1-HCOM [illegible]

DATE OF TEST : 15 DEC 75

CORE MATERIAL : C[illegible] URETHANE [illegible]

CORE DIMENSIONS: [illegible].766 X [illegible].5[illegible] X 5.[illegible] INCHES

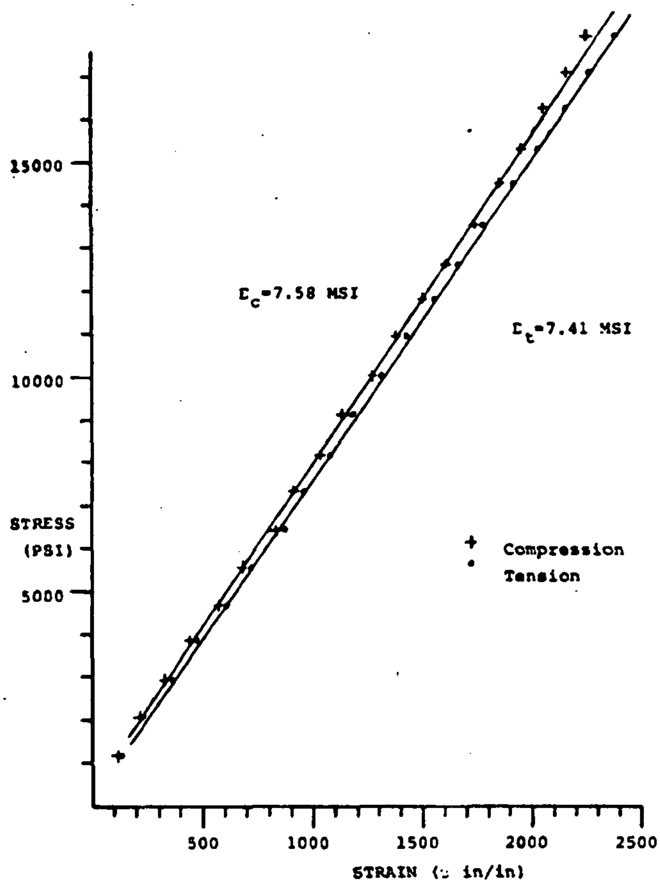
PLY THICKNESS : [illegible].0142 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	[illegible]39.	[illegible]	[illegible]
27.	1239.	[illegible]5.	199.
46.	2312.	311.	297.
66.	3178.	448.	417.
84.	4[illegible]3[illegible].	592.	5[illegible].
1[illegible]6.	50[illegible]7.	755.	[illegible]
126.	6[illegible]59.	886.	[illegible]21.
146.	7[illegible]21.	1[illegible]43.	[illegible]91.
167.	8[illegible]31.	1167.	11[illegible]1.
186.	9944.	1311.	1286.
206.	[illegible]76.	1439.	1391.
226.	1[illegible]869.	1567.	1526.
246.	1193[illegible].	17[illegible]7.	16[illegible].
[illegible]65.	12743.	1[illegible]4[illegible].	1846.
[illegible]86.	13753.	1[illegible]71.	[illegible]6.
[illegible]7.	14[illegible]3.	[illegible]135.	[illegible]15.
[illegible]	15677.	[illegible]	[illegible]

MAXIMUM LOAD = [illegible]26. POUNDS

MAXIMUM STRESS = 15677. PSI

MINIMUM [illegible] = 223. LB/IN



SPECIMEN NUMBER: [illegible]

DATE OF TEST : 17 DEC 75

CORE MATERIAL : [illegible]

CORE DIMENSIONS: [illegible] INCHES

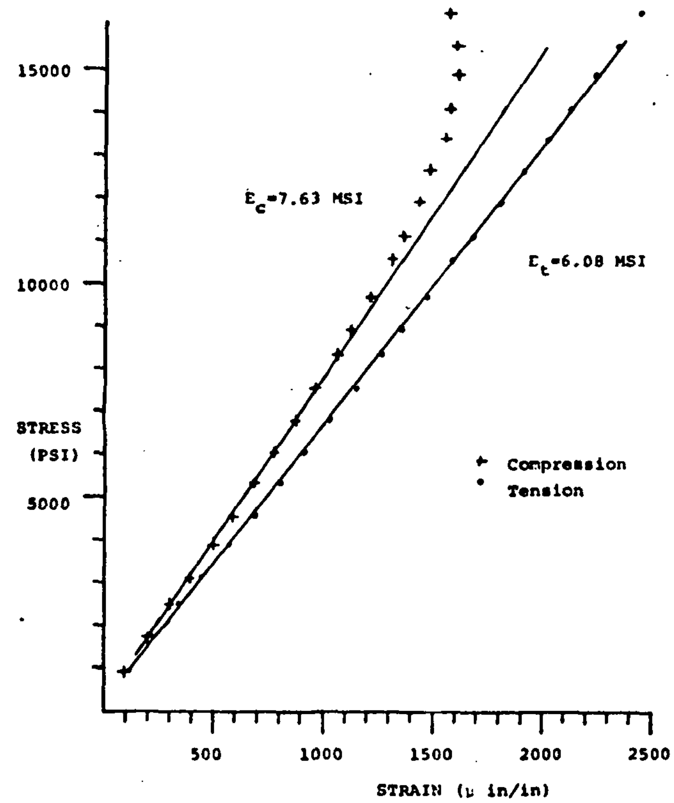
PLY THICKNESS : [illegible] INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	266.	[illegible]	[illegible]
[illegible]	[illegible]	181.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
65.	2925.	[illegible]	[illegible]
86.	[illegible]	[illegible]	[illegible]
106.	[illegible]	[illegible]	575.
126.	5598.	723.	685.
146.	[illegible]	879.	[illegible]
166.	7357.	[illegible]	917.
185.	8199.	[illegible]	[illegible]
206.	[illegible]	1111.	[illegible]
226.	10017.	[illegible]	[illegible]
247.	[illegible]	[illegible]	[illegible]
266.	[illegible]	1550.	[illegible]
286.	[illegible]	[illegible]	1611.
305.	13519.	1744.	[illegible]
327.	[illegible]	1926.	1951.
346.	15335.	[illegible]	[illegible]
367.	[illegible]	[illegible]	2064.
385.	[illegible]	[illegible]	2165.
[illegible]	[illegible]	[illegible]	2257.
436.	19491.		

MAXIMUM LOAD = [illegible] POUNDS

MAXIMUM STRESS = [illegible] PSI

MAXIMUM E = [illegible] IN/IN



SPECIMEN NUMBER: 1-HCOM [illegible]

DATE OF TEST : 16 DEC 75

CORE MATERIAL : [illegible] 9306-4

CORE DIMENSIONS: 0.791 X 2.692 X 5.11[illegible] INCHES

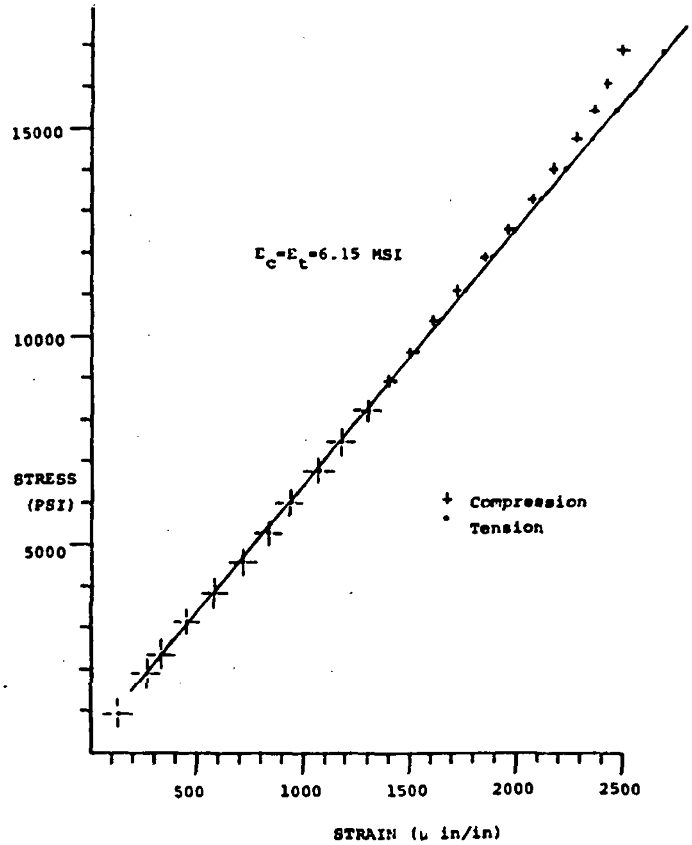
PLY THICKNESS : [illegible].[illegible]176 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	210.	[illegible]	[illegible]
26.	949.	111.	95.
43.	1752.	225.	[illegible]
69.	2519.	307.	332.
87.	3175.	43[illegible].	396.
106.	3869.	573.	50[illegible].
126.	4593.	693.	595.
146.	5329.	810.	693.
166.	6059.	915.	785.
186.	6793.	1025.	875.
206.	7511.	1150.	967.
228.	8121.	1263.	1057.
246.	8939.	1358.	1116.
266.	9707.	1483.	1227.
288.	10517.	1535.	1313.
306.	11167.	1693.	1367.
326.	11897.	1817.	1443.
346.	12627.	1933.	1497.
367.	13393.	2203.	1559.
386.	14087.	2143.	1589.
407.	14853.	2253.	1615.
426.	15546.	2353.	1633.
447.	16311.	2456.	1596.
456.	16641.	-----	-----

MAXIMUM LOAD = 456. POUNDS

MAXIMUM STRESS = 16641. PSI

MAXIMUM [illegible] = 393. IN/IN



SPECIMEN NUMBER: [illegible]

DATE OF TEST : 16 [illegible] 75

CORE MATERIAL : [illegible]

CORE DIMENSIONS: 0.769 X 3.620 X 5.[illegible] INCHES

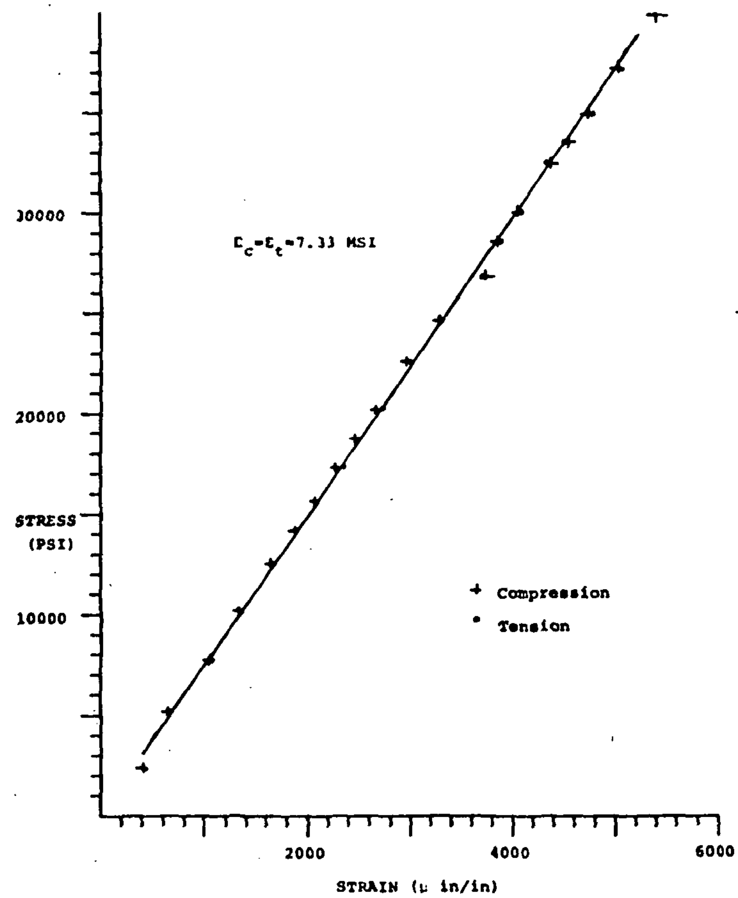
PLY THICKNESS : 0.0185 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN TENSION (U-IN/IN)	STRAIN COMPRESSION (U-IN/IN)
6.	314.	0.	0.
26.	946.	105.	105.
57.	1929.	267.	[illegible]
68.	2139.	339.	338.
86.	3123.	455.	459.
108.	3793.	583.	595.
124.	4588.	710.	719.
145.	5275.	841.	836.
165.	6002.	948.	919.
186.	6756.	1075.	1071.
206.	7441.	1191.	1197.
226.	8222.	1321.	[illegible]
246.	8947.	1437.	1405.
266.	9677.	1533.	[illegible]
296.	[illegible]	1649.	1668.
306.	11132.	1763.	1722.
327.	11874.	1813.	1854.
345.	12551.	1995.	1952.
366.	13315.	2123.	[illegible]
386.	14037.	2205.	2175.
406.	14729.	2154.	2270.
426.	15497.	2471.	2363.
446.	16235.	2581.	2473.
466.	16960.	2694.	2593.
486.	17640.		

MAXIMUM LOAD = 486. POUNDS

MAXIMUM STRESS = [illegible] PSI

MAXIMUM [illegible] = 337. LB/IN



SPECIMEN NUMBER: 1-H00[illegible] BEAM #9

DATE OF TEST : 5 FEB 7[illegible]

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.721 X 2.470 X 5.000 INCHES

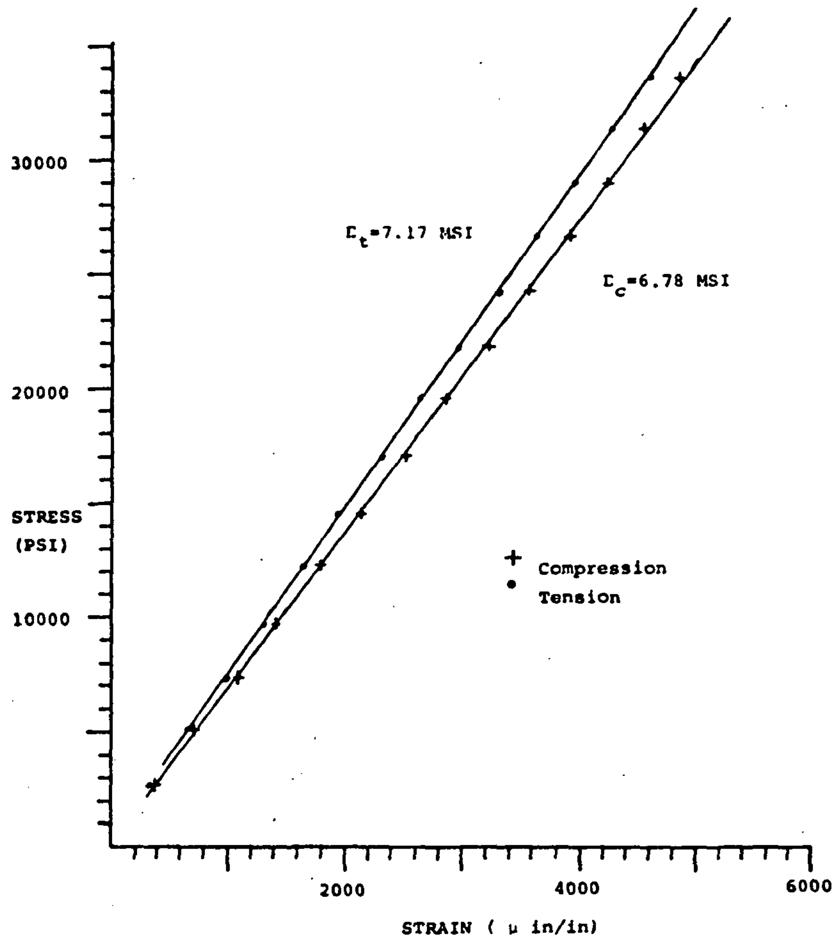
PLY THICKNESS : 0.0153 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	298.	0.	0.
50.	2479.	410.	410.
106.	5256.	660.	690.
156.	7736.	1050.	1070.
206.	10215.	1330.	1350.
254.	12595.	1640.	1660.
289.	14281.	1890.	1900.
316.	15670.	2080.	2090.
351.	17405.	2280.	2380.
378.	18744.	2490.	2500.
408.	20232.	2660.	2750.
456.	22612.	2980.	2980.
497.	24645.	3200.	3340.
541.	26827.	3760.	3740.
577.	28612.	3820.	3890.
637.	33130.	4070.	4373.
657.	32579.	4400.	4380.
678.	33620.	4560.	4530.
736.	35009.	4760.	4760.
753.	37340.	5050.	5110.
805.	39918.	5430.	5430.
828.	41059.	5610.	5620.
846.	41951.	************	************

MAXIMUM LOAD = 846. POUNDS

MAXIMUM STRESS = 41951. PSI

MAXIMUM [illegible] = 642. LB/IN



SPECIMEN NUMBER: 1-HOUR BEAM #1C

DATE OF TEST : 5 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.693 X 2.660 X 5.000 INCHES

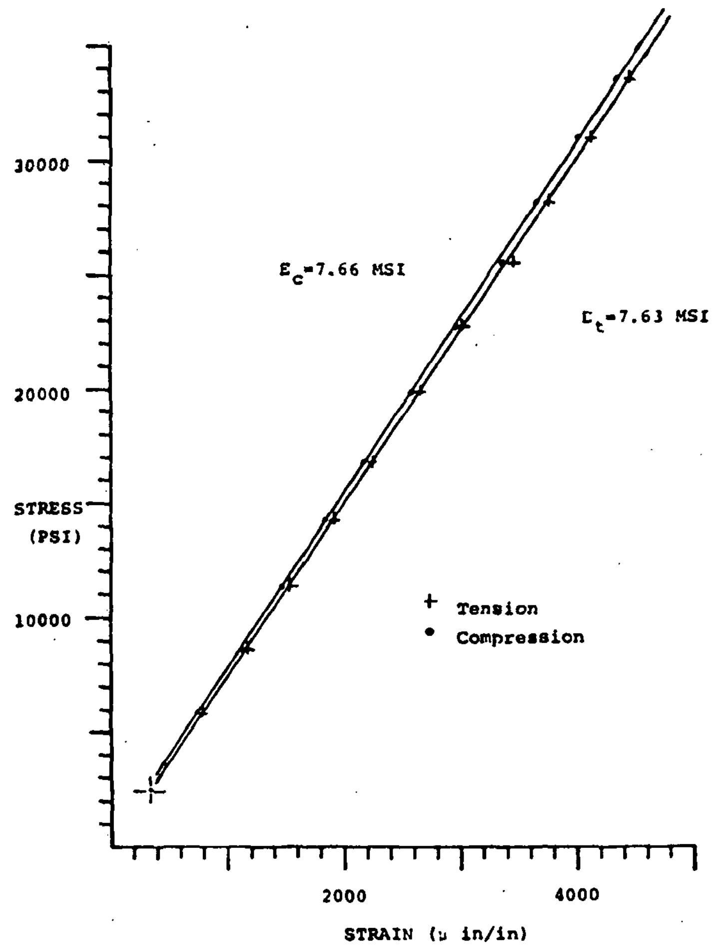
PLY THICKNESS : 0.0153 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	267.	0.	0.
58.	2776.	380.	340.
106.	5074.	730.	670.
156.	7467.	1100.	1000.
204.	9765.	1420.	1310.
254.	12349.	1800.	1640.
305.	14599.	2150.	1970.
357.	17089.	2510.	2310.
408.	19529.	2880.	2660.
458.	21922.	3240.	2990.
508.	24316.	3550.	3330.
554.	26709.	3910.	3640.
606.	29006.	4250.	3980.
658.	31495.	4590.	4300.
704.	33697.	4880.	4620.
756.	36146.	************	************

MAXIMUM LOAD = 756. POUNDS

MAXIMUM STRESS = 36146. PSI

MAXIMUM N = 554. LB/IN



SPECIMEN NUMBER: 1-HC01 BEAM #11

DATE OF TEST : 5 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.632 X 2.490 X 5.000 INCHES

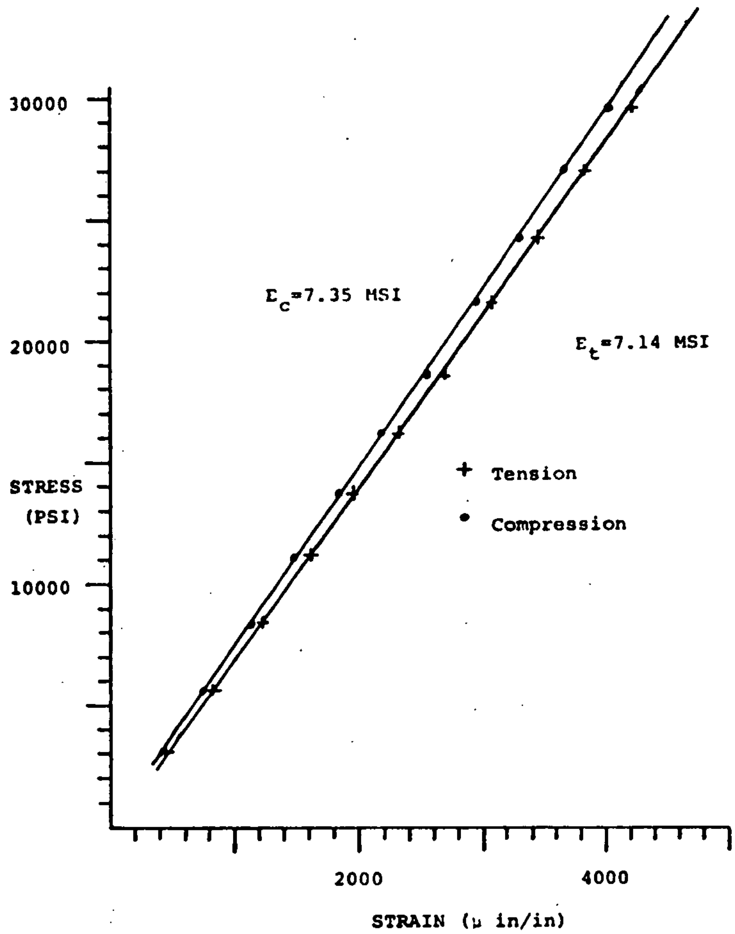
PLY THICKNESS : 0.0143 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	334.	0.	0.
49.	2504.	350.	390.
106.	5899.	760.	790.
156.	8682.	1120.	1170.
206.	11464.	1480.	1540.
258.	14358.	1830.	1930.
304.	16918.	2180.	2260.
359.	19979.	2550.	2670.
409.	22762.	2950.	3030.
459.	25545.	3370.	3450.
508.	28272.	3670.	3780.
557.	30999.	4020.	4150.
607.	33781.	4370.	4490.
637.	35451.	********************	********************

MAXIMUM LOAD = 637. POUNDS

MAXIMUM STRESS = 35451. PSI

MAXIMUM N = 507. LB/IN



SPECIMEN NUMBER: 1-MOON BEAM #12

DATE OF TEST : 5 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.730 X 2.400 X 5.000 INCHES

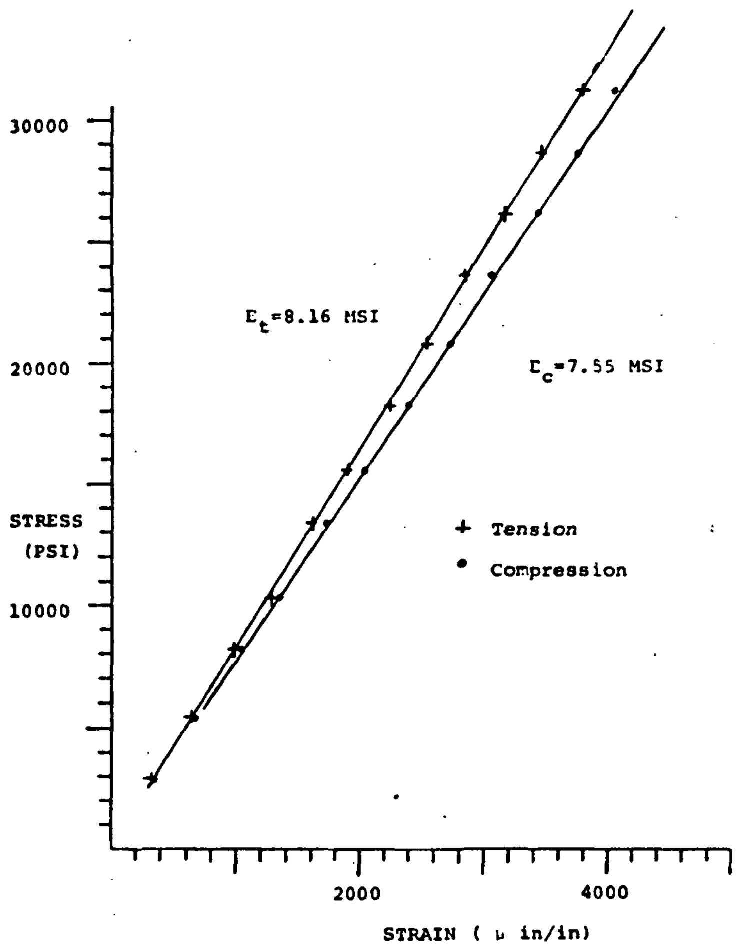
PLY THICKNESS : 0.0145 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	320.	0.	0.
58.	3089.	410.	450.
106.	5645.	760.	330.
158.	8415.	1140.	1230.
209.	11131.	1490.	1610.
258.	13740.	1640.	1980.
306.	16297.	2190.	2340.
354.	18853.	2560.	2700.
407.	21676.	2940.	3090.
457.	24339.	3300.	3460.
509.	27095.	3670.	3850.
557.	29664.	4020.	4210.
591.	31475.	**************	**************

MAXIMUM LOAD = 591. POUNDS

MAXIMUM STRESS = 31475. PSI

MAXIMUM N = 456. LB/IN



SPECIMEN NUMBER: 1-HOON BEAM # 15

DATE OF TEST : 5 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.692 X 2.050 X 5.000 INCHES

PLY THICKNESS : 0.0143 INCHES

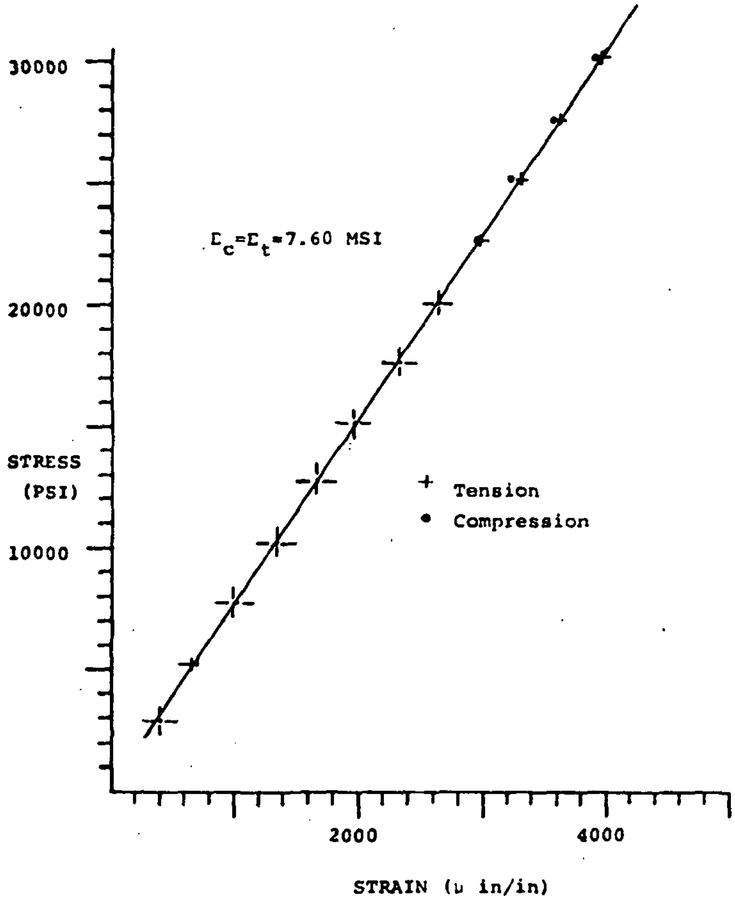
LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	309.	0.	0.
58.	2990.	360.	343.
106.	5465.	690.	650.
160.	8248.	1040.	950.
208.	10723.	1370.	1290.
261.	13455.	1720.	1613.
305.	15723.	2040.	1900.
356.	18353.	2400.	2240.
404.	20827.	2720.	2540.
457.	23559.	3070.	2860.
508.	26189.	3430.	3190.
557.	28715.	3760.	3490.
608.	31344.	4070.	3800.
636.	32787.********	********	********

MAXIMUM LOAD = 636. POUNDS

MAXIMUM STRESS = 32787. PSI

MAXIMUM [illegible] = 46[illegible]. U-IN/IN

28



SPECIMEN NUMBER: 1-HORN BEAM # 14

DATE OF TEST : 5 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.715 X 2.650 X 5.000 INCHES

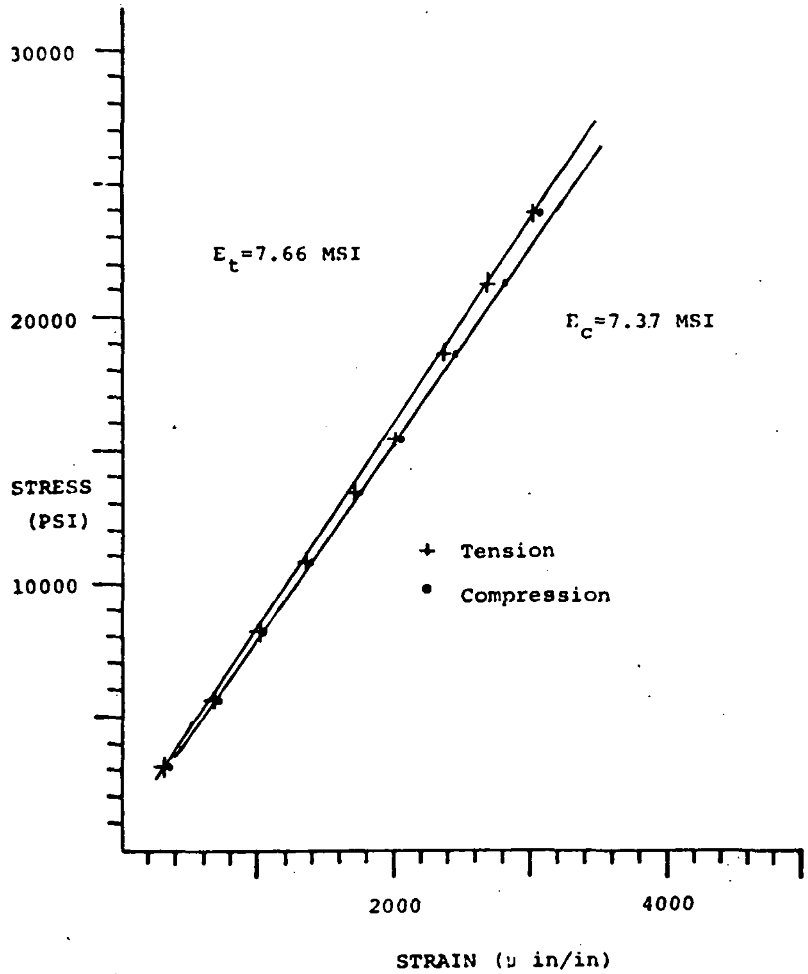
PLY THICKNESS : 0.0144 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	297.	0.	0.
60.	2974.	400.	400.
106.	5255.	700.	690.
157.	7783.	1040.	1030.
206.	10212.	1350.	1350.
259.	12740.	1640.	1630.
304.	15070.	1960.	1980.
357.	17698.	2330.	2330.
406.	20127.	2640.	2640.
456.	22606.	2950.	2960.
508.	25183.	3280.	3310.
558.	27662.	3590.	3620.
610.	30240.	3910.	3940.
646.	32025.	********************	********************

MAXIMUM LOAD = 646. POUNDS

MAXIMUM STRESS = 32025. PSI

MAXIMUM N = 461. LB/IN



SPECIMEN NUMBER: 1-HOON BEAM #15

DATE OF TEST : 12 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.710 X 2.640 X 5.000 INCHES

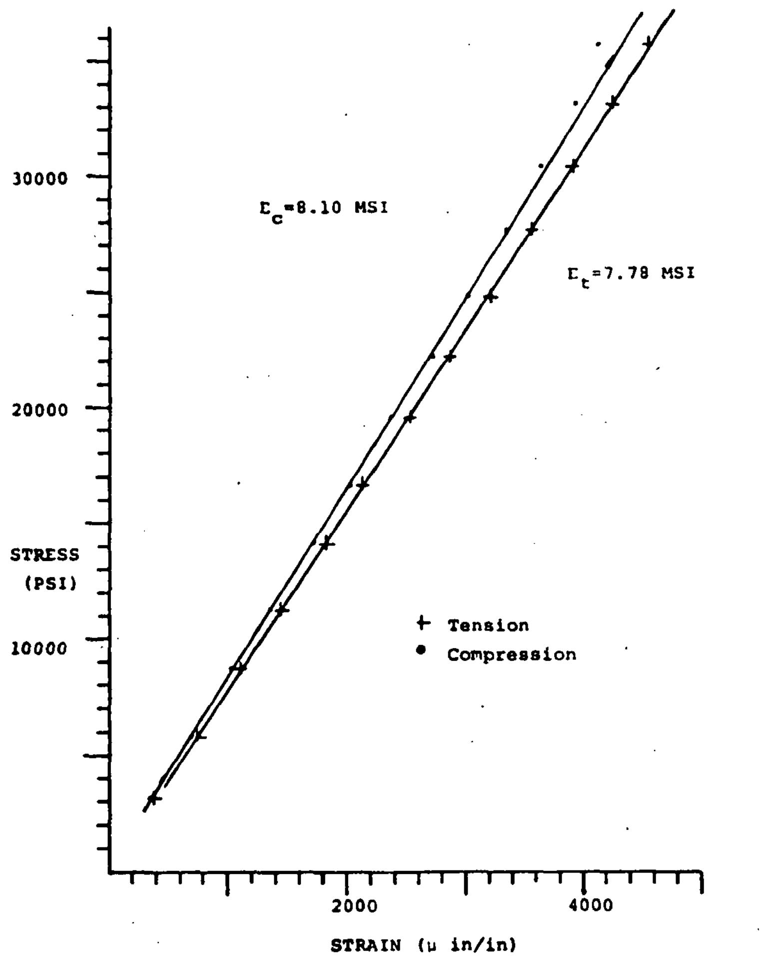
PLY THICKNESS : 0.0138 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
0.	314.	0.	0.
53.	3035.	360.	340.
106.	5547.	710.	700.
157.	8215.	1060.	1050.
207.	10852.	1400.	1360.
257.	13448.	1740.	1700.
305.	15960.	2070.	2010.
357.	18681.	2470.	2380.
409.	21345.	2810.	2700.
457.	23913.	3090.	3040.
507.	26530.	**************	**************

MAXIMUM LOAD = 507. POUNDS

MAXIMUM STRESS = 25533. PSI

MAXIMUM N = 366. LB/IN



SPECIMEN NUMBER: 1-HOUR BEAM # 16

DATE OF TEST : 12 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 3.669 X 2.640 X 5.000 INCHES

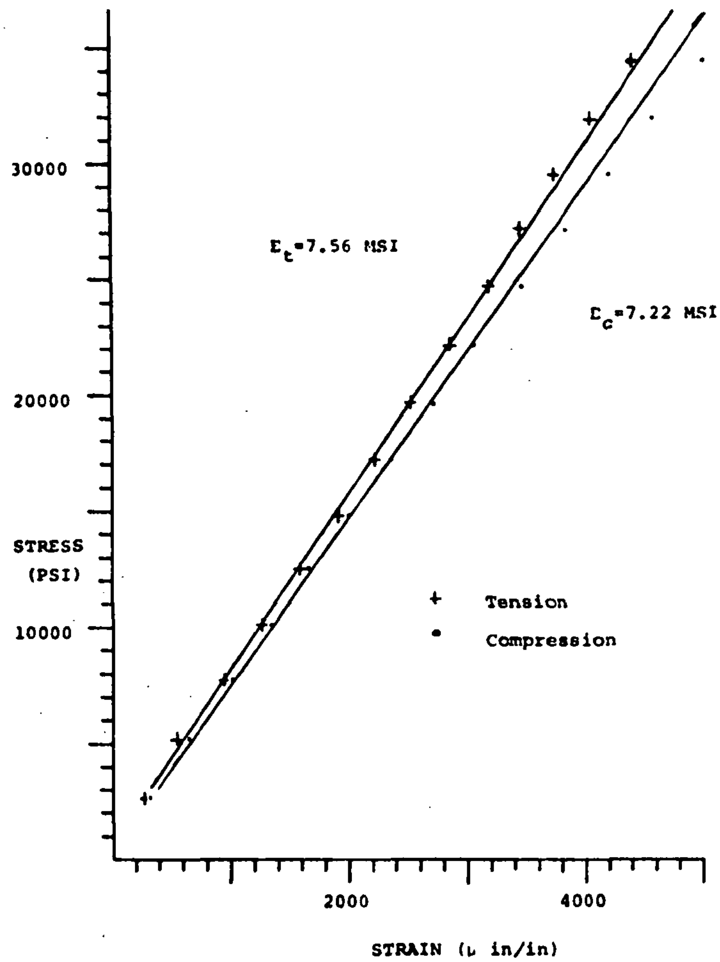
PLY THICKNESS : 0.0140 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	328.	0.	0.
58.	3170.	360.	390.
106.	5794.	700.	750.
160.	8746.	1040.	1110.
207.	11315.	1380.	1460.
258.	14102.	1710.	1820.
304.	16616.	2020.	2150.
358.	19566.	2390.	2550.
408.	22301.	2710.	2390.
456.	24925.	3010.	3220.
507.	27712.	3350.	3590.
558.	30500.	3650.	3940.
608.	33233.	3930.	4290.
654.	35747.	4130.	4590.
676.	36950.******************************		

MAXIMUM LOAD = 676. POUNDS

MAXIMUM STRESS = 36953. PSI

MAXIMUM N = 517. LB/IN



SPECIMEN NUMBER: 1-HOON BEAM # 17

DATE OF TEST : 12 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.714 X 2.680 X 5.000 INCHES

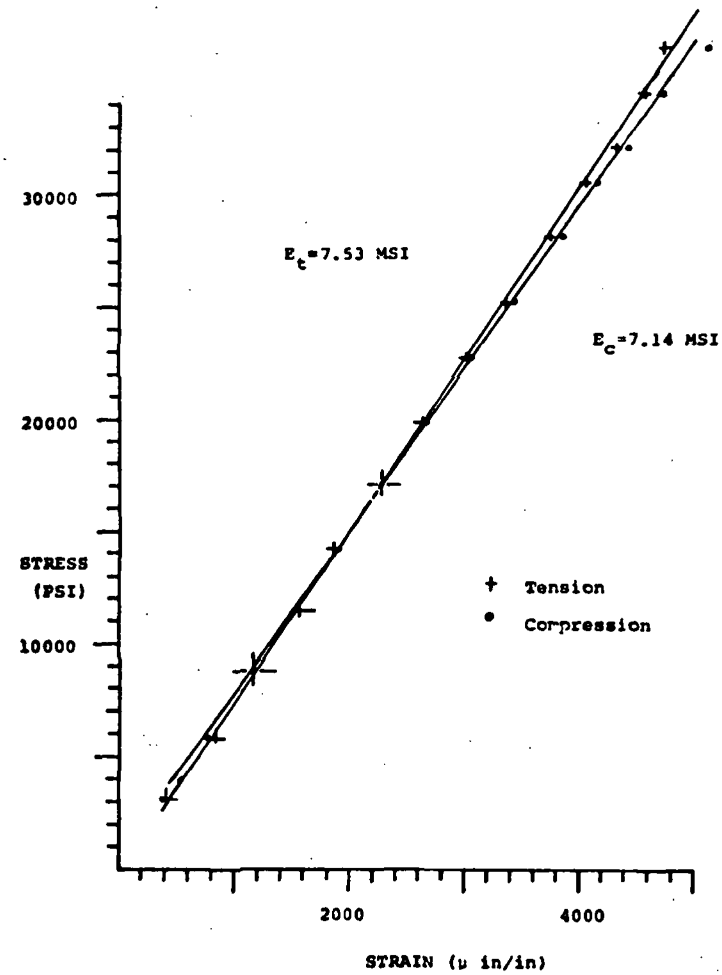
PLY THICKNESS : 0.0145 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	292.	0.	0.
55.	2661.	310.	290.
106.	5166.	660.	650.
159.	7701.	1010.	970.
207.	10069.	1350.	1290.
258.	12575.	1680.	1600.
305.	14866.	2020.	1920.
356.	17352.	2360.	2240.
402.	19594.	2720.	2540.
456.	22226.	3020.	2860.
508.	24760.	3460.	3200.
557.	27140.	3830.	3480.
607.	29585.	4210.	3790.
657.	32023.	4600.	4090.
708.	34508.	5030.	4410.
726.	35386.	************************	************

MAXIMUM LOAD = 726. POUNDS

MAXIMUM STRESS = 35386. PSI

MAXIMUM N = 513. LB/IN



SPECIMEN NUMBER: 1-HOOK BEAM A 1B

DATE OF TEST : 12 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.705 X 2.490 X 5.000 INCHES

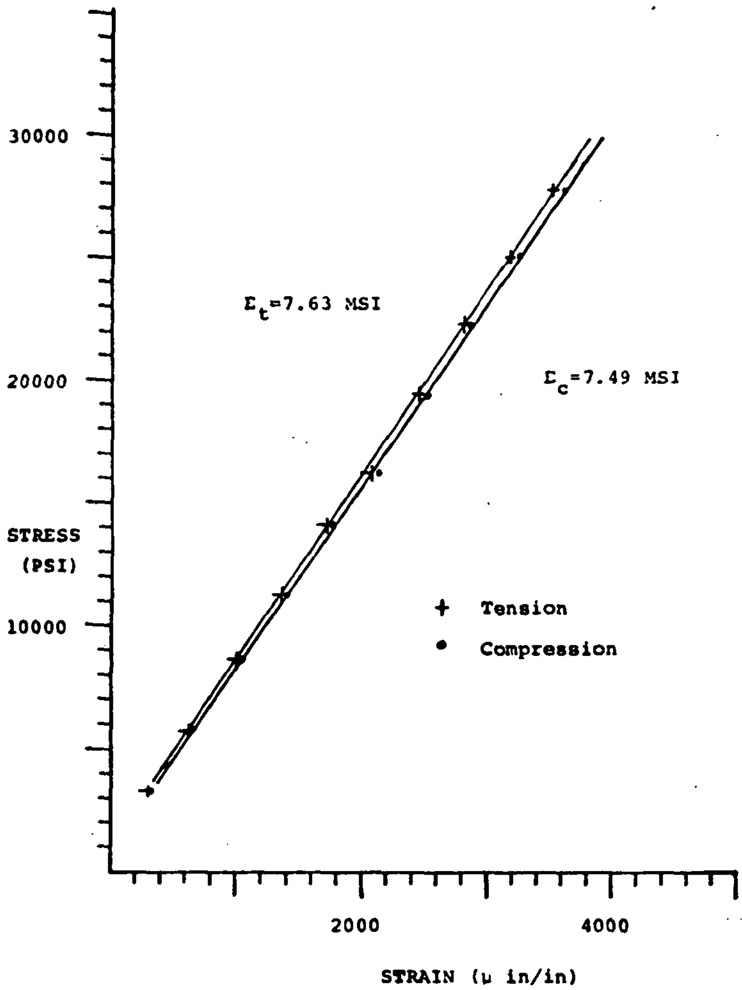
PLY THICKNESS : 0.0138 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	335.	0.	0.
56.	3128.	390.	430.
106.	5927.	760.	840.
159.	8863.	1160.	1190.
207.	11564.	1540.	1570.
256.	14301.	1900.	1980.
307.	17151.	2300.	2330.
356.	19888.	2680.	2650.
409.	22849.	3090.	3050.
454.	25363.	3440.	3380.
506.	28268.	3850.	3780.
548.	30614.	4150.	4080.
579.	32346.	4460.	4340.
620.	34636.	4760.	4600.
656.	36647.	5170.	4770.
662.	36983.	******************************	

MAXIMUM LOAD = 662. POUNDS

MAXIMUM STRESS = 36983. PSI

MAXIMUM N = 513. LB/IN



SPECIMEN NUMBER: 1-HOON BEAM # 15

DATE OF TEST : 12 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.704 X 2.570 X 5.000 INCHES

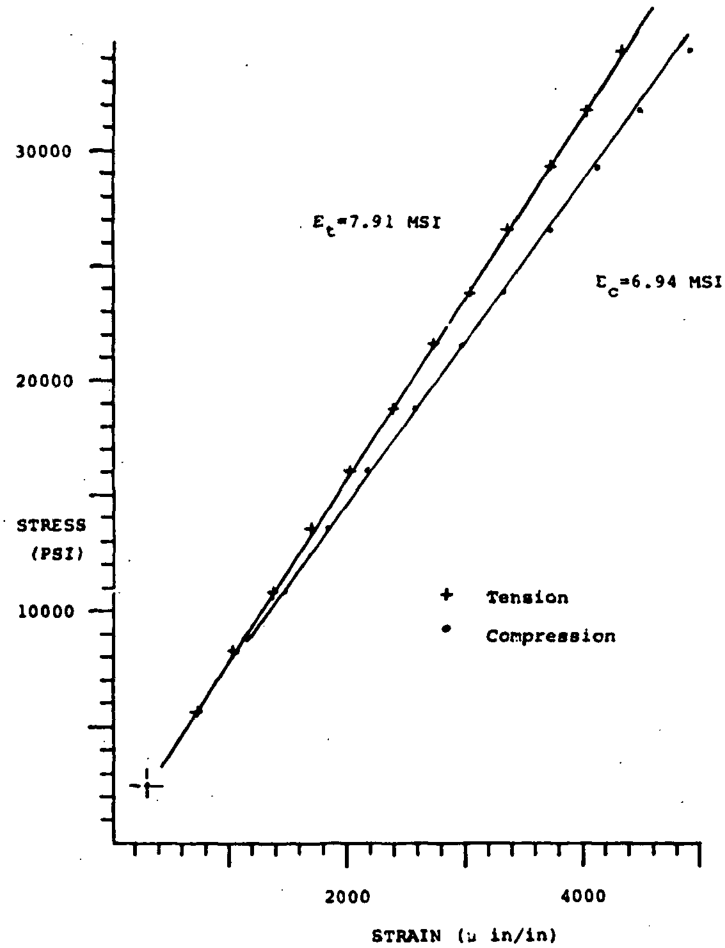
PLY THICKNESS : 0.0136 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	330.	0.	0.
61.	3356.	320.	310.
106.	5831.	660.	650.
157.	8657.	1040.	1030.
207.	11388.	1400.	1370.
256.	14084.	1770.	1730.
304.	16724.	2120.	2060.
354.	19475.	2550.	2450.
407.	22391.	2950.	2820.
456.	25086.	3280.	3190.
506.	27837.	3610.	3510.
560.	30[illegible].	**************	**************

MAXIMUM LOAD = 560. POUNDS

MAXIMUM STRESS = [illegible]. PSI

MAXIMUM N = 419. LB/IN



SPECIMEN NUMBER: 1-MODM BEAM # 2C

DATE OF TEST : 12 FEB 76

CORE MATERIAL : PVC FOAM

CORE DIMENSIONS: 0.705 X 2.570 X 5.000 INCHES

PLY THICKNESS : 0.0142 INCHES

LOAD (POUNDS)	STRESS (PSI)	STRAIN COMPRESSION (U-IN/IN)	STRAIN TENSION (U-IN/IN)
6.	315.	0.	0.
48.	2523.	300.	300.
108.	5678.	760.	710.
157.	8254.	1090.	1040.
208.	10935.	1470.	1370.
258.	13564.	1810.	1700.
305.	16034.	2190.	2030.
355.	18621.	2590.	2400.
410.	21554.	2990.	2740.
456.	23973.	3320.	3040.
506.	26601.	3720.	3380.
559.	29386.	4120.	3720.
606.	31858.	4500.	4030.
656.	34487.	4920.	4350.
696.	36590.******************************		

MAXIMUM LOAD = 696. POUNDS

MAXIMUM STRESS = 36590. PSI

MAXIMUM N = 523. L-/IN

VI. ACKNOWLEDGEMENTS

Undergraduate students from several classes and a few graduate students participated in the research described in this report. On their behalf the reporter, J. W. Mar, expresses the gratitude of the students to NASA for their support. Because of this NASA Grant, there are several generations of students who have more experiences with orthotropic materials than with isotropic materials, i.e., they understand the behavior of advanced composite materials better than metals. It is really this kind of an outlook which will lead to the imaginative exploitation of the advanced composites.

The participants in this project owe a debt of gratitude to Mrs. Anne Brocklebank who performed the administrative chores and who put together this end of the contract report.