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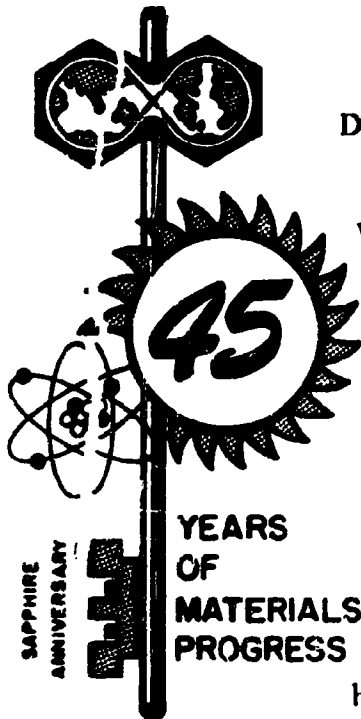
ASD-TDR-61-529

**DETERMINATION OF THE EFFECTS OF ELEVATED
TEMPERATURE MATERIALS PROPERTIES OF
SEVERAL HIGH TEMPERATURE ALLOYS**

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JUNE 1962



DIRECTORATE OF MATERIALS AND PROCESSES
AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND AND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

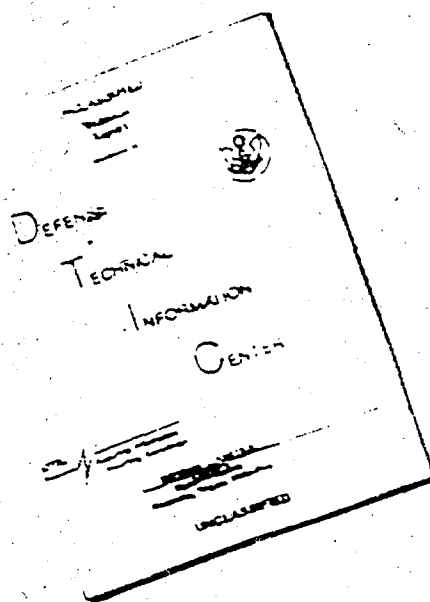
SEP 13 1962

Project No. 7381, Task No. 738103

YEARS
OF
MATERIALS
PROGRESS

(Prepared under Contract No. AF 33(616)-7056
by Southwest Research Institute, San Antonio, Texas;
M. M. Lemcoe, Alex Trevino, Jr., authors)

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FOREWORD

This report was prepared by Southwest Research Institute under USAF Contract No. AF 33(616)-7056. This contract was initiated under Project No. 7381, "Materials Application," Task No. 738103, "Data Collection and Correlation," and administered under the direction of the Directorate of Materials and Processes, Deputy Commander/Technology, Aeronautical Systems Division, with Mr. A. W. Brisbane acting as project engineer.

This report covers work conducted from March 1960 to October 1961.

We would like to acknowledge the assistance of the following who contributed to the success of this project: Miss Barbara Jean Pope, who helped with the data analysis; Messrs. W. L. Edwards and Robert L. Tuck for their painstaking efforts in the laboratory, and Mr. Rene Rivera for his drafting assistance.

ABSTRACT

This investigation was conducted to determine mechanical properties of several high performance alloys at room and elevated temperatures. The effects of temperature (up to 1900°F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing and shear properties were determined from measured stress-strain information in both the elastic and plastic range.

The following five materials were considered in the program:

1. 301 extra hard stainless steel
2. Ph15-7Mo (TH 1050)
3. AM 355
4. René 41
5. N-155

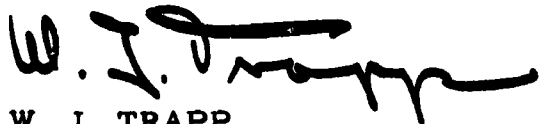
All material was from 0.050-inch sheet, except the material for the 1/8-inch diameter shear pins, which were fabricated from 1/4-inch plate. Heat treatment was in accordance with existing specifications for the materials, or other procedures approved by ASD to develop the optimum strength properties.

Descriptions of the test specimens, equipment, and procedures used are included. Test results are reported in tables and in curves showing the effects of temperature and time on the various mechanical properties.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:



W. J. TRAPP
Chief, Strength and Dynamics Branch
Metals and Ceramics Laboratory
Directorate of Materials and Processes

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LIST OF SYMBOLS

D	Diameter
E	Modulus of elasticity in tension
E _c	Modulus of elasticity in compression
e	Minimum distance from hole center-line to edge of sheet (in bearing tests)
F _{bru}	Ultimate bearing stress
F _{bry}	Bearing yield stress
F _{cy}	Compressive yield stress
F _{su}	Ultimate shear stress - pin shear = $\frac{2P}{\pi D^2}$
F' _{su}	Ultimate shear stress - sheet shear = $\frac{P}{th}$
F _{tu}	Ultimate tensile stress
F _{ty}	Tensile yield stress
G. L.	Gage length
h	Shear path of sheet shear specimen
ksi	Kips (1000 pounds) per square inch
P	Ultimate load observed on machine
psi	Pounds per square inch
t	Thickness of specimen
W	Half-width of sheet shear specimen

1. INTRODUCTION

There has been a pressing need in the aircraft and missile industries for the development of new high temperature alloys to meet the high strength-weight ratios required for the missile and aircraft structural and power plant components. Once these alloys are developed, there is, in general, an immediate need for reliable structural design data, the generation of which can not keep pace with the immediate needs of the aircraft and missile designers who utilize these new alloys. Of particular interest to them are design data for materials to be used for extended periods of time, at extremely elevated temperatures.

The purpose of this investigation was to determine the effects of prior exposure, at test temperature, on the elevated temperature smooth and sharp-notched tensile, compressive, bearing and shear properties of AM 355, N-155, Ph15-7Mo condition Th 1050, AISI 301 (60% cold reduced) stainless steel and Rene' 41.

The materials aforementioned were tested at temperatures up to 1900 F, after exposure at the test temperatures of up to 1000 hours.

II. SCOPE OF THE INVESTIGATION

A. Materials

The five materials evaluated here are standard, commercially available alloys which are being used in the aeronautical industry. Details regarding supplier, heat-treat condition, size, specification, etc., are listed below.

For all five materials listed below, 0.050-inch thick sheet material was tested. Plates of 1/4-inch thickness of these materials were used for the fabrication of the 1/8-inch diameter shear pins, with the exception of the 301 (60% cold reduced) stainless steel. No 1/4-inch plate was available from stock for the 301 stainless steel. Therefore, 0.050-inch sheet was used to determine the shear properties of this material.

1. Sheet Material

N-155 (Multimet)

Supplier: Haynes Stellite Company

Specification: AMS 5532B

Size: 0.050 in. X 36 in. X 96 in.

Heat No. M-5533

Condition: Solution treated by supplier

Rens 41

Supplier: Haynes Stellite Company

Specification: B-50T59-A-51

Size: 0.050 in. X 37 in. X 65 in.

0.050 in. X 42 in. X 45 in.

Heat No. TV-294

Condition: Annealed by supplier and heat-treated to class C by United Heat Treating Company, Fort Worth, Texas as follows:

Solution treat at 1950°F for 30 minutes, air cool;
age at 1400°F for 16 hours, air cool.

AISI 301 (60% Cold Reduced) Stainless Steel

Supplier: Ulbrich Stainless Steels, Inc.

Specification: 60% cold reduced

Size: 0.050 in. X 4 in. X 96 in.

Heat No. 153015

Condition: Cold rolled 60% from 0.125-inch strip by supplier

Ph15-7Mo Condition TH 1050 Stainless Steel

Supplier: Armco Steel Corporation

Specification: AMS 5520A

Size: 0.050 in. X 36 in. X 96 in.

Heat No. 890681

Condition: Annealed by supplier and heat treated to condition TH 1050 by United Heat Treating Co., Fort Worth, Texas as follows:

Heat at 1400°F for 90 minutes, then cool to 60°F within one hour; hold for minimum 30 minutes; subsequently heat at 1050°F for 90 minutes and air cool.

AM 355

Supplier: Allegheny Ludlum Steel Corporation

Specification: AMS 5547A

Size: 0.050 in. X 36 in. X 96 in.

Heat No. 89232

Condition: Annealed by supplier and heat treated to condition SCT 850 by United Heat Treating Co., Fort Worth, Texas as follows:

Heat at 1710°F for 10 minutes, air cool; cool to -100°F and hold for 3 hours; heat at 850°F for 3 hours, air cool.

2. **Plate Material**

N-155 (Multimet)

Supplier: Haynes Stellite Company

Specification: AMS-5532-B

Size: 1/4 in. X 12 in. X 24 in.

Heat No. M-5506

Condition: Solution treated by supplier

René 41

Supplier: Haynes Stellite Company

Specification: B-50T59-A-S1

Size: 1/4 in. X 12 in. X 24 in.

Heat No. TV-363

Condition: Annealed by supplier and heat treated to class C by United Heat Treating Co., Fort Worth, Texas as follows:

Solution treat at 1950°F for 30 minutes, air cool; age at 1400°F for 16 hours, air cool.

Ph15-7Mo Condition TH 1050

Supplier: Armco Steel Corporation

Specification: AMS-5520A

Size: 1/4 in. X 24 in. X 24 in.

Heat No. 49487-2A

Condition: Annealed by supplier and heat treated to condition
TH 1050 by United Heat Treating Co., Fort Worth,
Texas as follows:

Heat at 1400°F for 90 minutes, then cool to 60°F
within one hour; hold for minimum of 30 minutes; sub-
sequently heat at 1050°F for 90 minutes and air cool.

AM355

Supplier: Allegheny Ludlum Steel Corporation

Specification: AMS 5547A

Size: 1/4 in. X 12 in. X 24 in.

Heat No. 69803

Condition: Annealed by supplier and heat treated to condition
SCT 850 by United Heat Treating Co., Fort Worth,
Texas as follows:

Heat at 1710°F for 10 minutes, air cool; cool to
-100°F and hold for 3 hours; heat at 850°F for 3 hours,
air cool.

The chemical composition of each material as reported in the
suppliers certifications are reported in Table 2. The chemical analyses required
by the specifications are also listed.

B Mechanical Properties Determined

The various properties determined from each type of test performed are as
follows:

(1) Tensile tests of sheet

- a. Ultimate tensile strength
- b. Tensile yield strength (0.2% offset)
- c. Elongation in two-inch gage length
- d. Tensile stress at rupture, based on both original and final area
- e. Modulus of elasticity in tension
- f. Notched tensile strength
- g. Notched tensile ratio - ratio of notched tensile strength to
smooth tensile strength

(2) Compression tests of sheet

- a. Compression yield strength
- b. Modulus of elasticity in compression
- c. Tangent moduli (compression)

- (3) Bearing tests of sheet ($e/D = 2.0$ and $e/D = 1.5$)*
 - a. Ultimate bearing strength
 - b. Bearing yield strength
- (4) Shear tests (pin type for plate materials AM 355, N-155, Ph15-7Mo, and René 41, sheet shear for 301 stainless steel)
 - a. Ultimate shear strength
- (5) Room temperature and elevated temperature hardness of each material up to 1500°F
- (6) Room temperature tensile properties of Ph15-7Mo and AM 355, after exposure at temperatures higher than the tempering temperature
- (7) Ultimate tensile strength of the 1/4-inch plate material

C. Test Conditions

The above mechanical properties were obtained at the test temperatures specified in Table 1 for each material, after exposure at these test temperatures for 0.5, 10, 100, and 1000 hours. All tests on Ph15-7Mo, AM 355 and René 41 sheet were performed on specimens cut parallel to the principal direction of rolling, after having previously determined that the properties did not vary significantly with tests performed on specimens cut transverse to the direction of rolling. Tests on AISI 301 (60% cold reduced) stainless steel and N-155 sheet were performed on specimens cut parallel to the principal direction of rolling, as this was the direction that produced the lower ultimate tensile strength.

*Ratio of edge distance to hole diameter.

III. SPECIMEN PREPARATION

In order to achieve uniformity of test results, with variations resulting only from materials properties, the various types of specimens were machined to close tolerances. In an effort to eliminate variation in specimen properties which might be caused by fabrication techniques, the same procedures and personnel were used in each phase of fabrication for all materials. Machine shop procedures are described in III-C. Details of specimen fabrication are as follows.

A Sheet Specimens

The 0.050-inch sheet material received ranged in size from 4 in. X 96 in. to 42 in. X 145 in. On sheets that were 36 in. X 96 in. or larger, oversize specimen blanks were sheared in groups, with each group consisting of one specimen for each type of test as shown in Figure 1. The pattern for shearing a 36 in. X 96 in. sheet is illustrated in Figure 2. The three specimens to be tested for each condition were taken from widely separated groups, in order that the results reflect any materials variation within a sheet. The surfaces of the specimen were left in the as-received condition.

The specimen geometries for the various types of tests were identical for all materials, with the exception of the shear specimens. Because 1/4-inch plate was not available for the 301 extra full hard stainless steel, 1/8-inch diameter pin shear specimens could not be fabricated for this material. A sheet shear specimen (Fig. 6) was substituted for this material.

The specimens fabricated from the 301 stainless steel were sheared from sheets 4 in. X 96 in. The groups of specimens sheared consisted of one specimen for each type of test as shown in Figure 3. The pattern for shearing a 4 in. X 96 in. sheet is illustrated in Figure 4.

1. The tensile specimens were fabricated to conform with QQ-M-151, Type 5, with the ends modified for a pin and clevis type grip (Fig. 6). Groups of six of the oversize blanks were rigidly clamped together for gang-milling of the test section, after the end holes had been drilled. This procedure insured maintaining symmetry with respect to the longitudinal axis through the centers of the pins inserted in the holes.

2. Notched tensile specimens (Fig. 6) were machined to size in groups of six. Care was taken to hold the test section to a 0.500-inch width and the root radius to 0.040 inch within the required tolerances.

3. The 1/4-inch hole in the bearing specimens (Fig. 6) was spaced for the e/D ratios of 1.5 and 2.0. Groups of eight oversize blanks were machined to correct size and the holes drilled. The bearing holes were reamed, individually, to the required tolerances.

4. Compression specimens (Fig. 6) were machined to size in blocks of ten. Great care was exercised in squaring off the ends normal to the longitudinal axis, to maintain specified tolerances.

5. Shear specimens (Fig. 6) for the AISI 301 (60% cold reduced) stainless steel were machined individually being careful to hold the tangency of the slot and circular hole to within ± 0.001 inch.

B. Plate Specimens

Pin shear specimens of 1/8-inch diameter (Fig. 6) were made from 1/4-inch square blocks cut from the 1/4-inch plate. The specimens were turned to final dimensions on a lathe.

C. Specimen Fabrication Procedures

1. Sheet Specimens

All sheet specimens were first sheared on a Wysong and Miles power shear, leaving 1/16-inch stock on all edges for machining. This amount was found to be sufficient for removal of all material affected by the shearing operation.

The smooth and notched tensile specimens were then machined to size, in groups of fifteen, on a Smith and Mills 27-inch shaper, with a carbide tool bit operated at 8 strokes per minute and 0.010 feed.

The holes in the ends of these specimens, as well as those in the bearing specimens, were drilled individually in a drill jig of a 17-inch drill press. Standard H. S. S. drills were used with a heavy base sulphur oil as the coolant. After drilling, each specimen was reamed with a standard H. S. S. reamer, using the heavy base sulphur oil. The sharp burrs on the face of the specimens were removed with a counter bore with pilot cutter.

The tensile (smooth and notched) specimens were then grouped in lots of six, supported by dowel pins through the reamed holes. A 2-1/2-inch H. S. S. shell end mill was used to form the curved portion of the specimens and the test section. This operation was performed on a No. 16 Van Norman milling machine with a spindle speed of 50 rpm and a table feed of 0.6 inches per minute, using the heavy base sulphur oil as a coolant. The 60° V-notch in the notched tensile specimens was machined, using a formed milling cutter, with a 0.040-inch radius rounded edge. A spindle speed of 50 rpm was used in this operation.

The compression specimens were grouped in lots of six and ground to finish size on a Model 2L Brown and Sharpe surface grinder. The grinder had a spindle speed of 3600 rpm, and the specimens were fed at a rate of 0.040 inch cross feed. Soluble oil was used as a coolant.

The sheet shear specimens were machined in two operations. The 1/16-inch holes were located, marked and drilled on a Bridgeport Universal milling machine. A 14-inch diameter abrasive cut-off wheel was used to grind the 45° slots in the specimens using a spindle speed of 3600 rpm and soluble oil as coolant.

2. Plate Specimens

The 1/8-inch diameter shear pins were fabricated from 1/4-inch thick plate material. Specimen blanks 1/4 in. × 1/4 in. × 2 in. were sawed from the plate stock on a Do-All band saw. The specimens were then turned to size on a Le Blonde 13-inch geared head lathe. A Rex AAA tool bit with a 0 to 2° top rake and 8° front clearance was used for the turning operation with a spindle speed of 750 rpm. A feed of 0.015 inch per revolution was used for finish operations.

See Figure 6 for the geometries and tolerances for the above specimen types.

IV. TEST EQUIPMENT

A. Static Tests

1. Testing Machine

Static tests were performed in a Baldwin-Tate-Emery 200,000-pound universal testing machine. Periodic calibration of the machine confirmed accuracy of at least 1/4 percent of all ranges. The machine is equipped with a Baldwin Type MA-1 autographic recorder and a strain pacer. To maintain uniformity of results, a strain rate of 0.005 inch/inch/minute was used through yield.

2. Extensometers

A model PSH-8MS Baldwin-Lima-Hamilton Dual Extensometer was used to measure the deformation of specimens in all elevated temperature tests.

The instrument is a microformer type strain follower, designed for use in conjunction with the Type MA-1 autographic recorder mentioned above to produce a stress-strain diagram covering the entire deformation range of a tension test specimen. Test results can be recorded at either high (500:1) or low (40:1) ranges of strain magnification. The dual magnification feature permits the test to be recorded at high magnification through the elastic portion and continued to fracture at low magnification. Typical test set-ups are shown in Figures 7 through 14. At room temperature, one of each group of these specimens tested in tension was measured with Tuckerman optical strain gages. Accuracy checks, at room temperature, showed that the microformer repeatedly gave results for the modulus of elasticity within $\pm 1\%$ of the average of two optical strain gages mounted on opposite sides of the tensile specimens.

3. Test Furnace

A split-type three-zone resistance heating Marshall High Temperature Furnace was used in conjunction with the testing machine. The furnace had an inside diameter of 5 inches which accommodated the various types of test fixtures and specimens. With this unit a temperature of 2200° F can be maintained with a temperature distribution of $\pm 3^\circ\text{F}$ along its length of 16 inches. Very accurate temperature control was achieved by use of a Leeds and Northrup two-action proportional controller-recorder with the thermocouple mounted on or adjacent to the test specimen. Temperature distribution studies on various types of specimens indicated that temperature variations throughout the test section were less than $\pm 3^\circ\text{F}$ for the entire program. Figure 7 shows the furnace installed in the 200,000-pound BTE testing machine.

4. Aging Furnaces

Exposure of materials to elevated temperatures for the 0.5, 10, 100, and 1000 hour aging times was carried out in four different furnaces. The furnaces used were:

- (1) Model OV-18 Blue M Electric Laboratory Oven, with the forced draft feature added. This oven was used for the aging of all materials at temperatures of 400° and 600° F.
- (2) Lindberg Type RO-153012-S Electric Rod Box Furnace, with capabilities of operation up to 2100° F. Control of the furnace was achieved by the use of a saturable core reactor in conjunction with a Wheelco model 407 Capacitrol and a magnetic amplifier. This system provides a means of smoothly and steplessly controlling the power to the furnace so that close temperature tolerances ($\pm 5^\circ \text{F}$) could be achieved at these (1900° F) temperatures.
- (3) Lindberg Type 243618 EH Box Cyclone Furnace, with capabilities of operation up to 1200° F.
- (4) C. I. Hayes Model LR62 Electric Heat Treating Furnace with capabilities of operation up to 2000° F.

The furnaces were all calibrated with a standard Minneapolis Honeywell Chromel-Alumel thermocouple which was calibrated up to 2000° F at the Honeywell laboratories. Periodic checks were made using as many as nine type K thermocouples to completely define the temperature distribution within the furnaces. By the use of the forced draft features in the lower temperature furnaces and by limiting the volume of the furnace used for aging to approximately 0.5 cubic feet in the higher temperature ovens, it was possible to maintain a temperature distribution at ± 0.5 percent of the desired exposure temperature.

5. Test Apparatus

Unless otherwise noted below, the test fixtures used in this program were identical to those used on Contract AF33(616)-3348, "Determination of Materials Design Criteria for 6Al-4V Titanium Alloy at Room and Elevated Temperatures," and described in detail in WADC Technical Report 53-246, except that they were made of N-155 or Haynes Alloy 25 to withstand the more severe temperature environments encountered in this program.

The compression fixture (Fig. 14) consisted of a Haynes Alloy 25 plunger loaded by attachment to the machine crosshead. The specimen was supported on a Haynes Alloy 25 base with a Haynes LT-1B metal ceramic disc inserted in the top. To prevent buckling in the specimens, side plates with ground, lubricated surfaces were added.

Pin shear tests were conducted in a fixture similar to the one used in our previous program. However, the fixture was modified for our present program to permit use of replaceable hardened inserts as the shearing surfaces. The inserts were fabricated from MV-1 Latrobe tool steel for use at temperatures up to 1000°F, and from Unitemp Waspaloy for use at temperatures from 1000°F to 1900°F. These inserts were replaced after a series of 10 tests to eliminate effects due to wear and insure consistency and repeatability of results.

B. Hardness Tests

The hardness tests on the materials at room and elevated temperatures were conducted with a Rockwell High Temperature Hardness Tester, Model 6 JR-BB. This tester has a larger throat opening to accommodate the Marshall Furnace used in these elevated temperature hardness determinations. The furnace had capability of operation up to 1500°F, and, used with a 2-action Leeds and Northrup proportional controller recorder, was capable of maintaining a temperature distribution of $\pm 3^\circ\text{F}$ during the hardness tests.

V. TEST PROCEDURE

The various tests performed in this program were set up to reproduce the specified conditions as closely as possible. In general, three tests were performed on each material for each condition. Dummy test specimens with several calibrated thermocouples along their gage length were placed in the fixtures before each set of tests. Temperature distribution was checked and the control temperature was varied by changing one or more of the three powerstat settings, until the desired test temperature $\pm 3^\circ\text{F}$ was attained along the gage length. The controller settings thus determined were used in all subsequent testing at the same temperature. The procedures followed in conducting each type of test are discussed below.

A. Tensile Tests

The dimensions of each specimen were measured using a micrometer accurate to .0001 inch. The gage length was established on the specimen by means of two scribe marks that were indented into the specimen sufficiently to be visible after testing. A two-inch alloy gage block that was accurate to 0.001 inch was used to establish the distance between the scribe marks. The specimen was then placed in the pin and clevis arrangement for testing, and a small load applied. This initial loading helped to align the fixtures, holders, and specimens within the furnace, so that accurate placement of the extensometer knife edges could be made on the test section. Once the extensometer was attached, the control thermocouple was attached to the specimen and the furnace was shut.

After the specimen had reached the desired test temperature as indicated on the Leeds and Northrup controller-recorder and held for 30 minutes, it was loaded at a strain rate of 0.005 inch/inch/minute through yield, as indicated on the autographically recorded load-deformation curve. The high-low magnification switch on the extensometer switch box was then switched to low and loading was continued to failure at a head travel rate of 0.10 inch/minute.

After the specimen was removed from the grips, the two pieces were fitted together and measured for elongation and final area.

The elongation measurements were made with inside calipers graduated to 0.001 inch, while the width and thickness measurements were made with a micrometer with pointed anvils.

For the room temperature tests, using Tuckerman optical strain gages to measure deformation, the two gages were mounted directly opposite each other on the specimen gage length and held in position by light spring tension. The specimen was loaded by increments to allow accurate reading of the gages with the Tuckerman auto-collimator. When the deformation indicated by the gages showed that the yield stress had been reached, the gages were removed and the specimen loaded at the constant head travel rate to failure.

B. Compression Tests

After specimen dimensions were measured, a one-inch gage length was marked on the center section of the specimen. The specimen was centered on the fixture and supported by lubricated guide plates to prevent lateral buckling. A new high temperature lubricant, X285, manufactured by the Alpha Molykote Company, was used throughout the tests.

After a small compressive load was applied to steady the specimen, the extensometer knife edges were placed on the gage length. After heating to test temperature and holding for 30 minutes, the specimen was loaded at the constant strain rate through yield, as indicated by the curve drawn by the autographic recorder.

C. Bearing Tests

The bearing test consisted of loading the specimen in tension, via two hardened pins, which fitted through the clevises and reamed holes in the specimen. Prior to testing, the hole diameter was measured using a tapered pin marked in increments of 0.0002 inch. The thickness of the specimen was measured using a vernier micrometer graduated in 0.001 in. units. The specimen was then secured in the clevises with spacers on either side. The upper extensometer arm knife edges were clamped at the edges of the specimen at the center line of the bottom hole and pin, and the lower end of the microformer assembly was attached to the clevis for the same hole. Thus, the deformation measured was that of the center line of the pin relative to its original position at the center of the hole.

After heating to test temperature and holding for 30 minutes, the specimen was loaded at the constant strain rate with gage length assumed to be the diameter of the hole. Yield strength was established on the basis of 2 percent of the hole diameter offset, from the straight line position of the load deformation curve. Ultimate bearing strength was calculated from the maximum load recorded.

D. Shear Tests

Where possible, pin shear data were obtained on all materials. However, in the case of the 301 (60% cold reduced) stainless steel, no 1/4-inch plate was commercially available from stock so that sheet shear data was obtained for this material.

1. Pin Shear Tests

The 1/8-inch diameter pin shear specimens were inserted in the hardened inserts in the shear plates, the control thermocouple attached, and the furnace heated to test temperature. After a soaking period of 30 minutes, a tensile load was applied through the shear plates, until the pin failed in double shear. Only the ultimate load was recorded.

2 Sheet Shear Tests

Sheet shear tests were conducted on the 301 extra hard stainless steel. The specimen configuration used was adopted after an experimental program had been carried out to determine the most appropriate half-width to shear path ratio (henceforth to be designated as w/h ratio) to be used in this series of tests. Five sets of specimens were fabricated for this program, each with a different w/h ratio. The w/h values ranged from 4 to 8. Figure 16 is a curve of shear stress versus w/h ratio, and shows that constant values of shear stress were obtained for values w/h ratios of 7 or greater. For this reason, a w/h ratio of 7 was used for sheet shear phase of the program.

After measuring the shear path and thickness, the specimens were placed into the pin and clevis holders used in the tensile tests and heated to the test temperature. After a hold time of 30 minutes, the specimens were subjected to a tensile load. The specimens sheared along the shear path h, so that the shear stress could be calculated as $\sigma_s = \frac{P}{ht}$, where P is the ultimate load measured and t is thickness of the material.

VI. TEST RESULTS

The data resulting from individual tests are presented in tabular form in Tables 8 through 37. Curves showing the effect of temperature on the various properties investigated are also included as Figures 17 through 346. The results for the different test materials are grouped in the following order:

- (1) Ph15-7Mo(Condition TH 1050) Stainless Steel
- (2) AM 355
- (3) René 41
- (4) N-155
- (5) AISI 301 (60% Cold Reduced) Stainless Steel

The tables have been grouped in the following manner for each test material:

- (1) Tensile Properties, at Various Temperatures and Exposure Times
- (2) Notched Tensile Tests, at Various Temperatures and Exposure Times
- (3) Tensile Rupture Strengths, at Various Temperatures and Exposure Times
- (4) Compressive Properties at Various Temperatures and Exposure Times
- (5) Bearing Properties
- (6) Shear Properties

The graphs reported have been grouped as follows for each test material:

- (1) Properties, as functions of temperature, for constant exposure times. In these curves, properties are expressed as percentage of room-temperature properties. The points on these curves represent the average values shown in the tabulated data.
- (2) Typical tensile stress-strain curves. Each of these curves is a reproduction of the data from one specific test, and does not represent an average.

- (3) Typical curves showing tangent moduli as a function of stress for each compression test condition. Each of these curves represents the results of one specific test, rather than an average.
- (4) Effect of temperature on the rupture strength of each material, based on both original and final areas.

The room temperature properties were shown on the curves for all exposure times. This was done for comparative purposes, even though the exposure times for the room temperature tests were considerably longer than 1000 hours.

VII. DISCUSSION OF TEST RESULTS

A. Ph15-7Mo TH 1050 Stainless Steel

The results of the tests on this material are illustrated in Figures 17 through 82 and are tabulated in Tables 8 through 13.

Figures 17 through 24 show a decrease in the ultimate tensile strength and yield strength with increasing exposure times up to the 100-hour exposure for all test temperatures. However, after 1000 hours exposure there is a marked increase in these strengths of between 5 and 13 percent over the values after 100 hours exposure. This did not occur at 1000°F test temperature, however, where a further decrease in strength of about 1 percent, from the values after the 100-hour exposure, was noted. The greatest increase of both ultimate and yield strengths was observed at 800°F. The fact that the tensile properties did not increase after 1000-hour exposure at 1000°F can probably be attributed to the relative nearness of the test temperature to the tempering temperature of the material, namely 1050°F. This prolonged exposure at 1000°F may have caused the material to have lost some of its temper, hence the decrease in strength.

Figures 58 through 64 show that tensile elongation was not greatly or consistently affected by increases in the exposure times at the various test temperatures. Changes in exposure time affected the tensile and compressive modulus of elasticity values very much in the same manner as they did the tensile strength properties, noting, however, that the compressive moduli did not change as greatly as the tensile moduli.

Figures 33 through 39 show an increase in compressive yield strength for exposure time of 1000 hours, for all temperatures except 400°F. At 400°F, an increase in compressive yield strength is noted after 10 hours exposure, with a decrease of about 3 percent of the room temperature strength, after exposures for 100 and 1000 hours.

The 1000 hours exposure did not have as marked an effect on the bearing properties as it did on the tensile and compressive properties. Only at 800°F was a significant increase in bearing strength noted after 1000 hours exposure. The ultimate bearing strength and bearing yield strength generally decreased with increasing exposure times and temperatures, but the decrease was smaller than that noted for the tensile and compressive tests. There was no significant difference in bearing properties between tests conducted with an e/D ratio of 1.5 and those conducted with an e/D ratio of 2.0, as far as percentage of room temperature properties was concerned.

The shear strength of the material showed the greatest decrease with increasing temperature (Figs. 57 through 63) falling off to about 40 percent of the room temperature value at 1000°F. Here again, however, the shear strength increased after exposure for 1000 hours, over the value observed after 100 hour exposure.

There was a significant decrease in room temperature tensile properties of the material after exposure above its tempering temperature (1050°F). The ultimate tensile strength decreased about 12 percent of its value with no exposure, and the tensile yield strength decreased about 17 percent. The decrease was greater with increasing exposure time.

B. AM 355

The tensile strength and modulus values of this material decreased moderately with increasing exposure times at 400°F. An increase in strength and modulus was observed after exposure times of 100 and 1000 hours for test temperatures of 600° and 800°F. Exposure for 10 hours increased the tensile strength and modulus at 1000°F, but these decreased with further aging.

The tensile yield strength showed a similar behavior, but the percentage of room temperature values, at elevated temperatures, were not as great as the ultimate tensile strengths.

The ultimate bearing strengths and bearing yield strengths, at both e/D ratios, exhibited increases after prolonged exposure times which were similar to the increase in tensile strengths.

Figures 99 through 105 show an increase in compressive yield strength with an increase in exposure times at 400° and 800°F. A similar increase occurs at 600°F, after 100 hours and 1000 hours exposure. Prolonged exposure does not increase the compressive yield strength at 1000°F.

This material showed a decrease in ultimate shear strength after 100 hours exposure at 600° and 800°F, although an increase was observed after this exposure time at 400° and 1000°F. The shear strength increased again after 1000 hours exposure at all temperatures except 1000°F, where it decreased to about 48 percent of the room temperature value.

As in the case of Ph15-7Mo, there was a decrease in room temperature tensile properties of AM 355, after exposure at a temperature higher than the tempering temperature (850°F). Table 5 shows that the ultimate tensile strength decreased approximately 21 percent of its value with no exposure, and the tensile yield strength decreased about 16 percent. Figure 15 shows that these properties decreased with increasing exposure time.

C. René 41

Figures 149 through 155 show that increased exposure times had virtually no effect on the ultimate tensile strength of the material at 600°F. At the higher test temperatures of 900° and 1200°F, increased exposure times cause an increase in ultimate tensile strength, after 100 and 1000 hours exposure. At 1400°F, the aging temperature during heat treating, and above, the increased exposure times tend to decrease the ultimate tensile strength for this material.

The tensile yield strength increases with exposure time at 600°, 900° and 1200° F, after 100 and 1000 hours exposure, and exhibits a decrease in strength at 1400° and 1500° F, after exposure, similar to the decrease in ultimate tensile strength.

Tensile tests on this material at 900° and 1200° F produced a fairly discernible popping and cracking noise, during loading, which showed up as irregularities on the yield portions of some of the tensile stress-strain curves. This was investigated further, and in checking with the Haynes Stellite Company, it was learned that they had experienced similar behavior in tests on some of their other alloys. This behavior could probably best be explained as a mechanism of slip propagation where the grains or series of grains in the metal were not aligned most favorably in this particular straining direction, and as they failed, they emitted this popping and cracking noise.

Figures 173 through 188 show that the ultimate bearing strength and bearing yield strength behavior of this material is similar to its tensile strength behavior. The bearing properties generally increased, with increased exposure times for 600°, 900°, and 1200° F, but then decreased at 1400° and 1500° F. There was practically no difference between the results for both e/D ratios, as far as percentage of room temperature properties was concerned.

Table 20 shows that this material retained much of its room temperature hardness at elevated temperatures up to 1400° F. (This presented some difficulty in testing René 41 in pin shear, as it was harder at elevated temperatures than the first material used for the hardened shear inserts. This difficulty was readily overcome, however, by changing to Waspaloy inserts.)

Figures 203 through 206 show that for the 0.5 hour exposure, the ultimate strength of the material (as represented by the peak of the stress-strain curve) shifts to the right as the temperature is increased up to 900° F, whereas from 900° to 1500° F, the shift is to the left. This trend was found, in general, to reverse itself for longer exposure periods.

D. N-155 (Multimet)

Figures 215 through 280 and Tables 26 through 31 show the test results for this alloy.

Figures 215 through 222 show that generally the ultimate tensile strength decreased with increased exposure times. The tensile yield strength at 1400° F increased with increased exposure after 10 and 100 hours, but decreased approximately 10 percent of room temperature strength after 1000 hours exposure. The yield strength decreased gradually with increased exposure times at 1600°, 1800°, and 1900° F.

The bearing yield strength increased after all exposures at 1400° F and after the 10-hour exposure at 1600° and 1800° F. Increased exposure times at

1900°F had no consistent effect on the bearing yield strength. These results are presented in Figures 239 through 254.

Figures 255 through 261 show that exposure time had little effect on the ultimate shear strength of this material. The most significant change observed was the decrease noted after the 1000 hour exposure at 1600°F where the shear strength dropped about 5 percent of the room temperature strength from the value observed after 0.5 hours exposure.

Increased exposure times had no significant or consistent effect on tensile elongation. The greatest amount of elongation occurred after the 100 hour exposure at 1600°F.

Figures 231 through 238 show that the compressive properties at elevated temperatures did not decrease from the room temperature properties as much as the tensile properties. At 1400°F, the compressive yield strength and compressive modulus of elasticity were about 75 percent of the room temperature values, while the tensile strengths at 1400°F had decreased to 51 percent of the room temperature values.

The compressive properties showed a slight decrease with increasing exposure times at the elevated temperatures.

E. AISI Type 301 (60% Cold Reduced) Stainless Steel

Figures 281 through 346 and Tables 32 through 37 show the test results for this alloy.

At temperatures of 400° and 600°F, increased tensile strength properties were observed with increases in exposure times. At 800° and 1000°F, the tensile strength properties decreased with increasing exposure times, with the exception of the 10 hour exposure of 1000°F. A slight increase, of about 3 percent of room temperature ultimate tensile strength and tensile yield strength, was observed after this exposure, with a decrease upon further aging.

Figures 289 through 296 show that the notched tensile strengths and tensile moduli of elasticity followed the same general trend as the tensile strengths, although a slight increase in these properties was observed after the 10 hour exposure at 800°F.

Figures 305 through 320 show that the bearing properties were reasonably constant with increasing exposure times for both e/D ratios, up to 800°F. At 800°F, the bearing yield strength for $e/D = 1.5$ decreased to a value 59 percent of the room temperature value, after 1000 hours exposure, while for $e/D = 2.0$ it remained at about 70 percent of the room temperature value at 800°F, after 1000 hours. At 1000°F, both bearing yield strength and ultimate bearing strength decreased appreciably, with increasing exposure times.

Figures 297 through 304 show a peculiar behavior of this material in its compressive properties. At 400° and 600°F, there is a substantial increase in compressive yield strength and compressive modulus of elasticity with an increase in exposure times, so that after 10 hours exposure at 400°F, the compressive yield strength increases to a value slightly higher than the value at room temperature and increases even more after 100 and 1000 hours exposure. This increase in properties is noted at 800°F, after 100 and 1000 hours exposure, and at 1000°F after 10 hours exposure. At 1000°F, after 100 and 1000 hours exposure, the compressive strength properties decrease.

The increases in strength, after exposure, can probably be linked to the severe cold working this material has undergone. The residual stresses that were induced in the material at the time of cold working were relieved, after exposure at elevated temperatures, so that increased strength levels would be observed. After 10 hours exposure at 1000°F, the residual stresses have probably been completely relieved, so that further exposure then had a weakening effect on the material.

The ductility of this material in tension was uniformly low at temperatures up to 1000°F. The greatest ductility, in terms of elongation, was observed at 1000°F, the elongation being not appreciably affected by changes in exposure time.

VIII. CONCLUSIONS

The data on the materials presented in this report are considered representative of the materials commercially stocked. No effort was made to obtain material other than that commercially available.

In general, the strength properties of these five materials decreased with increasing temperature over the range investigated at the lower exposure times of 0.5 and 10 hours. However, Ph15-7Mo and AM 355 showed substantial increases in strengths after exposure for 100 and 1000 hours at 800°F and smaller increases at 600°F. At the higher test temperatures for each particular alloy, however, all materials showed a decrease in strength with increasing exposure times.

Increased exposure times had the least effect on René 41 over the temperature range for which it was designed. At the higher temperature of 1500°F, exposure time had slightly more effect, and this only after the 1000-hour exposure.

N-155 generally showed the most gradual decrease in strength properties, with increasing temperature, of all the materials tested. The 301 stainless steel exhibited the most significant change in strength properties, when testing temperature was increased from 800° to 1000°F, as its tensile strengths decreased from about 80 percent of room temperature values at 800°F to around 33 percent at 1000°F.

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TABLE 1. TEST TEMPERATURES FOR MATERIALS INVESTIGATED

<u>Material</u>	<u>Code Letter</u>	<u>Testing Temperature (°F)</u>
Ph15-7Mo Condition TH1050	B	Room, 400, 600, 800, 1000
301 (60% Cold Reduced) Stainless Steel	D	Room, 400, 600, 800, 1000
AM-355	E	Room, 400, 600, 800, 1000
Rene' 41	F	Room, 600, 900, 1200, 1400, 1500
N-155 (Multimet)	G	Room, 1400, 1600, 1800, 1900

TABLE 2. CHEMICAL COMPOSITIONS OF MATERIALS TESTED

(A. 0.050" Sheet)

Multimet - N-155 - Heat M-5533

<u>Cr</u>	<u>W</u>	<u>Fe</u>	<u>C</u>	<u>Si</u>	<u>Co</u>	<u>Ni</u>	<u>Mn</u>	<u>Cb+Ta</u>	<u>Mo</u>	<u>N₂</u>	<u>P</u>	<u>S</u>
22.20	2.50	Bal	.10	.68	19.80	20.00	1.52	.94	2.92	.11	.013	.011

René 41 - Heat TV294

<u>Cr</u>	<u>Fe</u>	<u>C</u>	<u>Si</u>	<u>Co</u>	<u>Ni</u>	<u>Mn</u>	<u>Mo</u>	<u>P</u>	<u>S</u>	<u>Al</u>	<u>Ti</u>	<u>B</u>
18.99	.63	.06	.10	11.26	Bal	.01	9.95	.001	.004	1.53	3.17	.006

301 Stainless Steel - Heat 153015

<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>
0.09	1.24	.030	.014	.56	17.25	7.25

AM-355 - Heat 89232

<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>N₂</u>
.13	.81	.014	.016	.30	15.09	4.27	2.55	.10

Ph15-7Mo - Heat 890681

<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Al</u>	<u>Mo</u>
.075	.56	.016	.013	.35	14.98	7.48	1.06	2.16

TABLE 2. CHEMICAL COMPOSITIONS OF MATERIALS TESTED (Cont'd)

(B. 1/4" Plate)

Multimet - N-155 - Heat M-5506

Cr	W	Fe	C	Si	Co	Ni	Mn	Cb+Ta	Mo	N ₂	P	S
20.84	2.58	Bal	.11	.59	20.49	19.63	1.43	.93	3.01	.11	.011	.015

Rene' 41 - Heat TV-363

Cr	Fe	C	Si	Co	Ni	Mn	Mo	P	S	Al	Ti	B
19.10	.79	.04	.10	10.99	Bal	.07	10.14	.001	.008	1.55	3.14	.006

AM-355 - Heat 69803

C	Mn	P	S	Si	Cr	Ni	Mo	N ₂
.13	.80	.017	.017	.30	15.69	4.14	2.94	.090

Ph15-7Mo - Heat 49487-2A

C	Mn	P	S	Si	Cr	Ni	Al	Mo
.073	.56	.022	.013	.41	14.85	2.32	1.21	2.24

TABLE 3. CHEMICAL RANGE REQUIREMENTS

René 41 - AMS Spec. No. 5545

Carbon (C)	0.12 max
Manganese (Mn)	0.10 max
Silicon (Si)	0.50 max
Sulfur (S)	0.015 max
Chromium (Cr)	18.00 - 20.00
Cobalt (Co)	10.00 - 12.00
Molybdenum (Mo)	9.00 - 10.50
Iron (Fe)	5.00 max
Titanium (Ti)	3.00 - 3.30
Aluminum (Al)	1.40 - 1.60
Boron (B)	0.0030 - 0.010
Nickel (Ni)	Remainder

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Ph15-7Mo - AMS Spec. No. 5520A

Carbon (C)	0.09 max
Manganese (Mn)	1.00 max
Silicon (Si)	1.00 max
Phosphorus (P)	0.04 max
Sulphur (S)	0.03 max
Chromium (Cr)	14.00 - 16.00

TABLE 3. CHEMICAL RANGE REQUIREMENTS (Cont'd)

Ph15-7Mo - AMS Spec. No. 5520A (Cont'd)

Nickel (Ni)	650 - 775
Molybdenum (Mo)	2.00 - 3.00
Aluminum (Al)	0.75 - 1.50

AM 355 - AMS Spec. No. 5547A

Carbon (C)	0.10 - 0.15
Manganese (Mn)	0.50 - 1.25
Silicon (Si)	0.50 max
Phosphorus (P)	0.040 max
Sulphur (S)	0.030 max
Chromium (Cr)	15.00 - 16.00
Nickel (Ni)	4.00 - 5.00
Molybdenum (Mo)	2.50 - 3.25
Nitrogen (N ₂)	0.07 - 0.13

N-155 Multimet - AMS Spec. No. 5532B

Carbon (C)	0.08 - 0.16
Manganese (Mn)	1.00 - 2.00
Silicon (Si)	1.00 max
Phosphorus (P)	0.040 max
Sulphur (S)	0.030 max

TABLE 3. CHEMICAL RANGE REQUIREMENTS (Cont'd)

N-155 Multimet - AMS Spec. No. 5532B (Cont'd)

Chromium (Cr)	20.00 - 22.50
Nickel (Ni)	19.00 - 21.00
Cobalt (Co)	18.50 - 21.00
Molybdenum (Mo)	2.50 - 3.50
Tungsten (W)	2.00 - 3.00
Columbium + Tantalum (Cb + Ta)	0.75 - 1.25
Nitrogen (N ₂)	0.10 - 0.20
Iron (Fe)	Remainder

301 Stainless Steel - AMS Spec. No. 5519E

Carbon (C)	0.15 max
Manganese (Mn)	2.00 max
Phosphorus (P)	0.040 max
Sulphur (S)	0.030 max
Silicon (Si)	1.00 max
Chromium (Cr)	17.00 min
Nickel (Ni)	7.00 min
Molybdenum (Mo)	0.50 max
Copper (Cu)	0.50 max

TABLE 4. MILL REPORTS OF MECHANICAL PROPERTIES

<u>Material</u>	<u>Yield Strength (0.2% offset psi)</u>	<u>Ultimate Tensile Strength (psi)</u>	<u>Elongation (% in 2")</u>	<u>Hardness</u>
<u>A. 0.050" Sheet</u>				
N-155 (Multimet)	52,100	108,950	50.0	RB 92
AM-355	176,340	277,940	12.0	RC 45
René 41	81,400	147,000	40.0	RB 98
Ph15-7Mo	50,400	127,200	41.5	RB 85
301 Stainless Steel	246,000	262,000	6.5	RC 52
<u>B. 1/4" Plate</u>				
N-155 (Multimet)	53,900	112,100	51.0	RB 92
AM-355	60,410	186,010	36.0	RB 98
René 41	79,500	131,000	44.0	RB 95
Ph15-7Mo	77,375	132,925	25.0	RC 22

TABLE 5. ROOM TEMPERATURE TENSILE PROPERTIES
OF Ph15-7Mo AND AM 355 AFTER EXPOSURE ABOVE
TEMPERING TEMPERATURE

<u>Specimen Number</u>	<u>Exposure Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Yield Strength (ksi)</u>	<u>E (psi×10⁻⁶)</u>	<u>Elongation in 2 Inches (%)</u>
<u>AM 355</u>						
E 44A	950	0.5	177.20	159.20	30.47	12.5
E 16A	950	0.5	170.11	152.87	29.26	12.5
		Average	173.66	156.04	29.87	12.5
E 13A	950	10	161.30	131.42	27.57	14.0
E 66A	950	10	161.30	131.42	27.37	14.3
		Average	161.30	131.42	27.47	14.2
E 102A	950	100	156.13	114.94	26.98	15.5
E 14A	950	100	155.17	112.64	26.46	16.2
		Average	155.65	113.79	26.72	15.9
E 54A	950	1000	146.36	100.38	23.00	16.6
E 93A	950	1000	144.06	99.23	23.16	16.5
		Average	145.21	99.81	23.08	16.6

TABLE 5. ROOM TEMPERATURE TENSILE PROPERTIES
OF Ph15-7Mo AND AM 355 AFTER EXPOSURE ABOVE
TEMPERING TEMPERATURE (Cont'd)

<u>Specimen Number</u>	<u>Exposure Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Yield Strength (ksi)</u>	<u>E (psi×10⁻⁶)</u>	<u>Elongation in 2 Inches (%)</u>
<u>Ph 15-7Mo TH 1050</u>						
B 62A	1100	0.5	171.64	147.39	27.97	13.8
B 88A	1100	0.5	173.18	147.51	27.97	13.5
		Average	172.41	147.45	27.97	13.7
B 51A	1100	10	152.87	117.24	24.90	12.8
B 93A	1100	10	153.26	119.92	25.10	13.0
		Average	153.07	118.58	25.00	12.9
B 56A	1100	100	142.53	98.85	23.75	14.5
B 95A	1100	100	144.06	100.00	23.95	15.1
		Average	143.30	99.43	23.85	14.8
B 34A	1100	1000	136.40	95.40	22.45	17.5
B 97A	1100	1000	132.95	92.72	22.61	17.4
		Average	134.68	94.06	22.53	17.5

TABLE 6. TENSILE TESTS OF 1/4-INCH PLATE MATERIALS

<u>Material</u>	<u>Specimen Number</u>	<u>Tensile Strength (ksi)</u>	<u>Hardness (Rockwell)</u>
AM 355	E 1A	209.69	C 46.0
	E 2A	210.68	C 47.0
	Average	210.19	C 46.5
René 41	F 1A	187.24	C 44.0
	F 2A	186.57	C 45.5
	Average	186.91	C 44.8
Ph15-7Mo	B 1A	195.20	C 42.5
	B 2A	194.40	C 43.0
	Average	194.80	C 42.8
N-155	G 1A	112.12	B 92.0
	G 2A	111.90	B 94.0
	Average	112.01	B 93.0

TABLE 7. ROOM TEMPERATURE SHEET SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL AT VARIOUS w/h RATIOS

<u>Specimen Number</u>	<u>w (in.)</u>	<u>h (in.)</u>	<u>w/h</u>	<u>Ultimate Shear Strength (ksi)</u>
DF 1	0.750	0.1875	4	168.37
DF 2	0.750	0.1875	4	166.28
DF 3	0.750	0.1875	4	169.42
Average				168.02
DF 4	0.750	0.150	5	173.86
DF 5	0.750	0.150	5	173.86
DF 6	0.750	0.150	5	174.47
Average				174.73
DF 7	0.750	0.125	6	174.40
DF 8	0.750	0.125	6	177.60
DF 9	0.750	0.125	6	175.20
Average				175.73
DF 10	0.750	0.107	7	179.59
DF 11	0.750	0.107	7	181.51
DF 12	0.750	0.107	7	179.59
Average				180.23
DF 13	0.750	0.0938	8	181.24
DF 14	0.750	0.0938	8	182.40
DF 15	0.750	0.0938	8	180.17
Average				181.27

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
B 66A(T)*	Room	--	194.60	175.10	28.80	8.5	C 42 0
B 86A		--	195.56	175.40	28.10	8.7	C 42.5
B 36A		--	196.60	180.00	28.81	8.6	C 41 0
	Average		195.59	176.83	28.57	8.6	C 41 8
B 83A	400	0.5	173.98	160.16	27.23	5.5	C 40 5
B 13A		0.5	175.40	160.10	27.00	5.2	C 40 0
B 144A		0.5	175.30	161.00	27.20	5.0	C 39 0
	Average		174.89	160.42	27.14	5.2	C 39.8
B 26A		10	170.11	157.83	27.01	4.7	C 39.5
B 41A		10	169.73	160.15	27.01	4.8	C 40.0
B 142A		10	169.35	157.09	26.92	5.0	C 39.5
	Average		169.73	158.36	26.98	4.8	C 39.6
B 31A		100	165.90	154.02	26.82	5.1	C 39.0
B 52A		100	167.05	154.79	26.82	5.2	C 38.5
B 94A		100	164.40	151.00	27.01	5.1	C 38.5
	Average		165.78	153.27	26.88	5.1	C 38.6
B 71A		1000	183.67	164.90	26.73	5.7	C 39.5
B 32A		1000	175.61	154.88	26.51	5.5	C 40.0
B 24A		1000	180.08	160.15	26.82	5.8	C 39.5
	Average		179.79	159.98	26.69	5.7	C 39.6

*Tuckerman Optical Strain Gage

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
B 92A	600	0.5	165.13	147.51	26.25	4.0	C 34.0
B 61A		0.5	165.52	147.89	26.25	3.8	C 34.5
B 46A		0.5	165.90	147.89	26.34	3.8	C 34.0
		Average	165.52	147.76	26.28	3.9	C 34.8
B 84A	10	10	162.07	146.51	26.05	5.0	C 34.0
B 93A		10	163.79	146.74	26.05	4.0	C 34.0
B 146A		10	162.45	145.59	25.96	3.9	C 33.0
		Average	162.77	146.28	26.02	4.3	C 33.6
B 91A	100	100	160.15	145.98	26.05	5.6	C 34.5
B 43A		100	159.00	143.68	25.96	5.7	C 34.0
B 22A		100	159.00	145.21	25.86	5.5	C 32.5
		Average	159.38	144.96	25.96	5.6	C 33.6
B 74A	1000	1000	169.35	145.21	26.05	5.7	C 37.5
B 65A		1000	169.73	147.51	25.86	5.4	C 37.0
B 141A		1000	170.50	145.59	25.86	5.8	C 36.5
		Average	169.86	146.10	25.92	5.6	C 37.0

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
B 82A	800	0.5	150.96	132.95	24.90	12.0	C 34.0
B 35A		0.5	153.26	134.87	25.29	11.5	C 33.5
B 67A		0.5	152.94	134.90	25.10	11.9	C 33.5
		Average	152.39	134.24	25.10	11.8	C 33.6
B 18A		10	149.20	130.10	23.67	10.4	C 31.0
B 57A		10	149.80	126.82	24.71	10.1	C 32.0
B 72A		10	149.02	127.97	24.71	10.5	C 32.5
		Average	149.34	128.30	24.36	10.3	C 31.8
B 147A		100	148.60	128.00	23.60	10.6	C 34.0
B 54A		100	144.83	125.67	24.71	11.0	C 31.5
B 11A		100	144.06	124.90	24.51	11.0	C 31.0
		Average	145.83	126.19	24.27	10.9	C 32.1
B 87A		1000	172.20	150.61	25.91	11.7	C 38.5
B 77A		1000	171.40	147.30	25.91	11.1	C 38.0
B 27A		1000	170.11	149.80	26.09	10.7	C 38.0
		Average	171.22	149.23	25.90	11.2	C 38.1

TABLE 8. TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
B 96A	1000	0.5	102.68	82.76	22.22	20.5	C 30.0
B 14A		0.5	104.98	83.14	22.41	23.6	C 28.0
B 45A		0.5	102.30	85.00	22.23	22.2	C 29.0
		Average	103.32	83.63	22.29	22.1	C 29.0
B 33A	1000	10	102.10	82.40	22.20	24.8	C 23.0
B 85A		10	101.96	81.96	22.35	25.1	C 24.0
B 53A		10	103.53	82.35	22.75	24.3	C 23.0
		Average	102.53	82.24	22.43	24.7	C 23.3
B 143A	1000	100	100.10	79.80	21.9	22.0	C 24.0
B 73A		100	100.00	80.00	22.55	21.9	C 23.0
B 16A		100	98.82	79.22	22.55	22.6	C 22.0
		Average	99.64	79.67	22.33	22.2	C 23.0
B 37A	1000	1000	94.50	76.24	22.10	20.4	C 20.0
B 81A		1000	97.65	80.23	21.91	20.8	C 21.0
B 26A		1000	96.47	78.43	21.96	20.3	C 20.0
		Average	96.21	78.30	21.99	20.5	C 20.3

TABLE 9. NOTCHED TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
B 94B	Room	--	214.32	
B 71B		--	213.38	
B 43B		--	212.39	
		Average	213.36	1.091
B 63B	400	0.5	186.49	
B 14B		0.5	185.21	
B 82B		0.5	186.44	
		Average	186.05	1.063
B 12B		10	181.27	
B 73B		10	180.12	
B 31B		10	180.12	
		Average	180.50	1.056
B 92B		100	172.32	
B 54B		100	173.46	
B 13B		100	173.28	
		Average	173.02	1.044
B 66B		1000	192.39	
B 86B		1000	191.63	
B 55B		1000	192.25	
		Average	192.09	1.068

TABLE 9. NOTCHED TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Notched Strength Ratio
B 52B	600	0.5	170.03	1.028
B 93B		0.5	171.20	
B 22B		0.5	169.08	
		Average	170.10	
B 41B		10	168.00	1.036
B 95B		10	169.04	
B 24B		10	168.75	
		Average	168.60	
B 11B		100	163.83	1.024
B 83B		100	163.67	
B 56B		100	162.11	
		Average	163.20	
B 75B		1000	177.80	1.065
B 65B		1000	181.60	
B 34B		1000	180.00	
		Average	179.80	
B 64B	800	0.5	157.97	1.035
B 85B		0.5	158.17	
B 32B		0.5	157.14	
		Average	157.76	
B 72B		10	154.98	1.039
B 62B		10	155.16	
B 21B		10	155.56	
		Average	155.23	
B 25B		100	153.78	1.053
B 51B		100	154.18	
B 91B		100	152.59	
		Average	153.52	
B 35B		1000	173.60	1.016
B 42B		1000	173.76	
B 96B		1000	174.60	
		Average	173.99	

TABLE 9. NOTCHED TENSILE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
B 102B	1000	0.5	107.91	
B 45B		0.5	108.94	
B 76B		0.5	107.97	
	.	Average	108.27	1.048
B 46B		10	107.14	
B 81B		10	106.35	
B 23B		10	106.75	
		Average	106.75	1.041
B 16B		100	104.56	
B 84B		100	104.96	
B 44B		100	104.92	
		Average	104.81	1.052
B 74B		1000	102.38	
B 61B		1000	102.38	
B 101B		1000	102.38	
		Average	102.38	1.064

TABLE 10. ROPTURE STRENGTHS OF DUE 7Mg BASED
ON BOTH ORIGINAL AND FINAL AREAS

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
B 66A	Room	--	163.4	220.9
B 86A		--	165.4	210.4
B 36A		--	164.0	209.2
		Average	164.3	213.5
B 83A	400	0.5	156.9	209.7
B 13A		0.5	158.5	200.0
B 144A		0.5	154.5	253.9
		Average	156.6	221.2
B 26A		10	153.6	237.3
B 41A		10	151.7	218.8
B 142A		10	150.4	233.6
		Average	151.9	229.9
B 31A		100	151.3	187.2
B 52A		100	147.5	182.5
B 94A		100	149.8	195.5
		Average	149.5	188.4
B 71A		1000	159.2	190.6
B 32A		1000	151.2	199.6
B 24A		1000	153.3	204.1
		Average	154.5	198.1

TABLE 10. RUPTURE STRENGTHS OF Ph15-7Mo BASED
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
B 92A	600	0.5	146.0	167.8
B 61A		0.5	146.3	165.4
B 46A		0.5	147.1	167.4
		Average	146.4	166.8
B 84A		10	147.1	177.8
B 93A		10	147.1	196.9
B 146A		10	151.3	182.9
		Average	148.5	185.8
B 91A		100	150.2	176.6
B 43A		100	146.3	176.9
B 22A		100	146.0	171.6
		Average	147.5	175.0
B 74A	800	1000	152.5	204.6
B 65A		1000	153.5	205.1
B 141A		1000	151.3	199.5
		Average	152.4	203.0
B 82A		0.5	129.9	204.2
B 35A		0.5	134.1	200.5
B 67A		0.5	136.0	202.6
		Average	133.3	202.4
B 18A		10	139.3	208.6
B 57A		10	140.0	215.1
B 72A		10	138.4	217.5
		Average	139.2	213.7
B 147A		100	138.4	208.4
B 54A		100	135.3	207.8
B 11A		100	133.3	201.2
		Average	135.7	205.8
B 87A		1000	146.9	192.5
B 77A		1000	155.1	183.1
B 27A		1000	163.3	188.9
		Average	155.1	188.1

TABLE 10. RUPTURE STRENGTHS OF Ph15-7Mo BASED
ON BOTH ORIGINAL AND FINAL AREAS (CONT'D)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
B 96A	1000	0.5	84.3	205.6
B 14A		0.5	87.0	224.8
B 45A		0.5	95.6	220.4
		Average	88.9	216.9
B 33A		10	93.5	236.1
B 85A		10	96.1	242.6
B 53A		10	94.1	230.8
		Average	94.5	236.5
B 143A		100	93.9	233.3
B 73A		100	93.3	235.6
B 16A		100	91.8	228.1
		Average	93.0	232.3
B 37A		1000	66.9	111.5
B 81A		1000	64.8	130.0
B 26A		1000	65.1	123.9
		Average	65.6	121.8

TABLE 11. COMPRESSIVE PROPERTIES OF PH15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi × 10⁻⁶)</u>
B 5354E	Room	--	200.96	29.45
B 34E		--	202.99	29.62
B 4344E		--	211.20	29.76
		Average	205.05	29.61
B 46E	400	0.5	178.56	27.84
B 61E		0.5	190.08	27.84
B 16E		0.5	184.00	28.64
		Average	184.21	28.11
B 15E		10	200.96	27.20
B 93E		10	187.84	28.80
B 54E		10	185.92	27.84
		Average	191.57	27.94
B 12E		100	183.04	27.68
B 75E		100	178.56	27.52
B 93E		100	185.60	28.32
		Average	182.40	27.84
B 91E		1000	191.04	27.52
B 76E		1000	171.84	28.00
B 56E		1000	185.28	28.16
		Average	182.72	27.90

TABLE 11. COMPRESSIVE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	E_c (psi $\times 10^{-6}$)
B 44E	600	0.5	180.48	26.40
B 63E		0.5	175.36	26.72
B 94E		0.5	165.12	26.24
		Average	173.65	26.45
B 8586E		10	170.88	26.56
B 33E		10	187.20	26.72
B 72E		10	179.52	26.40
		Average	179.20	26.56
B 15E		100	173.76	26.72
B 83E		100	180.48	26.72
B 51E		100	177.92	26.40
		Average	177.39	26.61
B 52E		1000	188.16	26.72
B 8182E		1000	185.92	27.04
B 84E		1000	186.24	27.20
		Average	186.77	26.99
B 11E		0.5	164.80	26.40
B 36E		0.5	166.40	25.44
B 86E		0.5	168.00	25.44
		Average	166.33	25.76
B 45E		10	162.56	25.44
B 53E		10	164.16	26.08
B 14E		10	156.16	25.12
		Average	160.96	25.55
B 95E		100	161.92	25.12
B 71E		100	160.00	25.12
B 32E		100	156.16	25.92
		Average	159.36	25.39
B 81E		1000	174.08	26.08
B 6162E		1000	176.00	26.24
B 9596E		1000	172.80	26.08
		Average	174.29	26.13

TABLE 11. COMPRESSIVE PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec psi X 10⁻⁶</u>
B 13E	1000	0.5	115.64	22.56
B 62E		0.5	122.24	22.40
B 41E		0.5	117.76	22.72
		Average	118.55	22.56
B 35E		10	103.08	20.32
B 55E		10	101.60	23.20
B 92E		10	104.00	21.76
		Average	102.89	21.76
B 194E		100	101.60	22.80
B 73E		100	100.00	21.20
B 21E		100	104.96	22.08
		Average	102.19	22.03
B 7172E		1000	115.52	22.40
B 7576E		1000	112.64	22.80
B 82E		1000	110.08	22.72
		Average	112.75	22.64

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
B 22C	Room	--	317.60	279.20
B 26C		--	315.20	264.80
B 86C		--	317.55	270.20
		Average	316.78	271.40
B 93C	400	0.5	296.80	254.40
B 62C		0.5	300.00	249.60
B 14C		0.5	294.40	258.40
		Average	297.06	254.13
B 21C		10	289.60	252.00
B 76C		10	296.00	255.60
B 56C		10	295.20	248.00
		Average	293.60	251.86
B 65C		100	292.00	250.40
B 25C		100	288.80	243.20
B 94C		100	296.80	256.00
		Average	292.53	249.86
B 53C		1000	288.80	248.80
B 51C		1000	297.60	256.00
B 61C		1000	294.40	252.80
		Average	293.60	252.53

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
B 54C	600	0.5	291.20	250.80
B 11C		0.5	283.20	241.60
B 82C		0.5	287.20	246.40
		Average	287.20	246.26
B 96C		10	277.60	243.20
B 55C		10	283.20	236.00
B 73C		10	288.00	249.60
		Average	282.93	242.93
B 81C		100	280.00	240.00
B 13C		100	276.80	237.60
B 43C		100	279.20	243.20
		Average	278.66	240.26
B 32C		1000	290.40	249.60
B 75C		1000	288.00	247.20
B 44C		1000	285.60	245.20
		Average	288.00	247.33
B 36C	800	0.5	247.20	216.80
B 64C		0.5	244.80	214.40
B 12C		0.5	250.40	219.60
		Average	247.46	216.93
B 15C		10	243.20	220.00
B 63C		10	240.80	215.60
B 95C		10	246.40	224.80
		Average	243.46	220.13
B 47C		100	244.00	228.00
B 85C		100	243.20	227.20
B 16C		100	245.60	231.20
		Average	244.26	228.80
B 33C		1000	270.40	236.00
B 52C		1000	264.80	232.00
B 35C		1000	275.20	242.00
		Average	270.13	236.66

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Bearing Strength (ksi)</u>	<u>Bearing Yield Strength (ksi)</u>
B 71C	1000	0.5	169.60	159.40
B 92C		0.5	170.40	156.40
B 45C		0.5	171.20	157.60
		Average	170.40	157.46
B 53C		10	165.60	150.40
B 23C		10	165.60	148.80
B 72C		10	165.20	151.20
		Average	165.47	150.13
B 56C		100	163.20	148.80
B 31C		100	160.00	148.80
B 74C		100	164.00	148.00
		Average	162.40	148.53
B 42C		1000	141.60	118.80
B 46C		1000	140.00	120.00
B 91C		1000	140.80	119.20
		Average	140.80	119.33

TABLE 12. BEARING PROPERTIES OF TMS-7MC AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. $e/D = 2.0$

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Bearing Strength (ksi)</u>	<u>Bearing Yield Strength (ksi)</u>
B 43D	Room	--	400.80	322.40
B 46D		--	400.00	328.00
B 34D		--	398.40	320.00
		Average	399.73	323.47
B 25D	400	0.5	382.40	300.00
B 64D		0.5	378.40	296.00
B 142D		0.5	386.40	303.60
		Average	382.40	299.87
B 31D		10	377.60	296.80
B 63D		10	382.40	300.40
B 14D		10	380.00	298.40
		Average	380.00	298.53
B 11D		100	378.40	296.00
B 93D		100	377.60	296.80
B 65D		100	380.80	299.20
		Average	378.93	297.33
B 84D		1000	383.20	291.20
B 82D		1000	378.40	294.40
B 141D		1000	372.80	296.80
		Average	378.13	294.13

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
B 32D	600	0.5	364.80	291.20
B 62D		0.5	363.20	288.80
B 95D		0.5	367.20	294.40
		Average	365.07	291.47
B 96D		10	360.80	288.00
B 41D		10	366.00	290.40
B 33D		10	363.20	288.80
		Average	363.33	289.07
B 15D		100	360.80	286.40
B 86D		100	364.00	288.00
B 54D		100	368.00	288.00
		Average	364.27	287.47
B 21D		1000	369.60	292.80
B 16D		1000	367.20	296.00
B 73D		1000	372.40	289.60
		Average	369.73	292.80
B 83D	800	0.5	335.20	262.40
B 146D		0.5	328.00	259.20
B 144D		0.5	342.00	264.80
		Average	335.07	262.13
B 26D		10	328.00	260.00
B 72D		10	330.40	262.40
B 143D		10	333.20	264.00
		Average	330.53	262.13
B 51D		100	334.40	270.40
B 94D		100	333.60	272.00
B 24D		100	336.00	271.20
		Average	334.67	271.20
B 61D		1000	347.20	285.60
B 13D		1000	344.00	283.20
B 12D		1000	348.80	280.80
		Average	346.67	283.20

TABLE 12. BEARING PROPERTIES OF Ph15-7Mo AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Bearing Strength (ksi)</u>	<u>Bearing Yield Strength (ksi)</u>
B 22D	1000	0.5	220.00	190.40
B 76D		0.5	221.60	187.20
B 44D		0.5	220.00	194.40
		Average	220.53	190.67
B 21D		10	215.20	185.60
B 75D		10	211.20	184.00
B 52D		10	219.60	188.80
		Average	215.33	186.13
B 45D		100	211.20	182.40
B 71D		100	210.40	184.00
B 23D		100	211.20	184.00
		Average	210.93	183.47
B 55D		1000	190.40	151.20
B 91D		1000	192.00	151.20
B 66D		1000	188.00	150.40
		Average	190.13	150.93

TABLE 13. SHEAR PROPERTIES OF FM15-7M6 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
B 43F	Room	--	144.89
B 7F		--	147.34
B 9F		--	146.14
		Average	146.12
B 37F	400	0.5	113.47
B 30F		0.5	115.32
B 28F		0.5	112.27
		Average	113.69
B 49F		10	115.32
B 31F		10	113.07
B 32F		10	119.80
		Average	116.06
B 36F		100	115.07
B 34F		100	113.07
B 53F		100	114.91
		Average	114.35
B 35F		1000	119.92
B 33F		1000	117.89
B 26F		1000	118.70
		Average	118.84

TABLE 13. SHEAR PROPERTIES OF Ph15-7Mo AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Ultimate Shear Strength (ksi)
B 17F	600	0.5	109.06
B 39F		0.5	109.06
B 52F		0.5	105.95
		Average	108.02
B 29F		10	108.39
B 8F		10	105.45
B 38F		10	106.76
		Average	106.86
B 11F		100	107.86
B 51F		100	106.36
B 43F		100	107.58
		Average	107.27
B 6F	800	1000	113.82
B 2F		1000	116.67
B 15F		1000	115.24
		Average	115.24
B 90F		0.5	101.63
B 55F		0.5	100.64
B 40F		0.5	101.87
		Average	101.38
B 44F		10	101.42
B 13F		10	100.81
B 20F		10	100.81
		Average	101.01
B 54F	1000	100	109.76
B 23F		100	103.25
B 19F		100	106.50
		Average	106.50
B 4F		1000	115.04
B 41F		1000	115.45
B 21F		1000	115.04
		Average	115.18

TABLE 13. SHEAR PROPERTIES OF Ph15-7Mo AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Time Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
B 45F	1000	0.5	71.60
B 22F		0.5	74.00
B 14F		0.5	72.76
		Average	72.79
B 25F		10	74.40
B 5F		10	64.23
B 47F		10	69.92
		Average	69.52
B 3F		100	66.26
B 18F		100	67.07
B 10F		100	66.66
		Average	66.67
B 21F		1000	60.98
B 42F		1000	61.79
B 1F		1000	60.16
		Average	60.98

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
E 56A	Room	--	219.54	183.50	29.28	13.9	C 46.0
E 82A		--	220.30	184.61	30.23	13.3	C 46.5
E 12A(T)*		--	220.00	183.60	29.51	13.2	C 46.5
		Average	219.95	183.90	29.67	13.4	C 46.3
E 81A	400	0.5	209.16	161.35	26.25	9.9	C 40.0
E 53A		0.5	211.87	160.91	26.65	10.2	C 41.0
E 105A		0.5	210.72	162.83	27.33	10.0	C 40.0
		Average	210.58	161.70	26.74	10.0	C 40.6
E 63A		10	205.36	156.32	26.99	8.3	C 38.0
E 114A		10	210.34	160.92	26.54	8.3	C 38.0
E 43A		10	202.68	157.08	26.57	8.2	C 39.0
		Average	206.13	158.11	26.70	8.3	C 38.3
E 73A		100	201.92	152.11	26.19	8.2	C 36.0
E 46A		100	199.23	150.19	26.49	8.0	C 37.0
E 112A		100	205.36	153.20	26.53	8.2	C 36.0
		Average	202.17	151.83	26.40	8.1	C 36.3
E 41A		1000	198.47	142.15	26.51	8.8	C 35.0
E 15A		1000	199.62	143.68	26.26	8.4	C 36.0
E 22A		1000	199.62	142.15	26.35	9.0	C 35.0
		Average	199.24	142.66	26.37	8.7	C 35.3

*Tuckerman Optical Strain Gage

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
E 34A	600	0.5	206.51	155.94	26.20	8.6	C 40.0
E 78A		0.5	201.92	156.32	25.93	8.8	C 39.0
E 113A		0.5	204.98	155.56	25.67	8.7	C 39.0
		Average	204.47	155.94	25.93	8.7	C 39.3
E 101A		10	201.15	153.26	25.44	7.3	C 39.0
E 123A		10	201.53	155.17	25.07	7.2	C 38.0
E 31A		10	203.06	154.02	25.67	6.9	C 37.5
		Average	201.91	154.15	25.39	7.1	C 38.1
E 86A		100	203.45	153.64	25.82	6.2	C 38.0
E 61A		100	204.21	167.04	25.10	6.4	C 39.0
E 26A		100	204.60	160.15	25.67	6.0	C 39.0
		Average	204.09	160.28	25.53	6.2	C 38.3
E 105A		1000	205.75	158.24	25.86	7.9	C 37.0
E 24A		1000	207.66	158.50	25.86	7.1	C 38.0
E 72A		1000	206.71	158.24	25.48	7.5	C 38.0
		Average	206.71	158.33	25.73	7.5	C 37.6

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
E 25A	800	0.5	180.00	133.60	24.47	7.6	C 38.0
E 76A		0.5	182.80	132.80	24.78	7.9	C 38.5
E 104A		0.5	183.59	133.33	24.60	7.9	C 38.0
		Average	182.13	133.24	24.62	7.8	C 38.1
E 83A	1000	10	186.16	137.16	24.33	7.8	C 37.0
E 23A		10	185.82	136.02	24.43	7.6	C 38.0
E 124A		10	186.97	137.93	24.33	7.7	C 38.0
		Average	186.32	137.04	24.33	7.7	C 37.6
E 51A	100	100	193.48	141.38	24.52	6.2	C 38.5
E 32A		100	190.42	140.23	24.52	6.4	C 39.0
E 91A		100	190.80	139.85	24.71	6.3	C 39.0
		Average	191.57	140.49	24.58	6.3	C 38.3
E 65A	1000	1000	205.40	144.40	24.81	7.1	C 41.0
E 52A		1000	202.30	143.90	24.91	7.5	C 41.0
E 103A		1000	203.45	144.83	25.09	7.5	C 40.5
		Average	203.72	144.38	24.94	7.4	C 40.8

TABLE 14. TENSILE PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
E 106A	1000	0.5	125.96	98.08	20.96	12.5	C 35.0
E 112A		0.5	123.08	99.62	20.87	12.6	C 34.0
E 23A		0.5	126.92	97.69	20.88	11.6	C 33.5
		Average	125.32	98.46	20.90	12.2	C 34.1
E 101A	10	10	131.03	111.10	22.03	15.1	C 31.0
E 33A		10	132.57	108.43	22.32	14.1	C 29.5
E 55A		10	134.10	109.19	22.22	14.3	C 29.5
		Average	132.57	109.57	22.19	14.5	C 29.6
E 62A	100	100	116.98	94.34	20.38	16.3	C 26.0
E 74A		100	117.69	97.69	20.77	16.8	C 26.5
E 95A		100	116.86	92.72	20.50	15.8	C 24.5
		Average	117.18	94.92	20.55	16.3	C 25.6
E 94A	1000	1000	109.58	88.89	20.11	19.1	C 20.5
E 96A		1000	105.66	85.28	20.31	20.4	C 21.0
E 85A		1000	109.20	90.04	20.11	18.4	C 20.0
		Average	108.15	88.07	20.18	19.3	C 20.5

TABLE 15. NOTCHED TENSILE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
E 47B	Room	--	248.27	
E 55B		--	256.70	
E 94B		--	247.10	
		Average	250.69	1.140
E 101B	400	0.5	223.85	
E 44B		0.5	220.99	
E 67B		0.5	228.02	
		Average	224.29	1.065
E 88B		10	219.23	
E 27B		10	220.62	
E 123B		10	223.92	
		Average	221.26	1.073
E 31B		100	223.83	
E 121B		100	228.79	
E 57B		100	229.57	
		Average	227.40	1.125
E 93B		1000	226.80	
E 17B		1000	225.67	
E 86B		1000	223.75	
		Average	225.41	1.131

TABLE 15. NOTCHED TENSILE PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Notched Strength Ratio
E 28B	600	0.5	215.70	
E 32B		0.5	238.70	
E 114B		0.5	219.16	
		Average	224.19	1.096
E 61B		10	222.60	
E 37B		10	220.30	
E 108B		10	221.15	
		Average	221.35	1.051
E 92B		100	220.30	
E 56B		100	223.76	
E 14B		100	224.90	
		Average	222.99	1.093
E 72B	800	1000	229.12	
E 65B		1000	227.20	
E 121B		1000	228.00	
		Average	228.11	1.104
E 22B		0.5	203.83	
E 78B		0.5	205.35	
E 124B		0.5	203.83	
		Average	204.33	1.122
E 91B		10	206.13	
E 107B		10	205.10	
E 12B		10	206.15	
		Average	215.79	1.158
E 38B	800	100	209.06	
E 71B		100	208.08	
E 111B		100	208.05	
		Average	208.40	1.088
E 48B		1000	211.34	
E 98B		1000	213.23	
E 62B		1000	215.00	
		Average	213.19	1.046

TABLE 15. NOTCHED TENSILE PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
E 14B	1000	0.5	135.60	
E 103B		0.5	132.20	
E 96B		0.5	136.02	
		Average	134.61	1.074
E 51B		10	166.28	
E 106B		10	166.70	
E 85B		10	167.43	
		Average	166.80	1.258
E 26B		100	124.50	
E 84B		100	123.40	
E 66B		100	126.04	
		Average	124.65	1.064
E 77B		1000	105.40	
E 122B		1000	111.70	
E 63B		1000	110.15	
		Average	109.08	1.009

TABLE 16. RUPTURE STRENGTHS OF AM 355 BASED ON
BOTH ORIGINAL AND FINAL AREAS

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
E 56A	Room	--	183.91	281.36
E 82A		--	186.47	261.74
E 12A		--	194.12	267.57
		Average	188.16	270.22
E 81A	400	0.5	193.63	245.08
E 53A		0.5	194.64	249.02
E 105A		0.5	194.64	246.00
		Average	194.30	246.70
E 63A		10	185.82	263.44
E 114A		10	190.80	267.02
E 43A		10	181.92	259.18
		Average	186.18	263.21
E 73A		100	183.91	247.42
E 46A		100	183.91	253.97
E 112A		100	176.25	256.41
		Average	181.35	252.60
E 41A		1000	174.33	220.77
E 15A		1000	179.12	236.11
E 22A		1000	174.33	224.69
		Average	175.92	227.19

TABLE 16. RUPTURE STRENGTHS OF AM 355 BASED ON
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
E 34A	600	0.5	176.25	207.86
E 78A		0.5	178.93	229.60
E 113A		0.5	181.99	219.20
		Average	179.05	218.88
E 101A		10	193.49	235.76
E 123A		10	191.57	260.42
E 31A		10	191.57	243.31
		Average	192.21	246.49
E 86A		100	183.91	232.33
E 61A		100	183.91	232.33
E 26A		100	185.82	235.32
		Average	184.54	233.32
E 105A	800	1000	193.49	279.78
E 24A		1000	201.15	229.26
E 72A		1000	197.70	201.11
		Average	197.45	236.35
E 25A		0.5	153.60	196.92
E 76A		0.5	169.14	222.62
E 104A		0.5	169.92	223.65
		Average	164.22	214.39
E 83A		10	170.50	219.86
E 23A		10	167.82	216.83
E 124A		10	169.35	218.38
		Average	169.22	218.35
E 51A	800	100	149.43	207.89
E 32A		100	157.85	198.55
E 91A		100	170.11	233.68
		Average	159.13	213.37
E 65A		1000	186.21	212.41
E 52A		1000	187.74	229.08
E 103A		1000	184.29	210.69
		Average	186.08	217.39

TABLE 16. RUPTURE STRENGTHS OF AM 355 BASED ON
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
E 106A	1000	0.5	67.31	115.97
E 112A		0.5	66.15	112.20
E 23A		0.5	67.43	115.11
		Average	66.96	114.42
E 101A		10	67.05	108.02
E 33A		10	68.20	149.33
E 55A		10	65.90	132.31
		Average	67.05	129.55
E 62A		100	63.77	142.26
E 74A		100	65.38	147.06
E 95A		100	64.37	135.48
		Average	64.50	141.60
E 94A		1000	65.52	119.08
E 96A		1000	63.40	99.23
E 85A		1000	62.45	128.35
		Average	63.79	115.55

TABLE 17. COMPRESSIVE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi × 10⁻⁶)</u>
E 51E	Room	--	216.18	30.25
E 76E		--	216.56	29.51
E 43E		--	218.16	30.25
		Average	216.79	30.00
E 101E	400	0.5	176.92	28.15
E 614E		0.5	180.92	28.31
E 114E		0.5	184.31	28.46
		Average	180.72	28.31
E 312E		10	180.00	28.46
E 35E		10	181.54	27.69
E 124E		10	186.77	28.00
		Average	182.77	28.05
E 104E		100	182.46	27.54
E 82E		100	180.00	28.77
E 23E		100	186.15	28.77
		Average	182.87	28.36
E 512E		1000	183.08	28.15
E 32E		1000	185.85	28.92
E 113E		1000	195.08	28.92
		Average	188.00	28.66

TABLE 17. COMPRESSIVE PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	Ec (psi × 10 ⁻⁶)
E 834E	600	0.5	179.38	26.92
E 134E		0.5	174.15	26.92
E 65E		0.5	172.00	27.07
		Average	175.18	26.97
E 412E		10	172.31	26.92
E 22E		10	172.31	26.92
E 81E		10	173.85	26.77
		Average	172.82	26.87
E 21E		100	169.54	26.15
E 334E		100	177.57	26.92
E 1134E		100	173.54	26.92
		Average	173.55	26.66
E 434E		1000	176.92	26.92
E 25E		1000	174.77	27.07
E 111E		1000	184.62	27.07
		Average	178.77	27.02
E 456E	800	0.5	164.92	26.15
E 123E		0.5	163.08	26.15
E 62E		0.5	170.77	26.15
		Average	166.25	26.15
E 12E		10	166.46	26.15
E 93E		10	173.23	26.15
E 612E		10	167.08	26.31
		Average	168.92	26.20
E 55E		100	175.38	27.08
E 24E		100	169.85	25.69
E 102E		100	169.23	26.31
		Average	171.49	26.36
E 33E		1000	190.15	28.62
E 1056E		1000	195.38	28.62
E 356E		1000	193.38	27.69
		Average	192.97	28.31

TABLE 17. COMPRESSIVE PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi × 10⁻⁶)</u>
E 754E	1000	0.5	125.54	21.54
E 812E		0.5	128.31	22.31
E 61E		0.5	131.08	21.69
		Average	128.31	21.85
E 14E		10	116.92	21.54
E 1112E		10	120.92	21.15
E 86E		10	111.08	21.69
		Average	116.31	21.46
E 96E		100	108.31	21.54
E 16E		100	103.38	21.54
E 1012E		100	100.00	21.38
		Average	103.90	21.49
E 41E		1000	89.85	19.85
E 556E		1000	92.31	19.85
E 112E		1000	93.23	19.69
		Average	91.80	19.80

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
E 124C	Room	--	384.40	320.00
E 106C		--	385.60	320.00
E 15C		--	388.80	325.60
		Average	386.27	321.87
E 63C	400	0.5	354.40	303.20
E 94C		0.5	353.20	295.20
E 24C		0.5	356.00	300.80
		Average	354.53	299.73
E 62C		10	348.80	292.80
E 23C		10	352.00	295.20
E 114C		10	355.20	296.00
		Average	352.00	294.67
E 76C		100	356.00	288.00
E 94C		100	351.20	291.20
E 33C		100	347.60	295.20
		Average	351.60	291.47
E 13C		1000	350.40	291.20
E 121C		1000	346.40	294.40
E 61C		1000	353.60	290.40
		Average	350.13	292.00

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
E 53C	600	0.5	346.40	288.00
E 96C		0.5	351.20	292.80
E 32C		0.5	343.20	284.00
		Average	346.93	288.27
E 64C		10	345.60	286.40
E 31C		10	340.00	284.00
E 25C		10	342.80	284.80
		Average	342.80	285.07
E 35C		100	349.60	289.60
E 72C		100	344.00	284.80
E 85C		100	342.40	280.80
		Average	345.33	285.07
E 43C		1000	347.20	286.40
E 84C		1000	348.80	287.20
E 123C		1000	346.40	285.60
		Average	347.47	286.40
E 34C	800	0.5	320.00	270.40
E 112C		0.5	320.80	270.40
E 104C		0.5	320.00	270.40
		Average	320.27	270.40
E 101C		10	321.60	268.88
E 45C		10	320.80	272.00
E 71C		10	322.80	272.00
		Average	321.73	270.93
E 14C		100	328.00	275.20
E 73C		100	323.20	271.20
E 52C		100	320.40	268.00
		Average	323.87	271.47
E 105C		1000	324.80	272.00
E 65C		1000	328.80	275.20
E 36C		1000	320.00	269.60
		Average	324.53	272.27

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $c/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
E 102C	1000	0.5	232.80	203.20
E 44C		0.5	231.20	205.60
E 11C		0.5	230.40	199.20
		Average	231.47	202.67
E 83C		10	184.80	165.60
E 26C		10	184.00	164.40
E 66C		10	188.00	168.00
		Average	185.60	166.00
E 63C		100	172.00	147.20
E 12C		100	168.80	147.20
E 103C		100	175.20	150.40
		Average	172.00	148.27
E 82C		1000	167.20	140.00
E 111C		1000	166.40	140.00
E 16C		1000	168.00	141.60
		Average	167.20	140.53

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
E 86D	Room	--	496.00	400.00
E 103D		--	499.20	400.00
E 53D		--	500.80	400.80
		Average	498.67	400.27
E 122D	400	0.5	460.00	368.00
E 41D		0.5	462.40	372.80
E 65D		0.5	452.80	364.00
		Average	458.40	368.27
E 95D		10	450.40	361.60
E 21D		10	454.40	364.00
E 46D		10	457.60	367.20
		Average	454.13	364.27
E 85D		100	452.00	362.40
E 61D		100	456.00	366.40
E 24D		100	448.40	360.00
		Average	452.13	362.93
E 93D		1000	451.20	360.00
E 55D		1000	455.60	361.60
E 14D		1000	447.20	359.20
		Average	451.33	360.27

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
E 25D	600	0.5	440.40	353.60
E 105D		0.5	432.00	351.20
E 72D		0.5	436.00	352.00
		Average	436.13	352.27
E 32D		10	436.80	355.20
E 73D		10	434.40	350.40
E 114D		10	432.80	346.40
		Average	434.67	350.67
E 104D		100	435.20	356.00
E 26D		100	434.40	351.20
E 63D		100	430.40	346.00
		Average	433.33	351.07
E 33D		1000	436.80	354.40
E 102D		1000	436.00	356.80
E 74D		1000	438.80	353.60
		Average	437.20	354.93
E 82D	800	0.5	384.00	316.80
E 44D		0.5	388.80	319.20
E 12D		0.5	380.00	315.20
		Average	384.27	317.07
E 43D		10	384.80	319.20
E 16D		10	386.40	323.20
E 84D		10	384.00	316.00
		Average	385.07	319.47
E 54D		100	391.60	326.40
E 113D		100	383.20	315.20
E 42D		100	387.20	320.00
		Average	387.33	320.53
E 52D		1000	391.20	330.40
E 15D		1000	394.40	332.80
E 106D		1000	388.80	328.00
		Average	391.47	330.40

TABLE 18. BEARING PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $c/D = 2.0$				
Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
E 124D	1000	0.5	290.40	236.00
E 86D		0.5	288.80	230.40
E 36D		0.5	292.80	237.60
		Average	290.67	234.67
E 34D		10	266.40	211.20
E 83D		10	269.60	215.20
E 111D		10	266.40	213.60
		Average	267.47	213.33
E 121D		100	226.40	184.80
E 66D		100	224.00	180.80
E 23D		100	228.80	184.00
		Average	226.40	183.20
E 22D		1000	200.00	156.00
E 81D		1000	203.20	162.80
E 76D		1000	203.20	165.60
		Average	202.13	161.47

TABLE 19. SHEAR PROPERTIES OF AM 355 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
E 62F	Ambient	--	138.43
E 61F		--	135.49
E 60F		--	138.95
		Average	137.62
E 1F	400	0.5	121.14
E 2F		0.5	119.08
E 3F		0.5	123.06
		Average	121.09
E 4F		10	115.88
E 5F		10	118.70
E 6F		10	123.98
		Average	119.52
E 7F		100	118.17
E 8F		100	116.28
E 9F		100	121.02
		Average	118.49
E 46F		1000	123.78
E 47F		1000	121.95
E 48F		1000	122.76
		Average	122.83

TABLE 19. SHEAR PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Ultimate Shear Strength (ksi)
E 19F	600	0.5	121.95
E 20F		0.5	124.79
E 21F		0.5	123.37
		Average	123.37
E 22F		10	124.79
E 23F		10	113.01
E 24F		10	113.41
		Average	117.07
E 25F		100	119.11
E 26F		100	118.69
E 27F		100	118.90
		Average	118.90
E 29F	800	1000	122.36
E 30F		1000	123.17
E 28F		1000	122.77
		Average	122.77
E 12F		0.5	111.65
E 11F		0.5	110.02
E 10F		0.5	113.28
		Average	111.65
E 15F		10	112.27
E 14F		10	110.84
E 13F		10	122.69
		Average	115.27
E 17F	800	100	112.06
E 16F		100	110.24
E 18F		100	110.43
		Average	110.91
E 34F		1000	119.51
E 35F		1000	118.70
E 36F		1000	120.33
		Average	119.51

TABLE 19. SHEAR PROPERTIES OF AM 355 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
E 37F	1000	0.5	84.15
E 38F		0.5	74.39
E 39F		0.5	79.27
		Average	79.20
E 42F		10	66.26
E 40F		10	66.99
E 41F		10	66.67
		Average	66.64
E 43F		100	68.29
E 44F		100	72.76
E 45F		100	70.53
		Average	70.53
E 33F		1000	69.51
E 32F		1000	63.01
E 31F		1000	66.26
		Average	66.26

TABLE 20. TENSILE PROPERTIES OF RENE 41 AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
F 92A	Room	---	184.96	141.60	30.14	10.9	C 44.0
F 22A (T)*		---	186.32	142.37	29.91	10.0	C 43.0
F 37A		---	183.28	141.40	29.87	10.3	C 44.0
		Average	184.85	141.79	29.97	10.4	C 43.6
F 41A	600	0.5	172.10	127.05	28.12	13.8	C 43.0
F 103A		0.5	170.90	126.90	27.95	13.6	C 43.0
F 73A		0.5	170.11	126.50	28.97	14.0	C 43.0
		Average	171.03	126.82	28.05	13.8	C 43.0
F 28A	10	10	167.40	123.60	27.80	11.6	C 41.0
F 116A		10	167.90	121.80	27.65	11.2	C 42.0
F 25A		10	169.73	122.99	27.39	11.8	C 42.0
		Average	168.34	122.80	27.61	11.5	C 41.6
F 62A	100	100	169.35	126.44	27.90	13.3	C 42.0
F 71A		100	167.82	124.14	28.35	13.6	C 42.0
F 96A		100	168.20	124.52	27.78	13.3	C 42.0
		Average	168.45	126.03	28.01	13.4	C 42.0
F 26A	1000	1000	169.35	126.44	28.11	15.2	C 42.0
F 68A		1000	171.26	126.44	28.38	16.0	C 43.0
F 104A		1000	168.20	127.97	28.16	17.9	C 42.0
		Average	169.60	126.95	28.22	16.4	C 42.3

*Tuckerman Optical Strain Gage

TABLE 20. TENSILE PROPERTIES OF RENE 41 AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield St.ngth (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
F 108A	900	0.5	164.75	122.60	26.31	16.8	C 41 0
F 13A		0.5	165.90	124.35	26.78	16.8	C 41 0
F 55A		0.5	163.22	123.00	26.44	16.6	C 42 0
		Average	164.62	123.32	26.51	16.7	C 41.3
F 115A	1000	10	154.00	119.20	26.30	17.5	C 40.0
F 23A		10	159.96	123.19	26.44	17.6	C 39.0
F 44A		10	157.47	122.22	26.10	16.9	C 40.0
		Average	157.14	121.54	26.28	17.3	C 39.6
F 58A	1000	100	162.84	124.14	26.50	14.3	C 41.0
F 128A		100	160.92	124.50	25.93	14.0	C 40.0
F 32A		100	161.72	124.35	26.24	14.0	C 39.0
		Average	161.82	124.33	26.22	14.1	C 40.0
F 105A	1000	1000	165.20	124.49	26.36	14.6	C 41.0
F 61A		1000	164.50	124.50	26.10	14.1	C 41.0
F 12A		1000	162.80	125.86	26.42	14.3	C 42.0
		Average	164.16	124.95	26.29	14.3	C 41.3

TABLE 20. TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
F 15A	1200	0.5	160.60	122.40	25.42	7.6	C 40.0
F 42A		0.5	160.92	122.32	26.67	7.8	C 40.0
F 106A		0.5	160.54	123.37	25.67	7.4	C 39.0
		Average	160.67	122.70	25.59	7.6	C 39.6
F 47A	1100	10	155.17	121.07	25.15	5.2	C 34.0
F 118A		10	155.56	121.84	25.67	5.2	C 35.0
F 11A		10	156.70	121.65	24.90	5.4	C 35.0
		Average	155.81	121.52	25.24	5.3	C 34.6
F 48A	1000	100	161.30	121.46	25.10	6.2	C 38.0
F 24A		100	161.69	121.84	25.25	6.3	C 36.0
F 85A		100	161.30	122.61	25.86	6.2	C 38.0
		Average	161.43	121.97	25.40	6.2	C 37.3
F 27A	900	1000	162.07	122.03	25.25	7.6	C 36.0
F 78A		1000	161.69	122.61	25.82	7.0	C 38.0
F 107A		1000	161.88	121.46	25.86	6.3	C 37.0
		Average	161.88	122.03	25.98	7.0	C 37.0

TABLE 20. TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
F 74A	1400	0.5	145.21	114.94	19.54	5.3	C 31.0
F 66A		0.5	145.59	116.86	19.73	5.1	C 31.0
F 121A		0.5	145.02	116.09	19.73	5.5	C 33.0
		Average	145.27	115.96	19.67	5.3	C 31.6
F 54A	1000	10	142.15	112.64	19.54	5.4	C 24.0
F 102A		10	143.68	113.03	19.73	5.0	C 25.0
F 75A		10	143.30	111.11	19.92	5.5	C 24.0
		Average	143.04	112.26	19.73	5.3	C 24.3
F 56A	100	100	141.38	109.20	19.92	7.0	C 21.0
F 123A		100	143.15	111.49	19.54	8.2	C 24.0
F 81A		100	141.76	110.34	19.92	7.3	C 22.0
		Average	141.76	110.34	19.79	7.5	C 22.3
F 94A	1000	1000	132.18	98.47	19.92	8.3	C 18.0
F 126A		1000	131.80	97.70	19.64	8.7	C 17.0
F 51A		1000	130.27	96.93	19.16	8.9	C 19.0
		Average	131.41	97.70	19.57	8.6	C 18.0

TABLE 20. TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
F 57A	1500	0.5	127.97	105.75	18.77	4.4	A 82.0
F 31A		0.5	126.44	103.83	18.77	4.0	A 80.0
F 112A		0.5	129.50	106.90	18.97	4.2	A 81.0
		Average	127.97	105.49	18.84	4.2	A 81.0
F 45A	1000	10	124.52	100.38	18.58	6.3	A 75.0
F 21A		10	126.67	98.08	18.39	6.4	A 76.0
F 33A		10	122.99	100.00	18.39	6.5	A 78.0
		Average	124.39	99.49	18.45	6.4	A 76.3
F 63A	1000	100	116.86	93.87	18.58	7.4	A 75.0
F 97A		100	118.77	94.25	18.58	7.7	A 76.0
F 52A		100	114.97	95.40	18.58	7.9	A 76.0
		Average	116.87	94.51	18.58	7.7	A 75.7
F 124A	1000	1000	101.15	78.54	18.97	11.5	A 70.0
F 53A		1000	101.53	81.23	18.77	11.1	A 70.0
F 76A		1000	97.70	80.46	18.77	11.8	A 68.0
		Average	100.12	80.08	18.84	11.5	A 69.3

TABLE 21. NOTCHED TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
F 61B	Room	--	189.65	
F 87B		--	190.80	
F 24B		--	190.42	
		Average	190.29	1.029
F 43B	600	0.5	174.33	
F 114B		0.5	175.48	
F 84B		0.5	173.18	
		Average	174.33	1.019
G 88N		10	172.03	
F 111B		10	169.35	
F 13B		10	170.11	
		Average	170.50	1.013
F 54B		100	172.03	
F 53B		100	171.65	
F 125B		100	172.60	
		Average	172.09	1.022
F 134B		1000	173.56	
F 63B		1000	173.18	
F 23B		1000	173.95	
		Average	173.56	1.023

TABLE 21. NOTCHED TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Notched Strength Ratio
F 113B	900	0.5	167.05	1.015
F 75B		0.5	166.28	
F 42B		0.5	167.82	
		Average	167.05	
F 121B		10	163.98	
F 76B		10	160.92	1.027
F 85B		10	159.39	
		Average	161.43	
F 94B		100	162.45	
F 16B		100	164.37	
F 126B		100	163.98	1.012
		Average	163.60	
F 71B		1000	166.67	
F 12B		1000	167.43	
F 55B		1000	166.67	
	1200	Average	166.92	1.017
F 62B		0.5	163.22	1.017
F 45B		0.5	164.75	
F 113B		0.5	162.45	
		Average	163.47	
F 16B		10	158.24	1.015
F 125B		10	159.00	
F 93B		10	157.09	
		Average	158.11	
F 41B		100	162.45	
F 102B		100	162.45	1.012
F 86B		100	165.13	
		Average	163.34	
F 72B		1000	162.83	
F 30B		1000	163.60	
F 124B		1000	163.98	1.010
		Average	163.47	

TABLE 21. NOTCHED TENSILE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Tensile Strength (ksi)	Notched Strength Ratio
F 123B	1400	0.5	159.77	
F 44B		0.5	161.30	
F 92B		0.5	160.92	
		Average	160.66	1.106
F 52B		10	157.47	
F 22B		10	156.32	
F 115B		10	156.32	
		Average	156.70	1.095
F 104B		100	157.85	
F 36B		100	155.56	
F 112B		100	154.79	
		Average	156.07	1.101
F 56B	1500	1000	131.03	
F 101B		1000	132.18	
F 18B		1000	131.80	
		Average	131.67	1.002
F 32B		0.5	136.02	
F 66B		0.5	131.42	
F 122B		0.5	134.10	
		Average	133.85	1.046
F 81B		10	132.18	
F 116B		10	131.80	
F 35B		10	130.27	
		Average	131.42	1.057
F 15B	1500	100	126.82	
F 64B		100	124.52	
F 105B		100	125.67	
		Average	125.67	1.075
F 95B		1000	104.98	
F 14B		1000	104.98	
F 51B		1000	104.60	
		Average	104.85	1.047

TABLE 22. RUPTURE STRENGTHS OF RENÉ 41 BASED ON
BOTH ORIGINAL AND FINAL AREAS

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
F 92A	Room	--	182.18	192.44
F 22A		--	183.59	214.12
F 37A		--	180.08	195.84
		Average	181.95	200.80
F 41A	600	0.5	163.60	191.31
F 103A		0.5	164.75	207.23
F 73A		0.5	169.73	196.37
		Average	166.02	198.30
F 28A		10	162.84	-----*
F 116A		10	160.92	187.33
F 25A		10	168.58	198.83
		Average	164.11	193.08
F 62A		100	166.67	191.63
F 77A		100	160.15	184.96
F 96A		100	164.75	189.01
		Average	163.85	188.53
F 26A		1000	168.58	-----*
F 68A		1000	169.23	206.57
F 104A		1000	168.20	208.85
		Average	168.67	207.71

* Invalid test

TABLE 22. RUPTURE STRENGTHS OF RENÉ 41 BASED ON
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
F 108A	900	0.5	162.45	192.03
F 13A		0.5	153.26	190.29
F 55A		0.5	160.54	189.34
		Average	158.73	190.55
F 115A		10	150.19	181.73
F 23A		10	159.00	187.36
F 44A		10	155.94	183.91
		Average	155.04	184.33
F 58A		100	160.15	188.88
F 128A		100	153.26	169.06
F 32A		100	159.00	185.52
		Average	157.47	181.15
F 105A	1200	1000	159.00	194.47
F 61A		1000	157.39	179.20
F 12A		1000	158.62	184.82
		Average	158.33	186.16
F 15A		0.5	153.26	171.16
F 42A		0.5	155.17	173.97
F 106A		0.5	155.17	173.82
		Average	154.53	172.98
F 47A		10	153.26	168.07
F 118A		10	149.43	162.16
F 11A		10	153.26	173.31
		Average	151.98	167.84
F 48A	1200	100	160.92	173.55
F 24A		100	160.92	179.72
F 85A		100	154.02	174.18
		Average	158.62	175.81
F 27A		1000	160.15	173.80
F 78A		1000	160.92	175.73
F 107A		1000	157.85	171.67
		Average	159.64	173.73

TABLE 22. RUPTURE STRENGTHS OF RENÉ 41 BASED ON
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
F 74A	1400	0.5	141.76	153.21
F 66A		0.5	140.61	151.03
F 121A		0.5	139.85	148.80
Average			140.74	151.01
F 54A		10	137.93	152.74
F 102A		10	140.23	150.93
F 75A		10	140.23	149.51
Average			139.46	151.06
F 56A		100	134.10	143.15
F 123A		100	132.95	145.74
F 81A		100	136.40	148.89
Average			134.48	145.92
F 94A	1500	1000	123.75	134.30
F 126A		1000	126.82	139.25
F 51A		1000	126.44	136.93
Average			125.67	136.82
F 57A		0.5	124.90	145.15
F 31A		0.5	119.92	141.76
F 112A		0.5	122.99	143.82
Average			122.60	143.57
F 45A		10	113.41	131.91
F 21A		10	114.18	132.39
F 33A		10	114.56	135.42
Average			114.05	133.24
F 63A	1500	100	108.43	126.00
F 97A		100	105.75	123.60
F 52A		100	104.98	124.09
Average			106.38	124.56
F 124A		1000	91.57	104.87
F 53A		1000	91.95	106.15
F 76A		1000	86.59	99.96
Average			90.03	103.66

TABLE 23. COMPRESSIVE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi × 10⁻⁶)</u>
F 834E	Room	--	146.35	31.81
F 23E		--	148.50	31.38
F 102E		--	146.36	31.69
		Average	147.07	31.63
F 156E	600	0.5	146.05	29.84
F 91E		0.5	139.32	29.08
F 85E		0.5	141.76	28.79
		Average	142.38	29.24
F 96E		10	143.60	29.08
F 115E		10	140.84	28.79
F 656E		10	139.92	28.48
		Average	141.46	28.79
F 83E		100	145.14	29.54
F 103E		100	141.76	29.73
F 46E		100	139.32	28.48
		Average	142.07	29.25
F 31E		1000	143.60	30.16
F 101E		1000	139.32	29.08
F 1012E		1000	143.29	29.54
		Average	142.07	29.59

TABLE 23. COMPRESSIVE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	E_c (psi $\times 10^{-6}$)
F 82E	900	0.5	138.04	27.45
F 95E		0.5	137.41	28.55
F 74E		0.5	138.67	27.45
		Average	138.04	27.82
F 1112E		10	133.65	28.24
F 75E		10	143.37	28.55
F 134E		10	141.18	26.67
		Average	139.40	27.82
F 111E		100	141.18	27.92
F 84E		100	139.92	28.24
F 25E		100	139.61	27.45
		Average	140.24	27.87
F 104E		1000	137.79	27.25
F 53E		1000	143.29	28.02
F 1256E		1000	143.91	27.09
		Average	141.66	27.45
F 22E		0.5	133.80	26.03
F 56E		0.5	133.33	27.09
F 312E		0.5	139.01	27.71
		Average	135.38	26.95
F 114E		10	146.05	27.45
F 456E		10	140.24	27.56
F 52E		10	151.25	26.94
		Average	145.85	27.36
F 61E		100	145.44	27.56
F 113E		100	146.97	26.79
F 34E		100	143.91	27.40
		Average	145.44	27.25
F 35E		1000	142.07	26.79
F 76E		1000	143.91	26.03
F 434E		1000	144.21	26.79
		Average	143.40	26.54

TABLE 23. COMPRESSIVE PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	Ec (psi × 10 ⁻⁶)
F 412E	1400	0.5	122.66	19.90
F 11E		0.5	131.66	23.73
F 65E		0.5	129.52	24.34
		Average	127.95	24.04
F 334E		10	136.87	23.42
F 36E		10	131.66	25.41
F 81E		10	140.84	23.73
		Average	136.46	24.19
F 63E		100	135.94	24.50
F 956E		100	135.64	25.26
F 112E		100	147.27	23.73
		Average	139.62	24.50
F 1134E	1500	1000	115.12	21.43
F 66E		1000	113.90	22.96
F 534E		1000	113.29	22.96
		Average	114.10	22.45
F 42E		0.5	114.51	19.51
F 556E		0.5	115.58	19.90
F 71E		0.5	114.81	20.05
		Average	114.97	19.82
F 93E		10	106.55	18.75
F 33E		10	108.39	19.13
F 856E		10	107.16	18.98
		Average	107.37	18.95
F 44E	1500	100	99.51	16.53
F 92E		100	100.28	16.53
F 1056E		100	98.74	16.84
		Average	99.51	16.63
F 812E		1000	91.55	15.00
F 62E		1000	92.62	15.00
F 126E		1000	91.86	14.92
		Average	92.01	14.97

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
F 66C	Room	--	296.88	240.63
F 121C		--	300.78	233.59
F 24C		--	295.31	234.38
		Average	297.66	236.20
F 45C	600	0.5	279.30	221.88
F 74C		0.5	279.69	222.66
F 92C		0.5	280.47	223.44
		Average	279.82	222.66
F 101C		10	277.73	221.09
F 124C		10	278.91	221.88
F 83C		10	278.13	221.09
		Average	278.26	221.35
F 13C		100	278.13	219.53
F 34C		100	279.69	220.31
F 52C		100	276.95	220.70
		Average	278.26	220.18
F 106C		1000	278.91	221.88
F 63C		1000	279.69	223.44
F 32C		1000	278.13	219.53
		Average	278.91	221.62

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$				
Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
F 113C	900	0.5	274.22	216.41
F 51C		0.5	282.03	221.09
F 12C		0.5	268.75	217.97
		Average	275.00	218.49
F 102C		10	271.88	214.06
F 21C		10	275.00	217.97
F 55C		10	266.41	210.94
		Average	271.10	214.32
F 112C		100	271.09	214.06
F 76C		100	266.41	215.63
F 33C		100	275.78	214.84
		Average	271.09	214.84
F 61C		1000	273.44	217.19
F 84C		1000	266.41	212.50
F 115C		1000	279.69	214.84
		Average	273.18	214.84
F 14C	1200	0.5	261.72	203.91
F 93C		0.5	257.03	205.47
F 56C		0.5	265.63	203.13
		Average	261.46	204.17
F 54C		10	260.16	202.34
F 11C		10	257.03	201.56
F 35C		10	263.67	203.13
		Average	260.28	202.34
F 64C		100	257.81	203.13
F 23C		100	254.69	203.91
F 105C		100	260.16	202.73
		Average	257.55	203.26
F 25C		1000	259.38	202.34
F 125C		1000	258.59	201.56
F 71C		1000	259.38	202.73
		Average	259.12	202.21

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
F 82C	1400	0.5	230.47	188.28
F 126C		0.5	226.56	176.56
F 41C		0.5	232.81	189.84
		Average	229.95	184.89
F 35C		10	228.13	170.31
F 72C		10	225.00	171.88
F 116C		10	232.03	169.53
		Average	228.38	170.57
F 81C		100	221.88	167.97
F 43C		100	225.00	166.41
F 16C		100	218.36	169.14
		Average	221.75	168.51
F 85C	1500	1000	216.41	161.72
F 123C		1000	210.94	162.50
F 42C		1000	221.09	162.89
		Average	216.15	162.37
F 86C		0.5	194.92	166.80
F 31C		0.5	196.09	169.53
F 114C		0.5	193.75	167.18
		Average	194.92	167.84
F 103C		10	182.03	150.78
F 65C		10	179.69	153.13
F 22C		10	180.08	150.78
		Average	180.60	151.56
F 111C	1500	100	174.22	145.31
F 53C		100	171.48	138.28
F 26C		100	177.34	143.75
		Average	174.35	142.45
F 94C		1000	163.28	128.13
F 73C		1000	159.38	125.39
F 62C		1000	162.89	128.13
		Average	161.85	127.22

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
F 65D	Room	--	367.19	288.28
F 82D		--	370.31	289.84
F 105D		--	371.78	292.97
		Average	369.76	290.36
F 115D	600	0.5	345.31	272.65
F 123D		0.5	344.53	271.87
F 81D		0.5	346.09	273.04
		Average	345.31	272.52
F 24D		10	343.36	270.31
F 126D		10	342.96	270.31
F 101D		10	342.96	269.53
		Average	343.09	270.05
F 22D		100	342.57	271.87
F 66D		100	342.18	271.09
F 71D		100	341.79	272.65
		Average	342.18	271.87
F 107D		1000	343.36	271.09
F 26D		1000	343.75	270.31
F 62D		1000	346.09	272.65
		Average	344.40	271.35

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
F 94D	900	0.5	338.28	264.84
F 56D		0.5	342.18	267.96
F 13D		0.5	335.93	264.45
		Average	338.80	265.75
F 36D		10	332.81	261.71
F 84D		10	335.15	264.84
F 124D		10	330.46	258.59
		Average	332.81	261.71
F 114D		100	335.15	263.28
F 11D		100	334.37	265.62
F 72D		100	336.71	258.20
		Average	335.41	262.37
F 104D		1000	336.71	264.06
F 45D		1000	336.32	263.28
F 83D		1000	337.50	262.50
		Average	336.84	263.28
F 96D	1200	0.5	320.31	250.00
F 51D		0.5	322.65	253.90
F 15D		0.5	323.43	250.78
		Average	322.13	251.56
F 91D		10	318.75	249.21
F 54D		10	314.84	247.65
F 16D		10	312.50	246.87
		Average	315.36	247.91
F 74D		100	320.31	248.82
F 25D		100	317.18	248.43
F 116D		100	315.62	247.65
		Average	317.70	248.30
F 113D		1000	315.62	248.43
F 23D		1000	317.57	246.09
F 63D		1000	319.53	253.90
		Average	317.57	249.47

TABLE 24. BEARING PROPERTIES OF RENÉ 41 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
F 32D	1400	0.5	264.84	220.31
F 76D		0.5	266.40	219.53
F 125D		0.5	264.06	222.65
		Average	265.10	220.83
F 75D		10	263.28	217.18
F 33D		10	260.93	215.62
F 122D		10	265.62	218.75
		Average	263.28	217.18
F 12D		100	257.81	214.06
F 55D		100	260.93	215.62
F 106D		100	256.25	212.50
		Average	258.33	214.06
F 42D		1000	250.00	206.25
F 171D		1000	250.78	203.12
F 66D		1000	254.68	210.15
		Average	251.82	206.51
F 31D	1500	0.5	229.68	185.15
F 112D		0.5	226.56	185.93
F 73D		0.5	231.25	183.59
		Average	229.16	184.89
F 35D		10	225.78	182.81
F 121D		10	223.43	179.68
F 85D		10	227.34	184.37
		Average	225.52	182.29
F 103D		100	217.18	171.87
F 61D		100	214.84	175.00
F 44D		100	212.50	176.56
		Average	214.84	174.48
F 43D		1000	189.84	166.40
F 102D		1000	187.50	164.50
F 86D		1000	195.31	168.75
		Average	190.88	166.55

TABLE 25. SHEAR PROPERTIES OF RENÉ 41 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
F 6F	Room	--	113.69
F 5F		--	118.97
F 4F		--	112.88
		Average	115.18
F 9F	600	0.5	108.13
F 46F		0.5	110.16
F 61F		0.5	109.15
		Average	109.15
F 34F		10	109.50
F 45F		10	108.94
F 67F		10	109.35
		Average	109.22
F 63F		100	108.94
F 43F		100	113.41
F 59F		100	111.18
		Average	111.18
F 1F		1000	111.38
F 2F		1000	111.13
F 3F		1000	111.53
		Average	111.38

TABLE 25. SHEAR PROPERTIES OF RENÉ 41 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Ultimate Shear Strength (ksi)
F 14F	900	0.5	107.72
F 13F		0.5	107.30
F 15F		0.5	107.52
		Average	107.51
F 19F		10	106.10
F 21F		10	107.72
F 20F		10	107.32
		Average	107.05
F 34F		100	110.98
F 36F		100	111.18
F 35F		100	110.98
	1200	Average	111.05
F 33F		1000	108.54
F 32F		1000	110.37
F 31F		1000	109.15
		Average	109.35
F 73F		0.5	101.63
F 72F		0.5	103.45
F 71F		0.5	102.64
		Average	102.54
F 29F		10	106.10
F 28F		10	107.32
F 30F		10	106.71
		Average	106.71
F 9F		100	110.16
F 7F		100	111.79
F 8F		100	110.98
		Average	110.98
F 11F		1000	108.04
F 10F		1000	110.16
F 12F		1000	108.94
		Average	109.10

TABLE 25. SHEAR PROPERTIES OF RENE 41 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Ultimate Shear Strength (ksi)
F 23F	1400	0.5	97.15
F 24F		0.5	98.37
F 22F		0.5	97.97
		Average	97.76
F 49F		10	102.44
F 50F		10	91.46
F 51F		10	96.95
		Average	96.95
F 48F		100	93.90
F 47F		100	94.72
F 46F		100	95.12
		Average	94.58
F 37F	1500	1000	88.21
F 39F		1000	89.84
F 38F		1000	89.02
		Average	89.03
F 44F		0.5	78.05
F 43F		0.5	80.49
F 45F		0.5	79.27
		Average	79.27
F 41F		10	74.39
F 40F		10	74.80
F 42F		10	74.59
		Average	74.60
F 17F	1500	100	71.95
F 16F		100	71.34
F 18F		100	72.76
		Average	72.03
F 25F		1000	64.63
F 26F		1000	64.23
F 27F		1000	64.23
		Average	64.36

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi $\times 10^{-6}$)	Elongation in 2 inches (%)	Hardness (Rockwell)
G 73A	Room	--	119.76	59.43	29.21	49.4	B 92.5
G 34A(T)*		--	120.00	60.00	28.01	49.0	B 93.0
G 51A		--	111.54	57.31	30.19	49.5	B 92.5
		Average	117.10	58.91	29.14	49.3	B 92.7
G 22A	1400	0.5	60.15	31.42	20.01	41.9	A 46.0
G 62A		0.5	59.39	32.38	22.41	41.6	A 46.0
G 106A		0.5	59.77	32.38	21.55	41.6	A 45.0
		Average	59.77	31.90	21.32	41.7	A 45.7
G 42A		10	55.56	34.10	21.55	46.0	A 45.0
G 104A		10	55.56	33.33	21.07	47.0	A 45.0
G 17A		10	55.94	33.33	20.69	46.5	A 46.0
		Average	55.68	33.58	21.10	46.5	A 45.3
G 56A		100	52.49	38.31	19.73	45.0	A 50.0
G 93A		100	50.19	37.93	20.31	45.6	A 51.0
G 14A		100	52.80	37.50	20.29	44.3	A 51.0
		Average	51.82	37.91	20.11	44.96	A 50.7
G 92A		1000	54.89	32.57	20.11	43.5	A 55.0
G 65A		1000	52.49	31.42	19.73	43.9	A 55.0
G 24A		1000	54.02	31.03	20.11	43.2	A 53.0
		Average	53.80	31.67	19.98	43.5	A 54.3

*Tuckerman Optical Strain Gage

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
G 71A	1600	0.5	36.78	27.97	17.82	47.1	
G 107A		0.5	35.65	27.59	18.39	47.5	
G 96A		0.5	35.25	24.52	17.24	47.8	
		Average	35.89	26.69	17.81	47.4	
G 23A		10	33.33	23.75	17.62	45.0	
G 105A		10	33.91	25.86	19.16	47.0	
G 46A		10	34.48	27.97	18.20	48.0	
		Average	33.90	25.86	18.32	46.6	
G 35A		100	32.18	22.22	19.16	49.3	
G 22A		100	35.25	26.82	17.24	49.0	
G 96A		100	34.10	24.33	18.20	49.6	
		Average	33.84	24.45	18.20	49.3	
G 57A		1000	33.72	24.52	17.62	47.5	
G 72A		1000	34.48	25.52	16.86	46.0	
G 13A		1000	34.10	24.90	19.25	47.5	
		Average	34.10	24.98	17.91	47.0	

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi $\times 10^{-6}$)	Elongation in 2 inches (%)	Hardness (Rockwell)
G 101A	1800	0.5	16.09	12.26	13.41	46.3	
G 74A		0.5	13.79	11.49	15.33	45.0	
G 43A		0.5	15.13	11.30	14.37	46.1	
		Average	14.94	11.88	14.37	45.8	
G 54A	10	10	15.71	12.26	13.41	45.0	
G 36A		10	15.13	10.73	14.37	45.8	
G 103A		10	15.52	11.30	14.37	45.8	
		Average	15.42	11.50	14.05	45.5	
G 55A	100	100	15.33	11.49	13.89	46.8	
G 21A		100	14.18	10.34	14.37	48.1	
G 82A		100	14.94	10.92	13.98	47.8	
		Average	14.76	10.92	14.10	47.5	
G 87A	1000	1000	16.86	11.49	14.37	47.1	
G 53A		1000	14.18	10.34	13.41	44.1	
G 27A		1000	15.71	11.11	13.79	45.0	
		Average	15.52	10.92	13.86	45.4	

TABLE 26. TENSILE PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
G 61A	1900	0.5	11.49	9.49	11.49	37.8	
G 102A		0.5	12.45	9.20	9.58	38.0	
G 28A		0.5	12.07	9.20	11.49	38.0	
		Average	12.97	9.35	10.85	37.9	
G 77A		10	12.26	9.20	13.41	37.0	
G 18A		10	10.73	8.81	12.45	37.5	
G 44A		10	11.69	9.39	12.26	37.5	
		Average	11.50	9.01	12.70	37.3	
G 51A		100	10.73	8.43	10.92	36.8	
G 37A		100	12.07	7.85	10.54	38.5	
G 76A		100	11.49	8.43	11.11	38.1	
		Average	11.40	8.14	10.85	37.3	
G 66A		1000	9.58	7.66	10.50	35.5	
G 47A		1000	9.58	7.66	9.95	34.0	
G 84A		1000	9.58	8.43	10.54	34.5	
		Average	9.58	7.92	10.33	34.6	

TABLE 27. NOTCHED TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
G 96B	Room	--	109.23	
G 61B		--	109.40	
G 25B		--	113.67	
		Average	110.77	.946
G 34B	1400	0.5	68.05	
G 95B		0.5	69.36	
G 63B		0.5	70.57	
		Average	69.33	1.160
G 41B		10	72.80	
G 22B		10	71.76	
G 75B		10	71.19	
		Average	71.92	1.294
G 112B		100	78.46	
G 81B		100	79.00	
G 26B		100	75.09	
		Average	77.52	1.510
G 115B		1000	66.67	
G 23B		1000	67.62	
G 62B		1000	67.05	
		Average	67.11	1.250

TABLE 27. NOTCHED TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Notched Strength Ratio
G 53B	1600	0.5	50.62	1.435
G 91B		0.5	52.69	
G 114B		0.5	51.72	
		Average	51.68	
G 122B		10	49.23	1.446
G 54B		10	48.96	
G 36B		10	48.96	
		Average	49.05	
G 83B		100	51.11	1.513
G 11B		100	51.37	
G 124B		100	50.49	
		Average	51.02	
G 82B	1800	1000	36.78	1.023
G 35B		1000	32.95	
G 106B		1000	34.86	
		Average	34.87	
G 72B		0.5	25.00	1.705
G 94B		0.5	25.87	
G 33B		0.5	25.55	
		Average	25.47	
G 102B		10	27.12	1.763
G 44B		10	26.92	
G 13B		10	27.50	
		Average	27.18	
G 103B		100	25.24	1.785
G 14B		100	26.31	
G 31B		100	27.59	
		Average	26.35	
G 46B		1000	18.39	1.144
G 123B		1000	17.24	
G 111B		1000	17.62	
		Average	17.75	

TABLE 27. NOTCHED TENSILE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
G 52B	1900	0.5	17.69	
G 65B		0.5	16.89	
G 86B		0.5	17.24	
		Average	17.27	1.332
G 43B		10	16.47	
G 105B		10	17.70	
G 73B		10	16.09	
		Average	16.75	1.457
G 66B		100	15.71	
G 12B		100	16.48	
G 113B		100	15.32	
		Average	15.84	1.389
G 92B		1000	14.56	
G 55B		1000	15.33	
G 121B		1000	14.56	
		Average	14.82	1.547

TABLE 28. RUPTURE STRENGTHS OF N-155 BASED ON
BOTH ORIGINAL AND FINAL AREAS

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
G 73A	Room	--	111.50	188.10
G 34A		--	111.70	190.00
G 51A		--	103.80	187.07
		Average	109.00	188.39
G 25A	1400	0.5	49.80	83.55
G 62A		0.5	48.85	79.34
G 106A		0.5	47.51	77.50
		Average	48.72	80.13
G 42A		10	45.98	72.86
G 104A		10	45.21	71.65
G 17A		10	46.36	79.76
		Average	45.85	74.75
G 56A		100	37.55	75.21
G 93A		100	44.06	90.98
G 14A		100	45.98	82.02
		Average	42.53	82.73
G 92A		1000	49.04	82.05
G 65A		1000	45.98	92.10
G 24A		1000	44.44	78.11
		Average	46.48	84.08

TABLE 28. RUPTURE STRENGTHS OF N-155 BASED ON
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
G 71A	1600	0.5	13.41	28.41
G 107A		0.5	11.49	29.04
G 96A		0.5	16.09	37.30
		Average	13.66	31.58
G 23A		10	15.33	31.75
G 105A		10	11.49	25.47
G 46A		10	12.26	27.23
		Average	13.02	28.15
G 35A		100	12.26	36.41
G 22A		100	9.20	24.84
G 96A		100	10.73	25.00
	1800	Average	10.73	28.75
G 13A		1000	7.66	18.92
G 57A		1000	11.88	27.22
G 72A		1000	8.81	17.76
		Average	9.45	21.30
G 101A		0.5	0.38	0.84
G 74A		0.5	0.38	0.69
G 43A		0.5	0.77	1.74
		Average	0.51	1.09
G 54A		10	0.77	1.93
G 36A	1800	10	0.38	1.04
G 103A		10	0.77	1.69
		Average	0.64	1.55
G 55A		100	0.77	1.88
G 21A		100	0.38	0.88
G 82A		100	0.38	0.98
		Average	0.51	1.24
G 87A		1000	0.38	0.70
G 53A		1000	0.77	1.43
G 27A		1000	0.38	0.88
		Average	0.51	0.67

TABLE 28. RUPTURE STRENGTHS OF N-155 BASED ON
BOTH ORIGINAL AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
G 61A	1900	0.5	0.38	0.65
G 102A		0.5	0.38	0.73
G 28A		0.5	0.38	0.67
		Average	0.38	0.68
G 77A		10	0.38	0.67
G 18A		10	0.38	0.69
G 44A		10	0.38	0.69
		Average	0.38	0.68
G 51A		100	0.38	0.56
G 37A		100	0.38	0.65
G 76A		100	0.38	0.71
		Average	0.38	0.64
G 66A		1000	0.38	0.64
G 47A		1000	0.38	0.55
G 84A		1000	0.38	0.65
		Average	0.38	0.61

TABLE 29. COMPRESSIVE PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	E_c (psi $\times 10^{-6}$)
G 86E	Room	--	50.56	29.44
G 1056E		--	52.80	29.60
G 456E		--	53.76	30.24
		Average	52.37	29.76
G 76E	1400	0.5	40.00	21.60
G 33E		0.5	39.36	21.44
G 91E		0.5	39.36	21.28
		Average	39.57	21.44
G 14E		10	39.36	21.20
G 31E		10	39.04	21.12
G 92E		10	39.20	20.64
		Average	39.20	20.99
G 41E		100	38.72	20.96
G 82E		100	38.40	20.80
G 626#		100	39.36	21.20
		Average	38.83	20.99
G 65E		1000	38.08	20.64
G 32E		1000	37.76	20.32
G 83E		1000	38.08	20.48
		Average	37.97	20.48

TABLE 29. COMPRESSIVE PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	Ec (psi × 10 ⁻⁶)
G 84E	1600	0.5	30.08	17.60
G 102E		0.5	30.40	17.76
G 25E		0.5	30.72	18.08
		Average	30.40	17.81
G 61E		10	29.60	17.28
G 42E		10	29.44	17.28
G 24E		10	29.76	17.44
		Average	29.60	17.33
G 94E		100	28.48	16.80
G 72E		100	28.80	16.96
G 43E		100	29.12	17.12
		Average	28.80	16.96
G 96E		1000	26.40	15.84
G 73E		1000	26.88	16.00
G 44E		1000	27.20	16.16
		Average	26.83	16.00
G 71E	1800	0.5	17.28	13.60
G 104E		0.5	18.56	14.08
G 36E		0.5	17.60	13.60
		Average	17.81	13.76
G 65E		10	16.32	13.52
G 16E		10	16.80	13.20
G 112E		10	16.96	13.44
		Average	16.69	13.39
G 95E		100	16.32	12.96
G 12E		100	16.32	13.12
G 66E		100	15.68	13.60
		Average	16.11	13.23
G 1034E		1000	15.68	12.48
G 412E		1000	15.36	12.32
G 156E		1000	14.72	13.76
		Average	15.25	12.85

TABLE 29. COMPRESSIVE PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi × 10⁻⁶)</u>
G 62E	1900	0.5	12.48	10.56
G 756E		0.5	12.16	10.40
G 234E		0.5	12.00	10.40
		Average	12.21	10.45
G 556E		10	11.52	10.08
G 512E		10	12.00	10.24
G 63E		10	11.84	10.24
		Average	11.79	10.19
G 11E		100	9.60	9.60
G 101E		100	10.24	9.92
G 64E		100	9.92	9.76
		Average	9.92	9.76
G 103E		1000	7.68	8.00
G 46E		1000	8.64	8.32
G 75E		1000	8.32	8.16
		Average	8.21	8.16

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
G 35C	Room	--	199.20	85.60
G 46C		--	199.20	92.00
G 1C		--	196.00	89.60
		Average	198.13	89.07
G 76C	1400	0.5	111.60	65.60
G 54C		0.5	108.80	60.80
G 12C		0.5	110.40	63.20
		Average	110.26	63.20
G 81C		10	105.60	66.80
G 44C		10	107.20	65.60
G 53C		10	106.40	66.40
		Average	106.40	66.26
G 83C		100	107.20	74.40
G 66C		100	112.80	78.40
G 42C		100	110.00	76.40
		Average	110.00	76.40
G 71C		1000	109.60	73.60
G 92C		1000	110.00	73.60
G 15C		1000	110.00	73.60
		Average	109.86	73.60

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $c/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
G 13C	1600	0.5	61.20	48.00
G 86C		0.5	59.20	46.40
G 34C		0.5	55.20	44.00
		Average	58.53	46.13
G 93C		10	60.00	43.20
G 61C		10	58.00	44.00
G 25C		10	57.60	44.00
		Average	58.53	43.73
G 104C		100	59.20	44.00
G 11C		100	57.20	41.60
G 33C		100	51.20	41.60
		Average	55.86	42.40
G 43C		1000	57.60	40.80
G 74C		1000	56.80	43.20
G 96C		1000	55.20	38.40
		Average	56.53	40.80
G 31C	1800	0.5	33.20	24.00
G 125C		0.5	34.80	22.00
G 56C		0.5	34.00	23.20
		Average	34.00	23.00
G 62C		10	32.00	24.00
G 95C		10	32.00	21.60
G 36C		10	32.80	22.80
		Average	32.26	22.80
G 41C		100	31.60	25.20
G 14C		100	31.60	20.00
G 85C		100	32.00	22.40
		Average	31.73	22.53
G 106C		1000	35.20	16.00
G 23C		1000	31.20	23.20
G 26C		1000	34.40	19.60
		Average	33.60	19.60

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
G 51C	1900	0.5	26.40	16.40
G 45C		0.5	29.60	26.40
G 75C		0.5	28.00	21.20
		Average	28.00	21.33
G 126C		10	25.20	20.00
G 105C		10	28.80	19.20
G 84C		10	26.80	19.60
		Average	26.93	19.60
G 22C		100	23.20	20.00
G 121C		100	24.80	15.20
G 55C		100	24.00	17.60
		Average	24.00	17.60
G 82C		1000	23.20	17.60
G 103C		1000	25.20	20.00
G 16C		1000	24.40	18.80
		Average	24.26	18.80

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
G 86D	Room	--	262.40	132.80
G 11D		--	259.20	116.80
G 116D		--	256.00	100.80
		Average	259.20	116.80
G 16D	1400	0.5	143.20	76.00
G 81D		0.5	139.20	68.00
G 64D		0.5	141.20	72.00
		Average	141.20	72.00
G 66D		10	132.00	82.00
G 85D		10	134.40	83.20
G 22D		10	133.20	82.40
		Average	133.20	82.53
G 51D		100	136.40	86.80
G 83D		100	133.60	90.40
G 13D		100	135.20	86.00
		Average	135.06	87.73
G 98D		1000	135.60	85.20
G 33D		1000	136.00	94.40
G 74D		1000	136.00	90.00
		Average	135.86	89.86

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $c/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
G 77D	1600	0.5	70.00	51.60
G 102D		0.5	75.60	57.20
G 61D		0.5	72.00	32.20
		Average	72.53	48.00
G 63D		10	73.20	55.60
G 21D		10	83.20	54.00
G 94D		10	71.20	39.20
		Average	75.86	49.60
G 84D		100	72.80	46.00
G 11D		100	71.60	49.60
G 35D		100	71.20	47.20
		Average	71.86	47.60
G 72D		1000	70.40	45.20
G 95D		1000	69.60	47.60
G 36D		1000	64.80	46.40
		Average	68.26	46.33
G 73D	1800	0.5	44.00	20.00
G 46D		0.5	41.60	24.00
G 12D		0.5	42.80	22.00
		Average	42.80	22.00
G 41D		10	37.60	26.40
G 93D		10	38.00	30.00
G 62D		10	38.00	28.00
		Average	37.86	28.13
G 24D		100	37.60	29.60
G 55D		100	38.40	19.20
G 96D		100	38.00	24.40
		Average	38.00	24.40
G 25D		1000	40.00	20.00
G 32D		1000	40.00	20.00
G 82D		1000	39.20	19.60
		Average	39.73	19.86

TABLE 30. BEARING PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Bearing Strength (ksi)</u>	<u>Bearing Yield Strength (ksi)</u>
G 73D	1900	0.5	32.80	28.80
G 56D		0.5	36.80	19.20
G 104D		0.5	36.40	23.00
		Average	35.33	23.66
G 91D		10	30.40	22.80
G 65D		10	34.80	16.00
G 42D		10	32.40	19.20
		Average	32.53	19.33
G 103D		100	32.00	20.40
G 14D		100	31.20	22.80
G 52D		100	31.60	21.60
		Average	31.60	21.60
G 34D		1000	30.80	20.80
G 76D		1000	30.40	16.80
G 112D		1000	30.80	18.80
		Average	30.66	18.80

TABLE 31. SHEAR PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
G 6F	Room	--	83.26
G 43F		--	84.76
G 67F		--	84.02
		Average	84.01
G 41F	1400	0.5	43.67
G 4F		0.5	44.31
G 20F		0.5	44.72
		Average	44.23
G 5F		10	44.31
G 42F		10	42.28
G 66F		10	43.50
		Average	43.36
G 65F		100	40.20
G 20F		100	41.06
G 10F		100	42.28
		Average	41.18
G 14F		1000	40.65
G 63F		1000	42.68
G 47F		1000	41.06
		Average	41.46

TABLE 31. SHEAR PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Ultimate Shear Strength (ksi)
G 22F	1600	0.5	28.25
G 27F		0.5	28.25
G 60F		0.5	28.05
		Average	28.18
G 17F		10	27.24
G 59F		10	27.64
G 21F		10	27.42
		Average	27.43
G 40F		100	26.42
G 30F		100	26.02
G 26F		100	26.22
		Average	26.22
G 77F	1800	1000	23.58
G 79F		1000	23.98
G 78F		1000	23.17
		Average	23.58
G 9F		0.5	17.07
G 18F		0.5	17.07
G 25F		0.5	16.66
		Average	16.93
G 55F		10	16.87
G 49F		10	16.66
G 37F		10	16.66
		Average	16.73
G 19F	1800	100	16.66
G 15F		100	16.26
G 16F		100	17.07
		Average	16.66
G 80F		1000	15.04
G 81F		1000	14.64
G 51F		1000	15.04
		Average	14.91

TABLE 31. SHEAR PROPERTIES OF N-155 AT VARIOUS
TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
G 57F	1900	0.5	14.63
G 62F		0.5	17.07
G 45F		0.5	15.85
		Average	15.85
G 3F		10	13.82
G 52F		10	15.85
G 2F		10	14.84
		Average	14.84
G 58F		100	15.04
G 33F		100	14.63
G 53F		100	14.23
		Average	14.63
G 76F		1000	14.23
G 75F		1000	14.63
G 74F		1000	14.43
		Average	14.43

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL
AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
D 17A(T)*	Room	--	273.70	258.00	25.50	3.2	C 52.0
D 312A		--	269.02	256.86	25.29	3.0	C 52.5
D 48A		--	273.73	259.22	25.88	3.0	C 52.0
	400	Average	272.15	258.03	25.56	3.1	C 52.1
D 16A		0.5	249.41	225.88	24.31	2.9	C 47.5
D 213A			249.02	227.45	24.31	2.8	C 47.0
D 28A			250.98	228.24	24.51	2.8	C 47.0
		Average	249.80	227.19	24.38	2.8	C 47.1
D 51A		10	245.88	231.37	24.51	2.9	C 46.0
D 310A		10	246.67	229.80	24.71	2.8	C 46.0
D 410A		10	248.24	230.20	24.90	2.7	C 45.0
		Average	246.93	230.46	24.71	2.8	C 45.8
D 114A		100	248.63	236.08	24.71	2.5	C 47.0
D 42A		100	249.02	235.29	24.90	2.8	C 47.0
D 39A		100	248.63	232.94	24.71	3.1	C 47.0
		Average	248.76	234.77	24.77	2.8	C 47.0
D 61A		1000	248.43	226.67	24.51	2.9	C 48.0
D 210A		1000	251.76	227.06	24.51	2.9	C 48.0
D 23A		1000	247.84	223.53	24.31	2.5	C 47.0
		Average	249.34	225.75	24.44	2.8	C 47.6

*Tuckerman Optical Strain Gage

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL
AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
D 32A	600	0.5	237.25	218.82	22.57	4.0	C 43.5
D 18A		0.5	234.51	217.71	22.54	4.1	C 43.0
D 64A		0.5	237.65	215.80	22.94	3.8	C 43.0
		Average	236.47	217.44	22.68	4.0	C 43.1
D 43A	100	10	241.18	229.41	23.52	2.5	C 45.0
D 65A		10	236.80	224.71	23.52	2.4	C 46.0
D 47A		10	244.71	223.92	23.73	2.4	C 44.0
		Average	240.90	226.01	23.59	2.4	C 45.0
D 41A	100	100	239.22	223.53	23.13	2.5	C 45.0
D 69A		100	238.43	222.35	23.13	2.6	C 47.0
D 62A		100	239.61	234.51	23.33	2.6	C 47.0
		Average	239.09	226.80	23.20	2.6	C 46.3
D 212A	1000	1000	250.20	234.90	23.52	2.3	C 48.0
D 13A		1000	249.02	234.51	23.73	2.6	C 47.5
D 21A		1000	249.02	233.73	23.52	2.4	C 48.0
		Average	249.41	234.38	23.60	2.4	C 47.8

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL
AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi X 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
D 15A	800	0.5	231.37	213.73	21.56	3.8	C 44.0
D 22A		0.5	231.76	211.76	21.56	4.1	C 43.0
D 211A		0.5	233.33	216.86	21.96	4.0	C 43.0
		Average	232.15	214.12	21.69	4.0	C 43.3
D 413A		10	220.78	205.10	22.35	4.0	C 40.5
D 313A		10	223.53	200.00	22.15	4.2	C 43.0
D 31A		10	228.63	211.76	22.15	3.9	C 42.0
		Average	224.31	205.62	22.22	4.0	C 41.8
D 113A		100	203.92	185.10	21.96	4.4	C 41.0
D 33A		100	205.10	186.27	21.96	4.5	C 41.0
D 24A		100	208.24	182.35	21.76	4.1	C 40.5
		Average	205.75	184.57	21.89	4.3	C 40.8
D 45A		1000	184.31	161.96	22.15	3.8	C 41.0
D 63A		1000	183.92	161.96	21.56	3.6	C 40.0
D 66A		1000	186.27	162.75	21.76	3.8	C 38.0
		Average	184.83	162.22	21.82	3.7	C 39.6

TABLE 32. TENSILE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL
AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Tensile Strength (ksi)	Yield Strength (ksi)	E (psi × 10 ⁻⁶)	Elongation in 2 inches (%)	Hardness (Rockwell)
D 52A	1000	0.5	99.61	70.59	17.06	17.0	A 67.0
D 412A		0.5	98.04	73.73	17.25	16.8	A 68.0
D 112A		0.5	98.03	70.59	17.25	16.4	A 66.5
		Average	98.56	71.64	17.19	16.7	A 67.1
D 19A	100	10	109.80	83.53	18.24	22.7	A 63.0
D 37A		10	109.41	84.71	18.43	20.8	A 63.0
D 25A		10	103.82	77.64	18.04	20.0	A 62.0
		Average	107.68	81.96	18.24	21.2	A 62.6
D 64A	100	100	92.16	76.08	17.06	16.7	A 53.0
D 27A		100	90.19	76.47	17.25	17.0	A 54.0
D 44A		100	93.33	77.25	17.25	15.0	A 55.0
		Average	91.89	76.60	17.19	16.2	A 54.0
D 67A	1000	1000	70.20	60.78	17.06	18.2	A 52.0
D 11A		1000	67.84	61.18	16.86	18.1	A 52.0
D 14A		1000	72.15	62.35	16.86	18.5	A 53.0
		Average	70.06	61.44	16.93	18.3	A 52.3

TABLE 33. NOTCHED TENSILE PROPERTIES OF 301(50% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
D 18B	Room	--	282.35	
D 22B		--	284.35	
D 37B		--	283.92	
		Average	283.53	1.042
D 12B	400	0.5	266.27	
D 19B		0.5	265.88	
D 62B		0.5	266.27	
		Average	266.47	1.067
D 410B		10	260.98	
D 54B		10	260.78	
D 64B		10	261.17	
		Average	260.98	1.057
D 15B		100	263.53	
D 310B		100	263.14	
D 43 B		100	263.73	
		Average	263.47	1.059
D 13B		1000	264.71	
D 52B		1000	264.71	
D 45B		1000	263.92	
		Average	264.31	1.060

TABLE 33. NOTCHED TENSILE PROPERTIES OF 301(60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
D 33B	600	0.5	254.90	
D 49B		0.5	255.69	
D 34B		0.5	255.29	
		Average	255.30	1.080
D 63B		10	258.82	
D 313B		10	260.00	
D 311B		10	260.78	
		Average	259.87	1.079
D 24B		100	258.43	
D 31B		100	257.25	
D 11B		100	258.04	
	800	Average	257.91	1.079
D 210B		1000	263.53	
D 610B		1000	262.35	
D 42B		1000	262.75	
		Average	262.88	1.054
D 46B		0.5	243.14	
D 53B		0.5	247.06	
D 68B		0.5	240.39	
		Average	243.53	1.049
D 211B		10	245.49	
D 38B		10	245.88	
D 65B		10	244.71	
		Average	245.36	1.094
D 64B		100	217.25	
D 21B		100	216.86	
D 41B		100	214.12	
		Average	216.08	1.050
D 14B		1000	194.12	
D 48B		1000	195.69	
D 36B		1000	192.16	
		Average	193.99	1.050

TABLE 33. NOTCHED TENSILE PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Tensile Strength (ksi)</u>	<u>Notched Strength Ratio</u>
D 25B	1000	0.5	123.53	
D 112B		0.5	122.75	
D 21B		0.5	122.75	
		Average	123.01	1.248
D 61B		10	136.86	
D 413B		10	136.08	
D 26B		10	130.98	
		Average	134.64	1.250
D 47B		100	106.67	
D 314B		100	107.06	
D 111B		100	108.24	
		Average	107.32	1.168
D 67B		1000	91.37	
D 412B		1000	97.65	
D 16B		1000	94.12	
		Average	94.38	1.347

TABLE 34. RUPTURE STRENGTHS OF 301 (60% COLD REDUCED)
STAINLESS STEEL BASED ON BOTH ORIGINAL
AND FINAL AREAS

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
D 48A	Room	--	236.59	251.57
D 15A		--	235.29	263.16
D 312A		--	239.22	283.72
		Average	237.03	266.15
D 28A	400	0.5	236.08	264.61
D 16A		0.5	246.27	269.76
D 213A		0.5	235.29	257.73
		Average	239.21	264.03
D 51A		10	240.39	266.06
D 410A		10	243.14	268.51
D 310A		10	240.00	253.94
		Average	241.18	262.84
D 114A		100	247.06	270.04
D 42A		100	242.74	268.20
D 39A		100	243.13	250.51
		Average	244.31	262.92
D 210A		1000	231.37	266.61
D 61A		1000	239.22	273.42
D 23A		1000	229.41	258.73
		Average	233.33	266.25

TABLE 34. RUPTURE STRENGTHS OF 301 (60% COLD REDUCED)
STAINLESS STEEL BASED ON BOTH ORIGINAL
AND FINAL AREAS (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Based on Original Area (ksi)	Based on Final Area (ksi)
D 32A	600	0.5	231.36	253.98
D 18A		0.5	234.51	265.07
D 64A		0.5	234.31	261.60
		Average	233.39	260.22
D 43A		10	237.25	251.04
D 47A		10	238.98	260.74
D 65A		10	234.50	255.77
		Average	236.91	255.85
D 41A		100	221.56	228.28
D 69A		100	221.17	234.90
D 62A		100	223.53	236.51
		Average	222.09	233.23
D 212A		1000	246.27	262.65
D 13A		1000	239.21	255.66
D 21A		1000	238.43	250.21
		Average	241.30	256.17
D 15A	800	0.5	219.60	251.12
D 22A		0.5	215.68	269.21
D 211A		0.5	218.82	247.56
		Average	218.03	255.96
D 413A		10	213.72	242.10
D 313A		10	210.58	235.11
D 31A		10	215.29	255.71
		Average	213.20	244.31
D 113A		100	194.51	213.10
D 33A		100	191.40	221.90
D 24A		100	192.15	213.97
		Average	192.69	216.33
D 45A		1000	172.94	197.49
D 63A		1000	166.67	181.62
D 66A		1000	170.59	185.90
		Average	170.07	188.34

TABLE 34. RUPTURE STRENGTHS OF 301 (60% COLD REDUCED)
STAINLESS STEEL BASED ON BOTH ORIGINAL
AND FINAL AREAS (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Based on Original Area (ksi)</u>	<u>Based on Final Area (ksi)</u>
D 412A	1000	0.5	64.70	114.98
D 112A		0.5	61.18	122.16
D 52A		0.5	65.88	109.30
		Average	63.92	115.48
D 25A		10	64.31	101.30
D 37A		10	62.74	101.27
D 19A		10	58.04	97.43
		Average	61.70	100.00
D 27A		100	58.04	99.80
D 44A		100	68.63	95.47
D 64A		100	60.78	91.99
		Average	62.48	95.75
D 67A		1000	49.41	77.49
D 11A		1000	49.02	78.62
D 14A		1000	50.98	78.46
		Average	49.80	78.19

TABLE 35. COMPRESSIVE PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi × 10⁻⁶)</u>
D 29E	Room	--	207.69	26.98
D 210E		--	207.37	26.66
D 226E		--	204.24	26.98
		Average	206.47	26.87
D 211E	400	0.5	185.10	24.00
D 28E		0.5	194.51	24.63
D 14E		0.5	195.14	25.25
		Average	191.58	24.63
D 115E		10	207.06	25.98
D 218E		10	213.33	25.57
D 212E		10	202.35	25.57
		Average	207.58	25.71
D 311E		100	216.78	25.73
D 13E		100	213.33	25.25
D 127E		100	209.88	25.73
		Average	213.33	25.57
D 121E		1000	218.67	25.41
D 25E		1000	212.08	25.10
D 38E		1000	215.84	25.73
		Average	215.53	25.41

TABLE 35. COMPRESSIVE PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (° F)	Exposure Time (hr)	Compressive Yield Strength (ksi)	F _c (psi × 10 ⁻⁶)
D 17E	600	0.5	186.98	24.31
D 15E		0.5	188.24	24.31
D 229E		0.5	186.67	24.47
		Average	187.30	24.36
D 214E		10	203.92	24.31
D 26E		10	205.49	24.31
D 110E		10	195.76	24.62
		Average	201.72	24.41
D 217E		100	202.98	24.78
D 220E		100	203.92	24.47
D 122E		100	205.49	24.47
		Average	204.13	24.57
D 16E	800	1000	218.04	26.19
D 215E		1000	219.61	26.04
D 21E		1000	216.47	25.88
		Average	218.04	26.03
D 225E		0.5	180.08	23.53
D 116E		0.5	171.92	23.69
D 130E		0.5	175.06	23.69
		Average	175.69	23.64
D 224E		10	166.27	23.53
D 113E		10	167.84	23.53
D 27E		10	164.70	23.37
		Average	166.27	23.48
D 114E		100	170.98	23.84
D 111E		100	172.55	23.84
D 222E		100	172.55	24.00
		Average	172.03	23.89
D 228E		1000	177.25	23.53
D 125E		1000	177.57	24.31
D 36E		1000	178.82	24.31
		Average	177.88	24.05

TABLE 35. COMPRESSIVE PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES
AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (° F)</u>	<u>Exposure Time (hr)</u>	<u>Compressive Yield Strength (ksi)</u>	<u>Ec (psi X 10⁻⁶)</u>
D 19E	1000	0.5	101.96	19.61
D 33E		0.5	94.12	19.61
D 37E		0.5	109.80	20.39
		Average	101.96	19.87
D 39E		10	101.96	19.61
D 12E		10	106.67	19.14
D 310E		10	109.80	20.39
		Average	106.14	19.78
D 112E		100	88.78	20.39
D 230E		100	90.98	18.82
D 24E		100	92.16	19.58
		Average	90.64	19.60
D 124E		1000	91.29	18.66
D 118E		1000	87.85	18.82
D 11E		1000	81.57	18.51
		Average	86.90	18.66

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES AND
EXPOSURE TIMES

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
D 19C	Room	--	378.04	329.41
D 226C		--	372.16	332.94
D 126C		--	376.56	323.44
		Average	375.58	326.56
D 24C	400	0.5	357.03	314.84
D 211C		0.5	360.16	312.50
D 11C		0.5	364.06	320.31
		Average	360.41	315.88
D 120C		10	356.25	310.16
D 225C		10	357.81	306.25
D 32C		10	353.13	314.84
		Average	355.73	310.41
D 114C		100	355.47	310.16
D 29C		100	357.03	312.50
D 222C		100	359.38	308.59
		Average	357.29	310.41
D 37C		1000	360.94	320.31
D 34C		1000	357.81	306.25
D 119C		1000	358.59	312.50
		Average	359.11	313.02

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES AND
EXPOSURE TIMES (Cont'd)

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
D 117C	600	0.5	340.63	295.31
D 125C		0.5	335.16	296.09
D 52C		0.5	344.53	293.75
		Average	340.10	295.05
D 510C		10	342.19	297.66
D 111C		10	348.44	303.13
D 28C		10	336.72	292.97
		Average	342.45	297.92
D 22C		100	342.97	295.31
D 121C		100	345.31	300.78
D 223C		100	342.19	290.63
		Average	343.49	295.57
D 36C		1000	342.97	296.88
D 123C		1000	351.56	303.91
D 57C		1000	346.09	300.00
		Average	346.87	300.26
D 218C	800	0.5	290.63	257.03
D 215C		0.5	292.97	250.78
D 35C		0.5	289.06	263.67
		Average	290.88	257.16
D 112C		10	295.31	252.34
D 16C		10	298.44	257.81
D 12C		10	292.97	247.66
		Average	295.57	252.60
D 53C		100	289.84	230.47
D 23C		100	293.75	229.69
D 59C		100	288.28	233.59
		Average	290.62	231.25
D 118C		1000	242.97	201.56
D 219C		1000	238.28	189.84
D 26C		1000	239.84	195.31
		Average	240.36	195.57

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES AND
EXPOSURE TIMES (Cont d)

a. $e/D = 1.5$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
D 25C	1000	0.5	180.47	155.47
D 216C		0.5	186.72	153.13
D 31C		0.5	175.00	157.81
		Average	180.73	155.47
D 13C		10	165.63	143.75
D 27C		10	164.84	147.66
D 124C		10	164.06	145.31
		Average	164.84	145.57
D 212C		100	141.41	125.00
D 54C		100	144.53	121.09
D 18C		100	139.84	129.69
		Average	141.92	125.26
D 122C		1000	120.31	100.00
D 58C		1000	121.88	96.09
D 17C		1000	119.92	104.69
		Average	120.70	100.26

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES AND
EXPOSURE TIMES

b. $c/D = 2.0$

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Bearing Strength (ksi)</u>	<u>Bearing Yield Strength (ksi)</u>
D 16D	Room	--	470.31	423.44
D 222D		--	475.78	426.56
D 220D		--	469.97	421.88
		Average	472.02	423.96
D 56D	400	0.5	442.19	353.52
D 510D		0.5	439.06	361.72
D 24D		0.5	441.41	361.72
		Average	440.88	358.98
D 38D		10	439.84	360.16
D 216D		10	436.72	355.47
D 59D		10	429.69	351.56
		Average	435.41	355.73
D 33D		100	435.16	353.91
D 124D		100	435.16	353.81
D 118D		100	439.84	357.81
		Average	436.72	355.17
D 36D		1000	425.00	350.00
D 125D		1000	425.78	352.34
D 219D		1000	424.61	349.22
		Average	425.13	350.52

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES AND
EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Bearing Strength (ksi)	Bearing Yield Strength (ksi)
D 54D	600	0.5	415.69	337.25
D 29D		0.5	416.41	339.84
D 55D		0.5	418.75	342.19
		Average	416.95	339.76
D 224D		10	417.97	330.08
D 32D		10	417.97	345.31
D 211D		10	416.80	344.53
		Average	417.58	339.97
D 221D		100	417.97	339.84
D 121D		100	414.06	335.94
D 15D		100	422.66	342.97
		Average	418.23	339.58
D 21D	800	1000	426.67	347.45
D 117D		1000	421.09	348.44
D 225D		1000	421.88	346.88
		Average	423.21	347.59
D 18D		0.5	360.16	317.97
D 223D		0.5	360.16	314.84
D 53D		0.5	366.41	320.31
		Average	362.24	317.70
D 12D		10	360.16	310.94
D 13D		10	363.28	314.06
D 57D		10	367.97	316.41
		Average	363.80	313.80
D 201D	800	100	338.28	304.69
D 58D		100	339.84	305.47
D 115D		100	342.19	310.16
		Average	340.10	306.77
D 11D		1000	328.13	296.88
D 19D		1000	324.22	307.81
D 23D		1000	325.00	295.31
		Average	325.78	300.00

TABLE 36. BEARING PROPERTIES OF 301 (60% COLD REDUCED)
STAINLESS STEEL AT VARIOUS TEMPERATURES AND
EXPOSURE TIMES (Cont'd)

b. $e/D = 2.0$

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Bearing Strength (ksi)</u>	<u>Bearing Yield Strength (ksi)</u>
D 14D	1000	0.5	220.31	189.84
D 120D		0.5	221.88	196.88
D 27D		0.5	210.94	187.50
		Average	217.71	191.40
D 123D		10	189.84	160.16
D 17D		10	187.50	157.03
D 113D		10	190.63	153.91
		Average	189.32	157.03
D 122D		100	160.16	130.47
D 119D		100	164.06	134.77
D 34D		100	157.03	126.56
		Average	160.41	130.60
D 31D		1000	137.50	120.31
D 215D		1000	138.28	118.75
D 214D		1000	140.63	120.31
		Average	138.80	119.79

TABLE 37. SHEAR PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS
STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
D 69F	Room	--	90.65
D 38F		--	88.79
D 54F		--	87.85
		Average	89.10
D 510F	400	0.5	84.11
D 37F		0.5	84.11
D 11F		0.5	81.31
		Average	83.18
D 68F		10	83.18
D 313F		10	83.18
D 56F		10	84.11
		Average	83.49
D 57F		100	83.18
D 514F		100	82.24
D 42F		100	82.24
		Average	82.55
D 32F		1000	82.24
D 312F		1000	81.78
D 47F		1000	82.24
		Average	82.09

TABLE 37. SHEAR PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS
STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

Specimen Number	Test Temperature (°F)	Exposure Time (hr)	Ultimate Shear Strength (ksi)
D 63F	600	0.5	74.77
D 67F		0.5	77.57
D 53F		0.5	77.10
		Average	76.48
D 612F		10	77.57
D 22F		10	79.44
D 34F		10	78.50
		Average	78.50
D 12F		100	81.31
D 13F		100	79.44
D 36F		100	80.37
		Average	80.37
D 21F	800	1000	81.31
D 59F		1000	82.24
D 611F		1000	83.18
		Average	82.24
D 412F		0.5	74.77
D 33F		0.5	78.51
D 43F		0.5	72.90
		Average	75.39
D 311F		10	74.77
D 35F		10	75.70
D 415F		10	75.70
		Average	75.39
D 310F	800	100	70.09
D 411F		100	70.09
D 513F		100	71.03
		Average	70.40
D 615F		1000	63.08
D 414F		1000	63.55
D 46F		1000	61.68
		Average	62.77

TABLE 37. SHEAR PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS
STEEL AT VARIOUS TEMPERATURES AND EXPOSURE TIMES (Cont'd)

<u>Specimen Number</u>	<u>Test Temperature (°F)</u>	<u>Exposure Time (hr)</u>	<u>Ultimate Shear Strength (ksi)</u>
D 66F	1000	0.5	40.19
D 614F		0.5	43.93
D 48F		0.5	42.99
		Average	42.37
D 52F		10	39.72
D 23F		10	34.58
D 61F		10	32.71
		Average	35.67
D 51F		100	33.64
D 44F		100	39.25
D 316F		100	32.24
		Average	35.04
D 31F		1000	27.10
D 65F		1000	29.91
D 24F		1000	28.97
		Average	28.66

Smooth Tensile (A)		Bearing $e/D = 1.5$ (C)	Bearing $e/D = 2.0$ (D)
Notched Tensile (B)			
		Compression (E)	

FIGURE 1. CUTTING PATTERN FOR SHEET SPECIMENS - ALL MATERIALS
EXCEPT 301 STAINLESS STEEL

Identification Code

First Part, a letter = Material - B = Ph15-7 Mo, D = 301 Stainless Steel,
 E = AM 355, F = Rene' 41, and G = N-155 (Multimet)
 Second Part, a number = Location in sheet (first digit = longitudinal position
 and second digit = transverse position)
 Third Part, a letter = Individual specimen identification

Thus Specimen E32A = an AM 355 smooth tensile specimen from Group 32

(11)	(21)	(31)	(41)	(51)	(61)	(71)	(81)	(91)	(101)
(12)	(22)	(32)	(42)	(52)	(62)	(72)	(82)	(92)	(102)
(13)	(23)	(33)	(43)	(53)	(63)	(73)	(83)	(93)	(103)
(14)	(24)	(34)	(44)	(54)	(64)	(74)	(84)	(94)	(104)
(15)	(25)	(35)	(45)	(55)	(65)	(75)	(85)	(95)	(105)
(16)	(26)	(36)	(46)	(56)	(66)	(76)	(86)	(96)	(106)

FIGURE 2. PATTERN AND IDENTIFICATION CODE FOR SHEARING BLANKS
 FROM 3' X 8' SHEET

Smooth Tensile (A)	Bearing $\epsilon_D = 1.5$ (C)	Bearing $\epsilon_D = 2.0$ (D)
Notched Tensile (B)	Shear (F)	Compression (E)

FIGURE 3. CUTTING PATTERN FOR 301 STAINLESS STEEL SHEET SPECIMEN

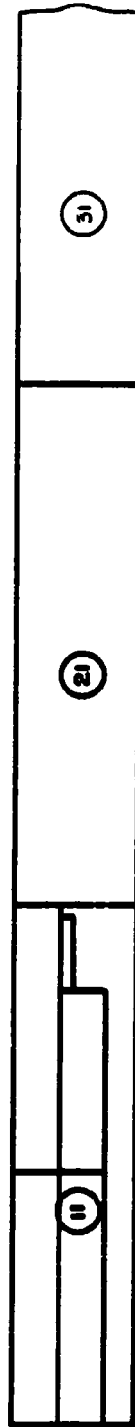


**FIGURE 4. PATTERN FOR SHEARING SPECIMEN BLANKS FROM 4" X 96" SHEET
FOR 301 STAINLESS STEEL**

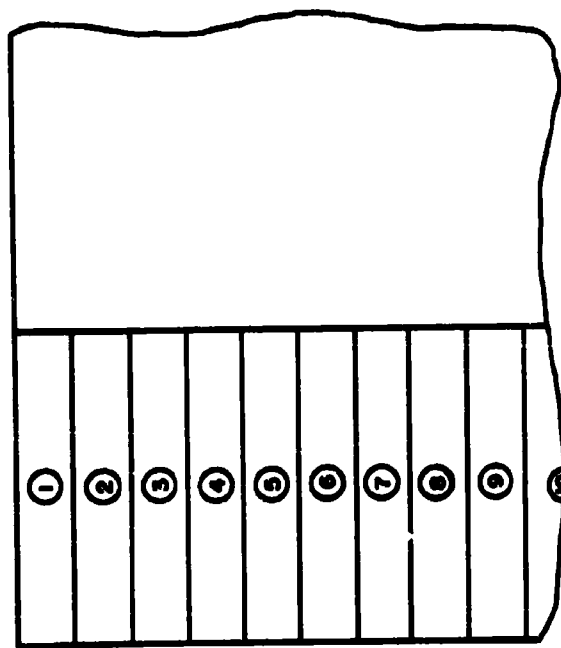


FIGURE 5. PATTERN FOR CUTTING SPECIMEN BLANKS FOR PIN SHEAR
SPECIMENS FROM 1/4" PLATE - ALL MATERIALS EXCEPT
301 STAINLESS STEEL

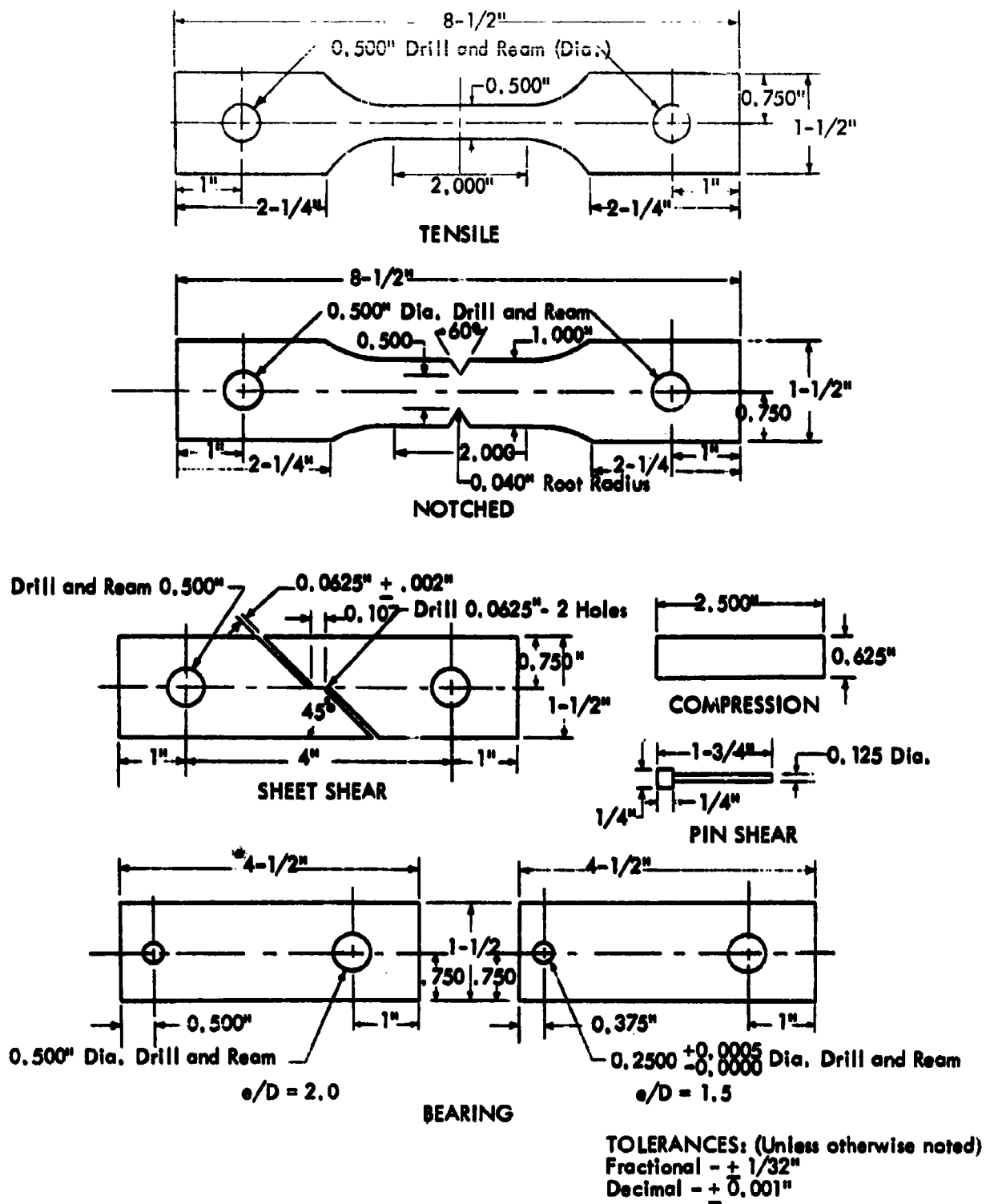


FIGURE 6. TEST SPECIMENS

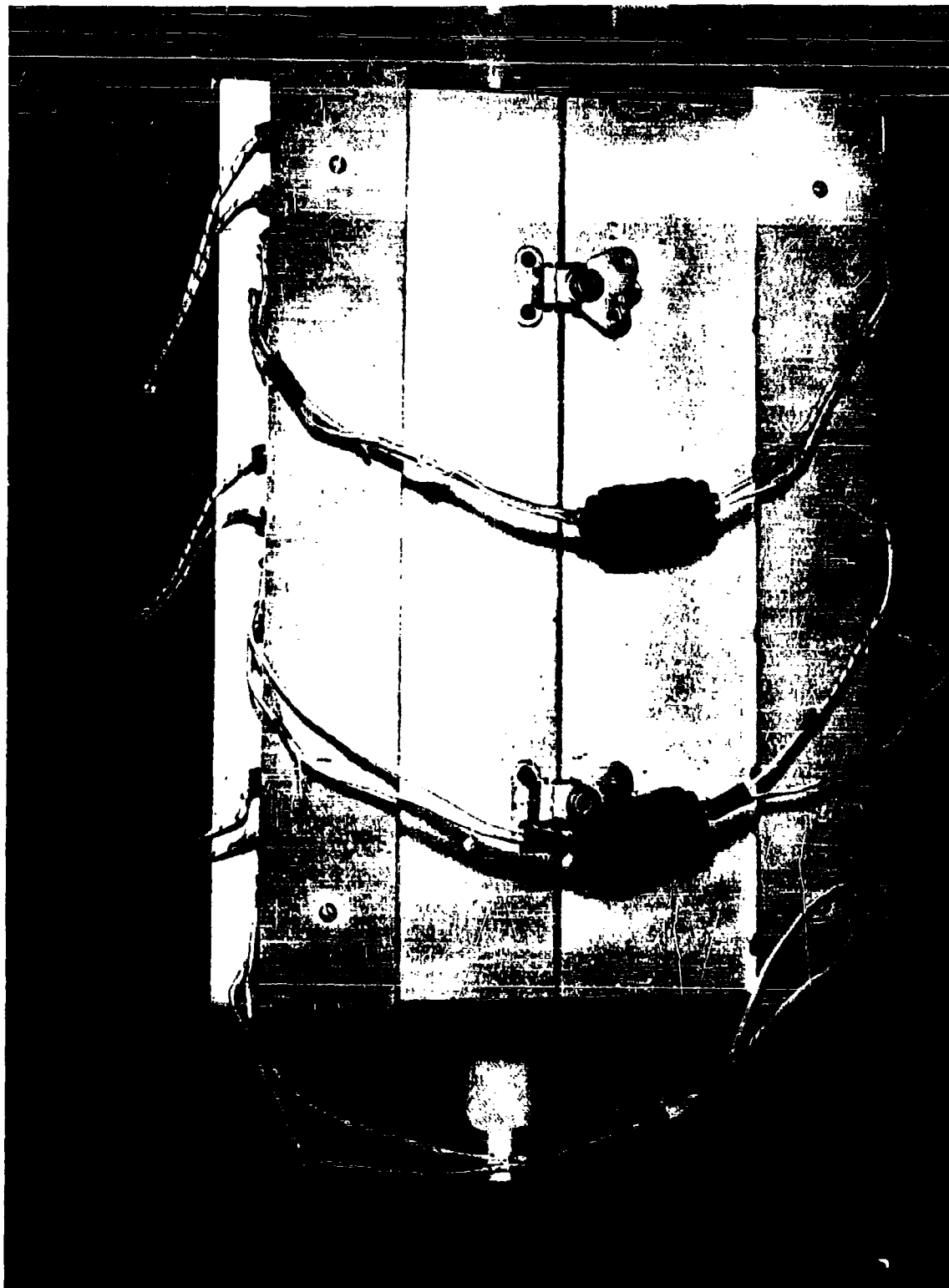


**FIGURE 7. TEST FURNACE INSTALLED IN 200,000 LB
UNIVERSAL TESTING MACHINE**

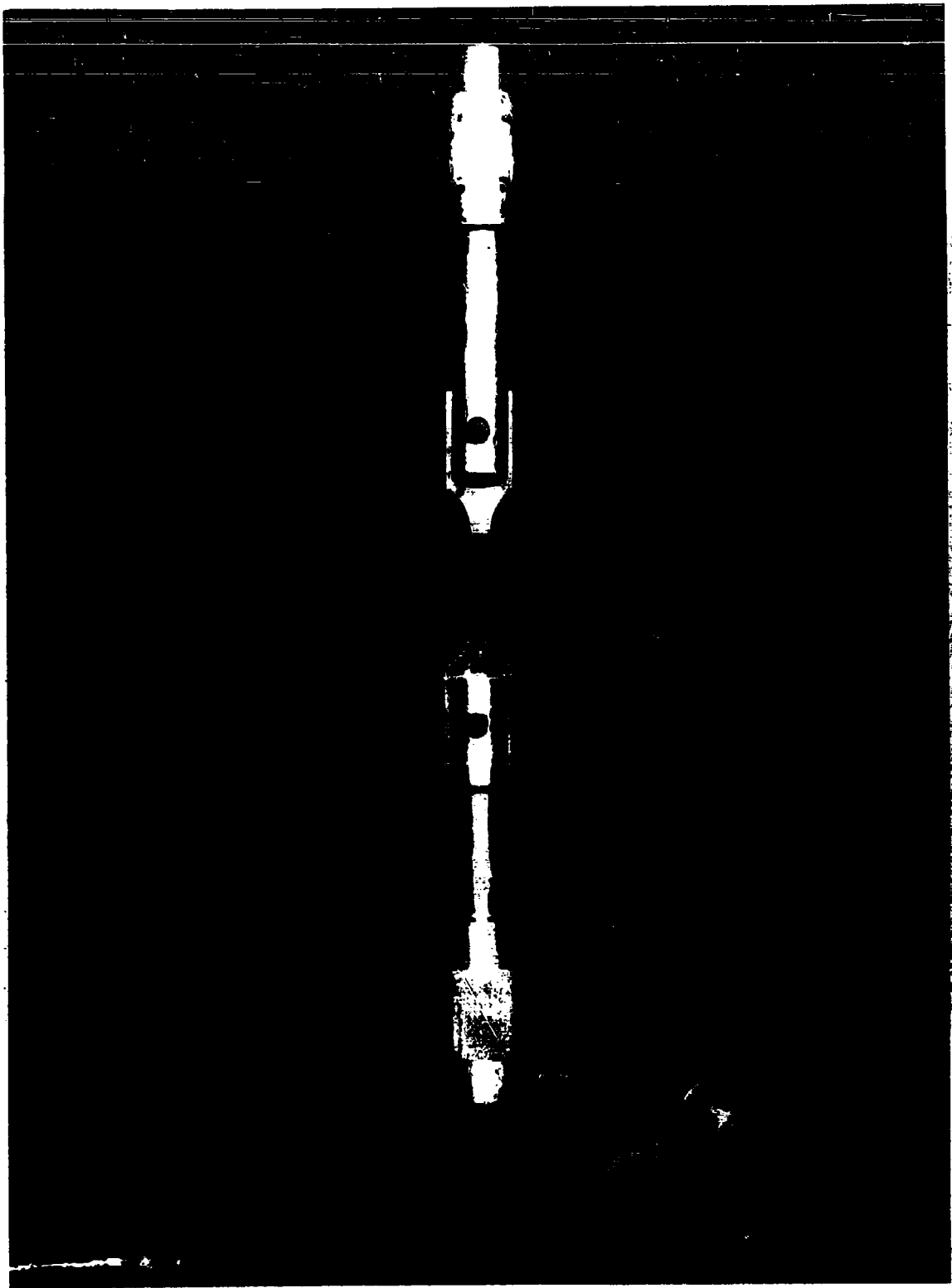


**FIGURE 8. TUCKETMAN OPTICAL STRAIN GAGE
ON TENSILE SPECIMEN**

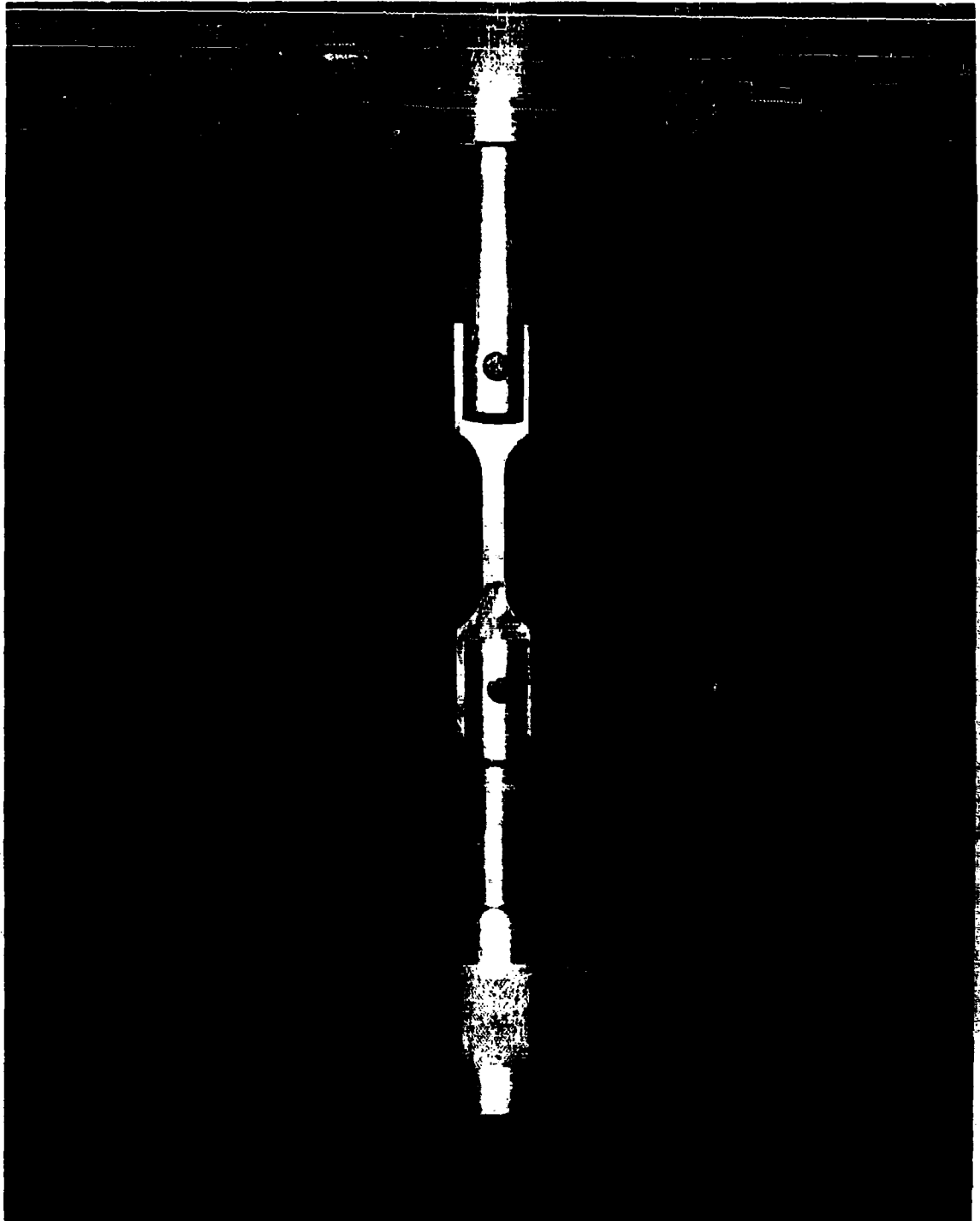


FIGURE 9. TENSILE TEST APPARATUS

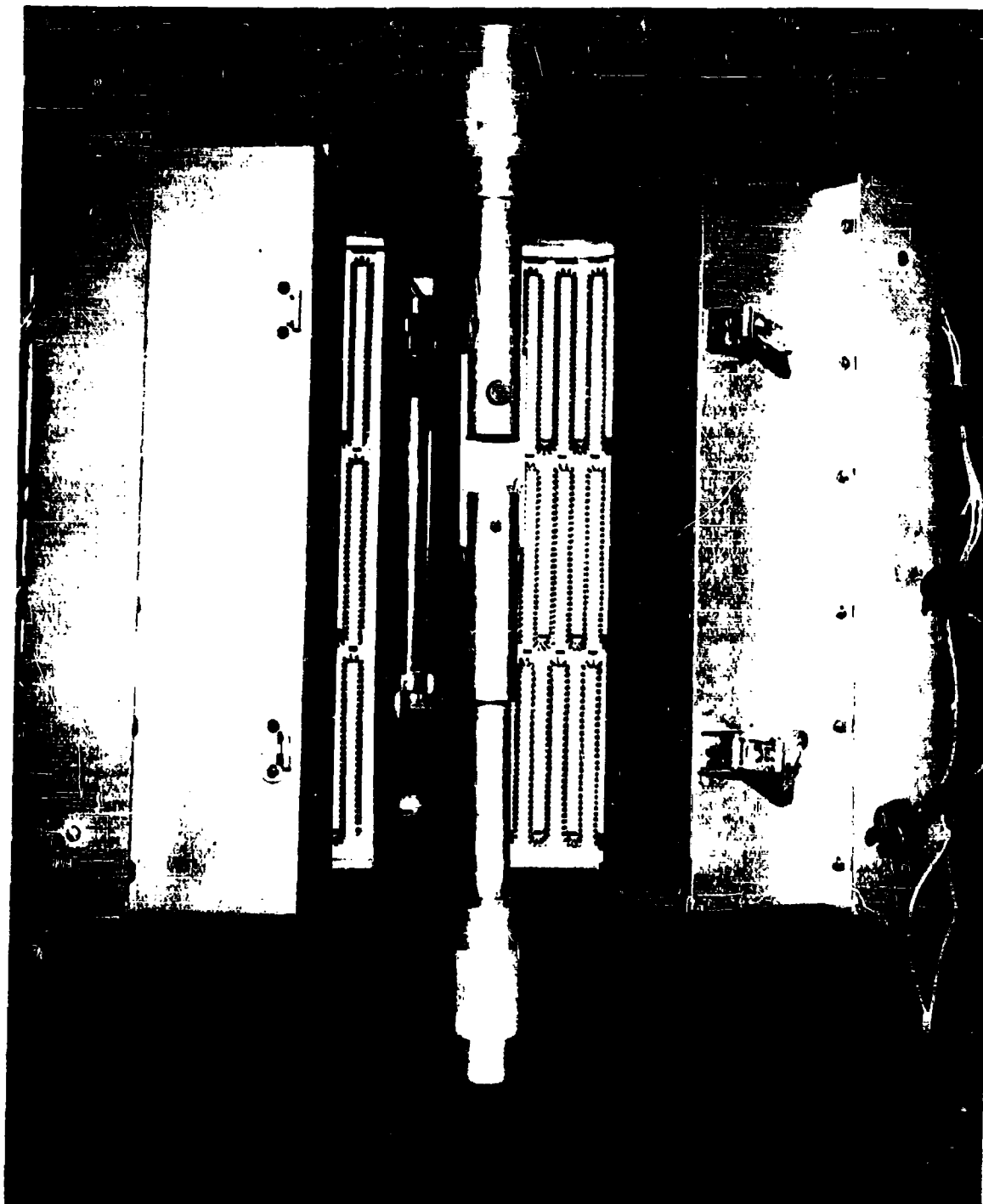


FIGURE 10. BEARING TEST APPARATUS IN TEST FURNACE

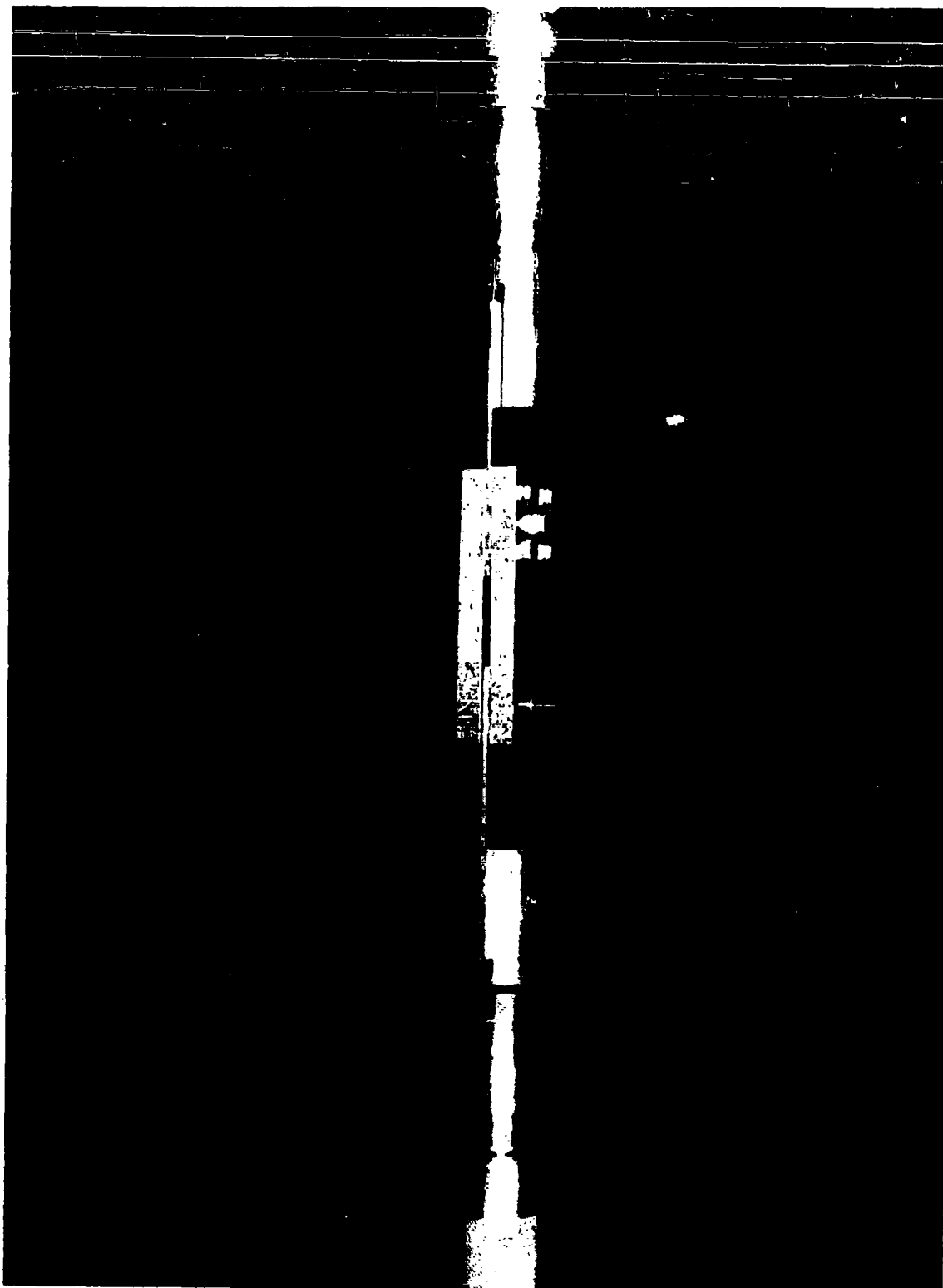


FIGURE 11. PIN SHEAR TEST APPARATUS

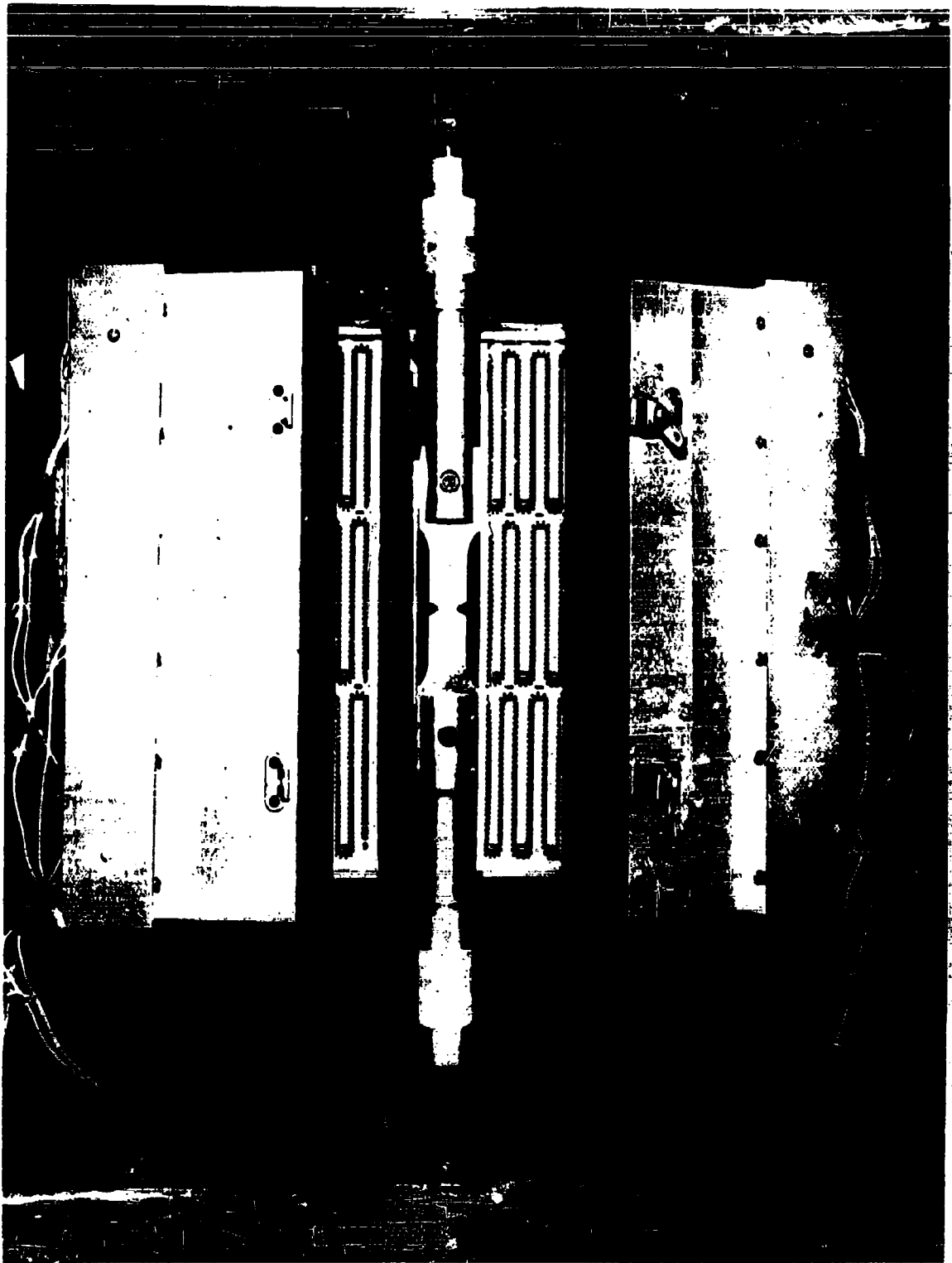


FIGURE 12. NOTCHED TENSILE TEST APPARATUS IN TEST FURNACE

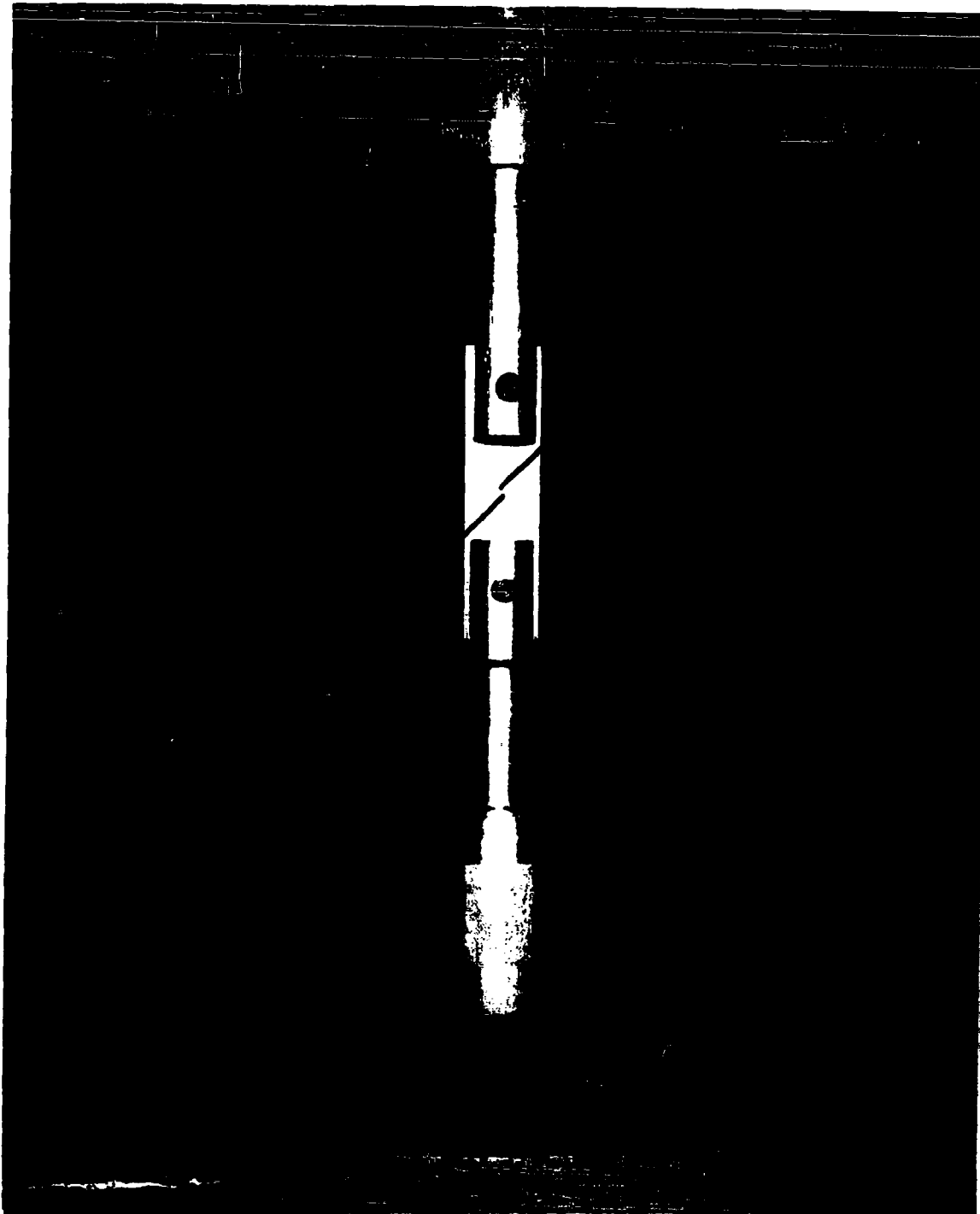


FIGURE 13. SHEET SHEAR TEST APPARATUS

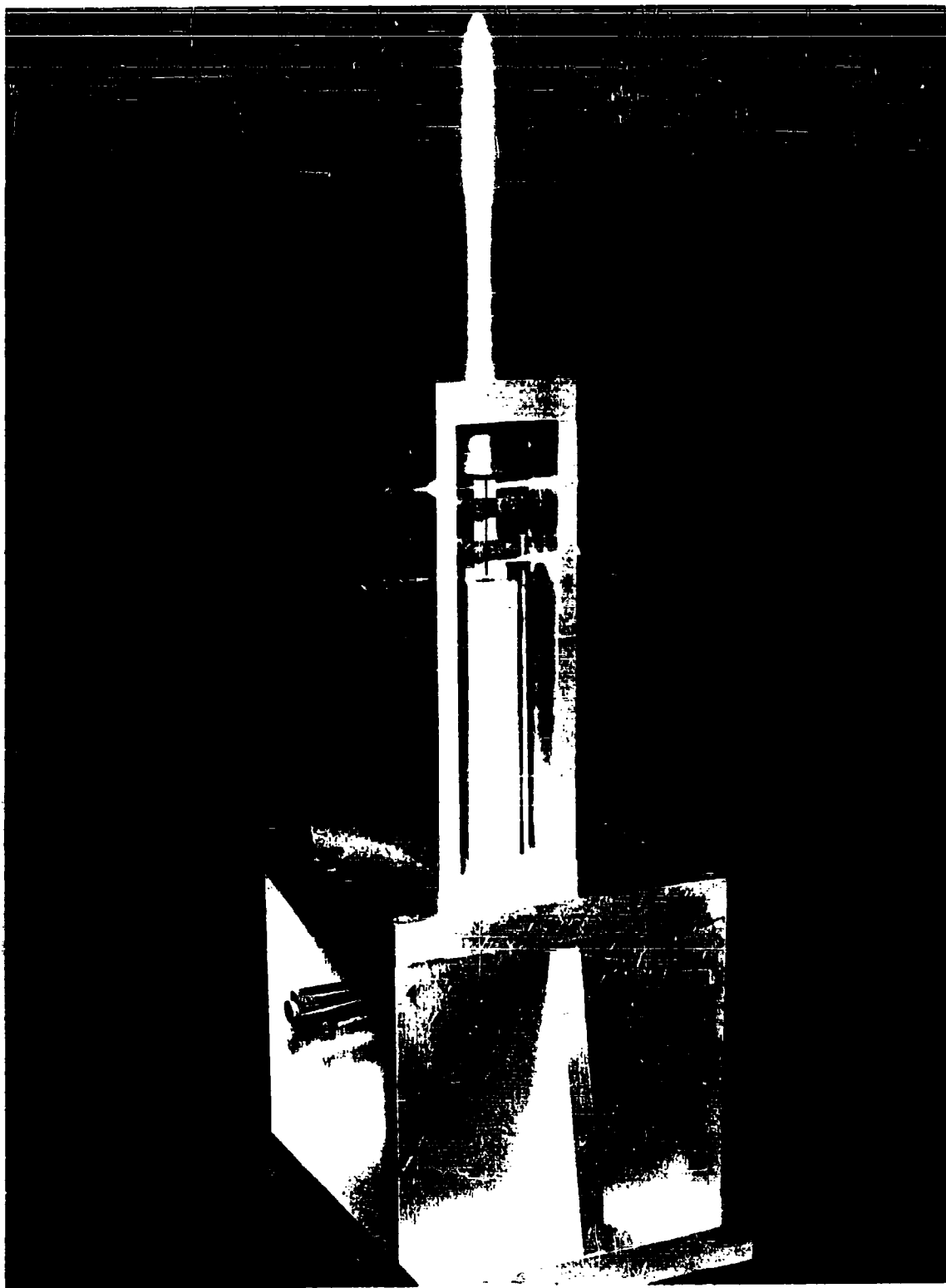


FIGURE 14. COMPRESSION JIG WITH MICROFORMER ATTACHED

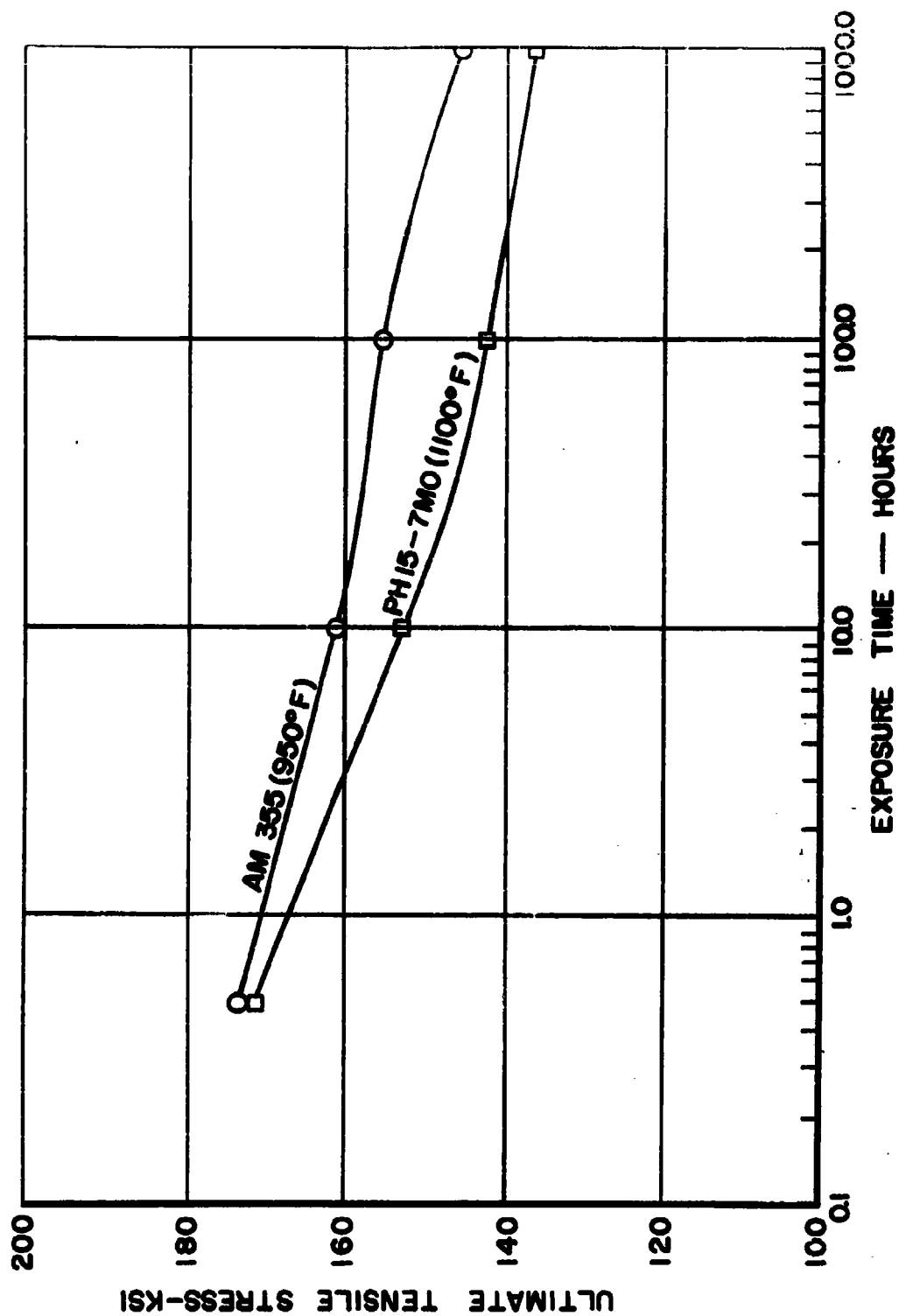


FIGURE 15. ROOM TEMPERATURE TENSILE PROPERTIES OF PH15-7MO AND AM 355 AFTER EXPOSURE ABOVE TEMPERING TEMPERATURES

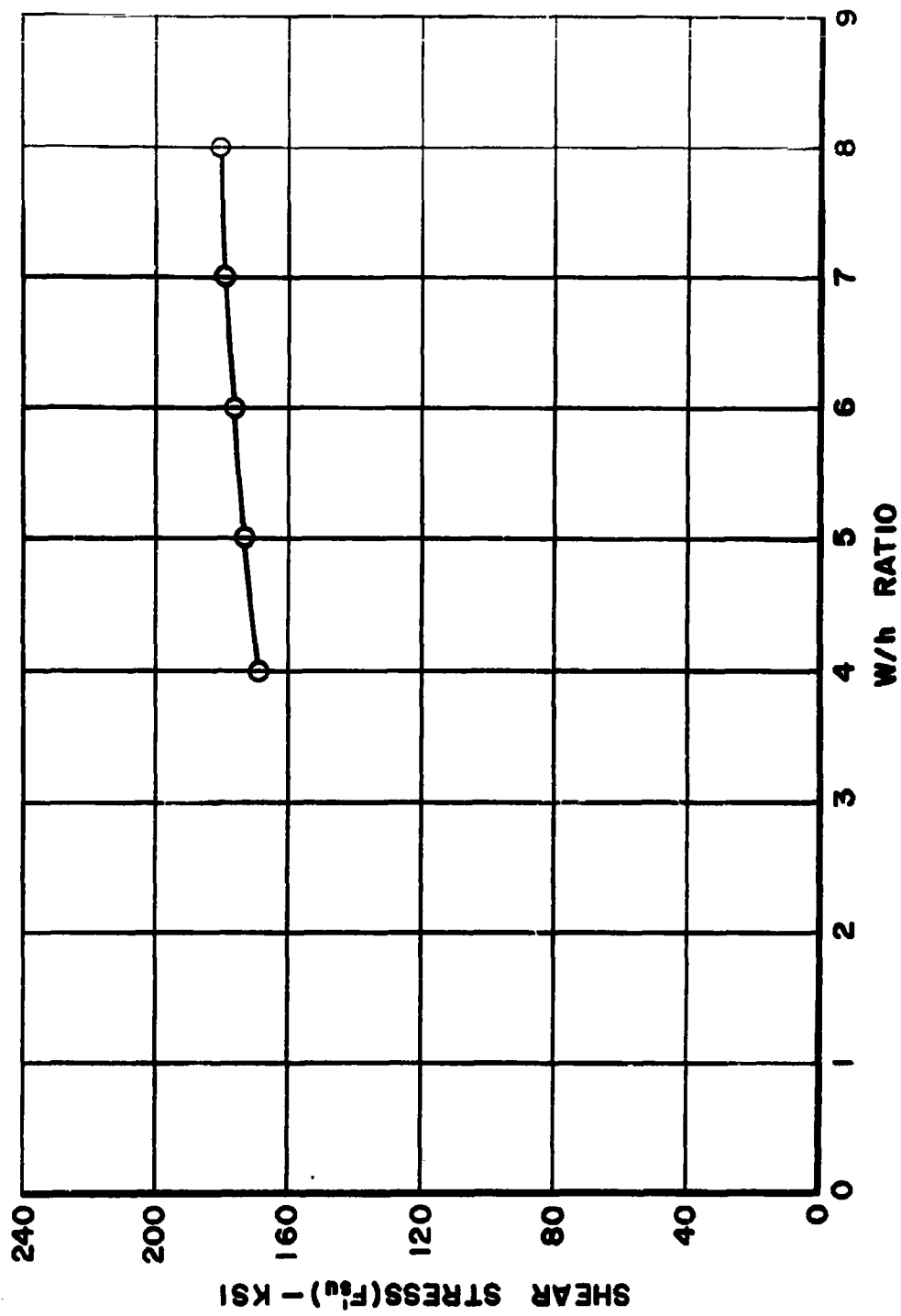


FIGURE 16. ROOM TEMPERATURE SHEET SHEAR STRESS OF 301
(60% COLD REDUCED) STAINLESS STEEL AT VARIOUS
W/h RATIOS

APPENDIX 1

SUMMARY OF ROOM TEMPERATURE PROPERTIES OF Ph15-7Mo

Form: 0.050 Inch Sheet

Condition: TH 1050

Properties:

Ultimate Tensile Strength	-	F_{tu}	=	195,590 psi
Tensile Yield Strength	-	F_{ty}	=	176,830 psi
Modulus of Elasticity	-	E	=	28.57×10^6 psi
Percent of Elongation in 2 inches			=	8.6
Notched Tensile Strength	-	F_{tu}	=	213,360 psi
Compressive Yield Strength	-	F_{cy}	=	205,050 psi
Compressive Modulus of Elasticity	-	E_c	=	29.61×10^6 psi
Ultimate Bearing Strength				
(e/D = 1.5)	-	F_{bru}	=	316,780 psi
(e/D = 2.0)	-	F_{bru}	=	399,730 psi
Bearing Yield Strength				
(e/D = 1.5)	-	F_{bry}	=	271,400 psi
(e/D = 2.0)	-	F_{bry}	=	323,470 psi
Ultimate Shear Strength	-	F_{su}	=	146,120 psi

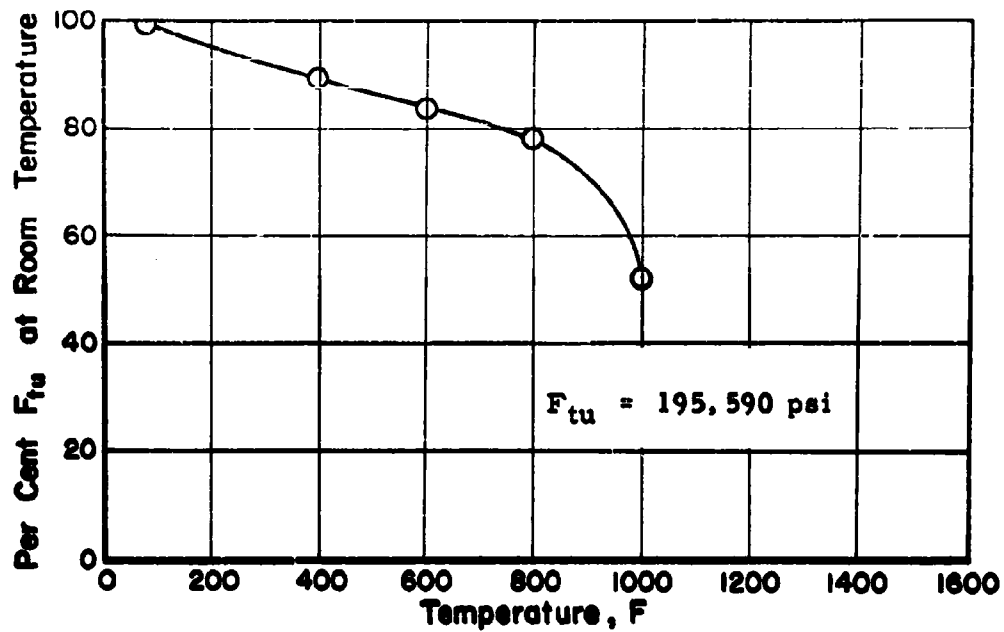


FIGURE 17. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF
Ph15-7Mo EXPOSED 0.5 HOURS

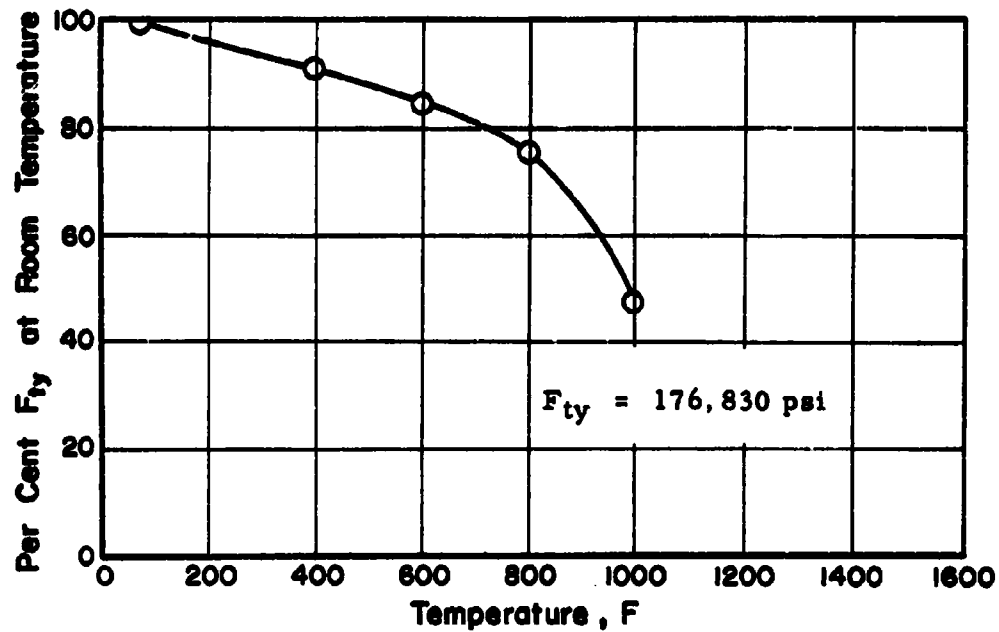


FIGURE 18. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF Ph15-7Mo
EXPOSED 0.5 HOURS

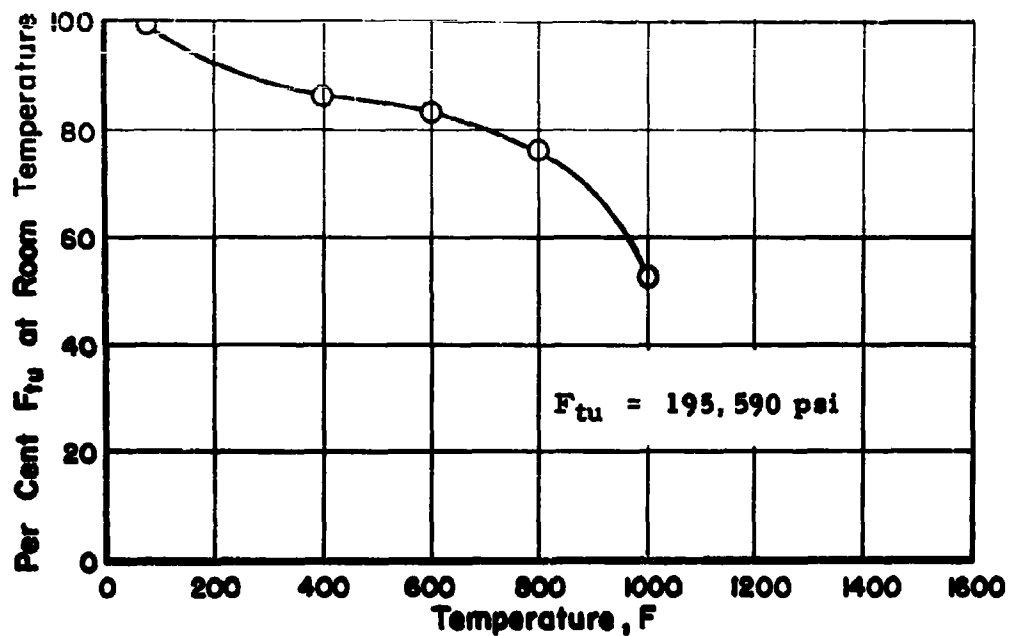


FIGURE 19. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF
Ph15-7Mo EXPOSED 10 HOURS

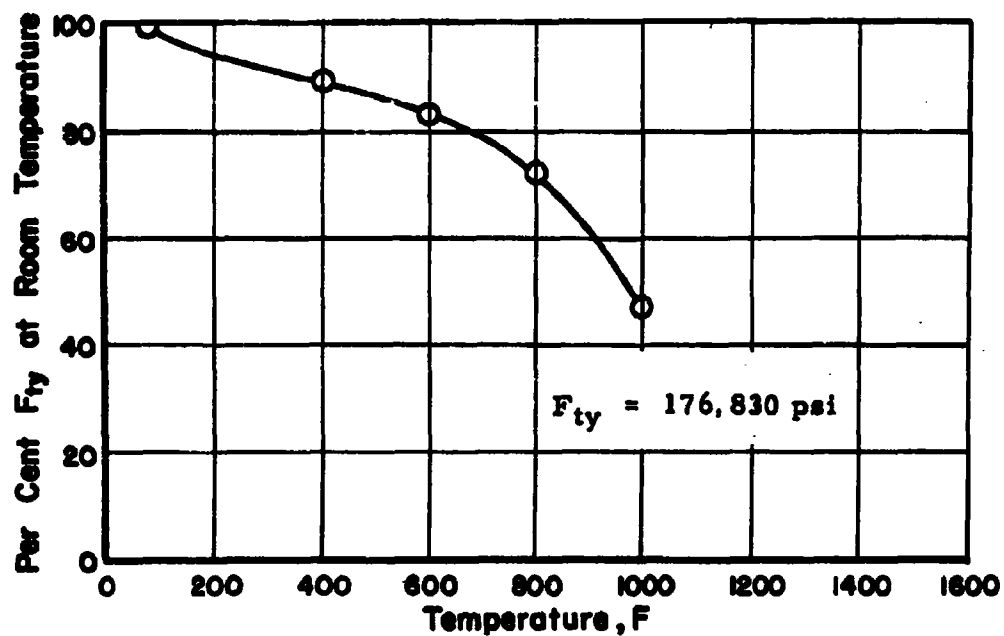


FIGURE 20. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF Ph15-7Mo
EXPOSED 10 HOURS

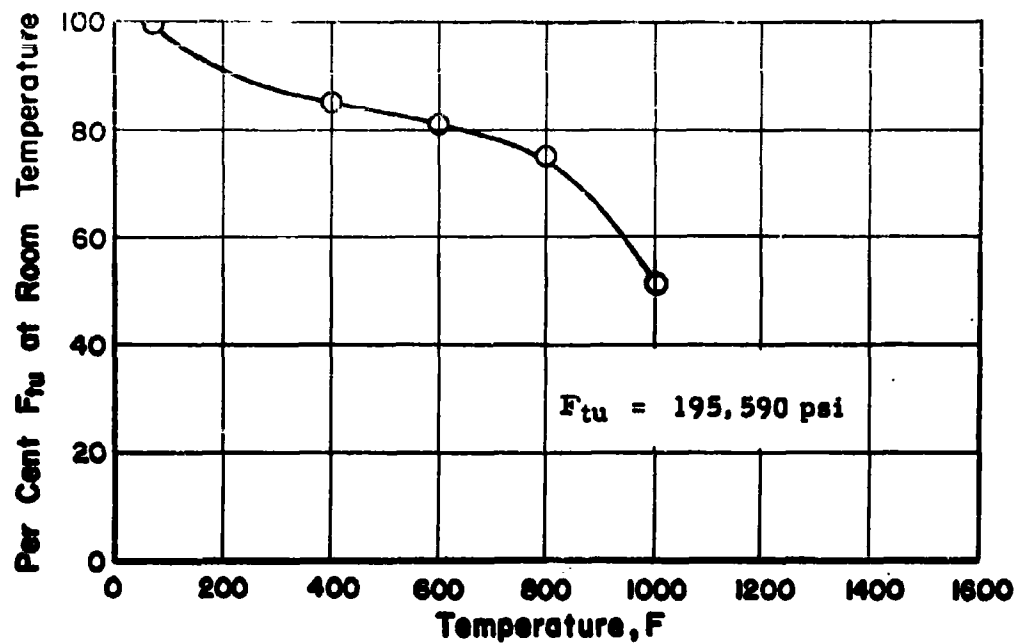


FIGURE 21. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF
Ph15-7Mo EXPOSED 100 HOURS

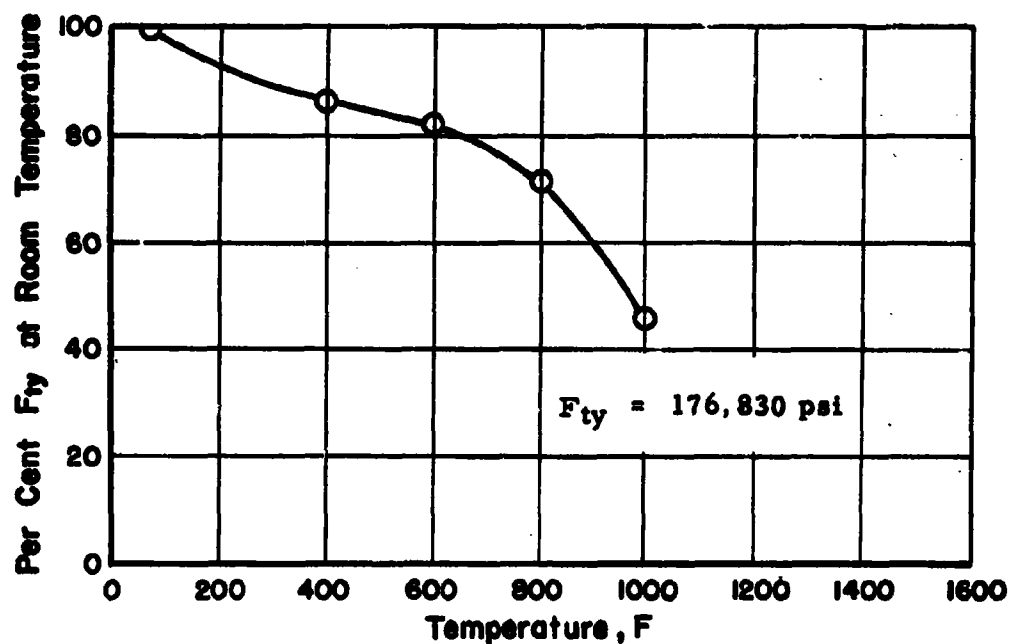


FIGURE 22. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF Ph15-7Mo
EXPOSED 100 HOURS

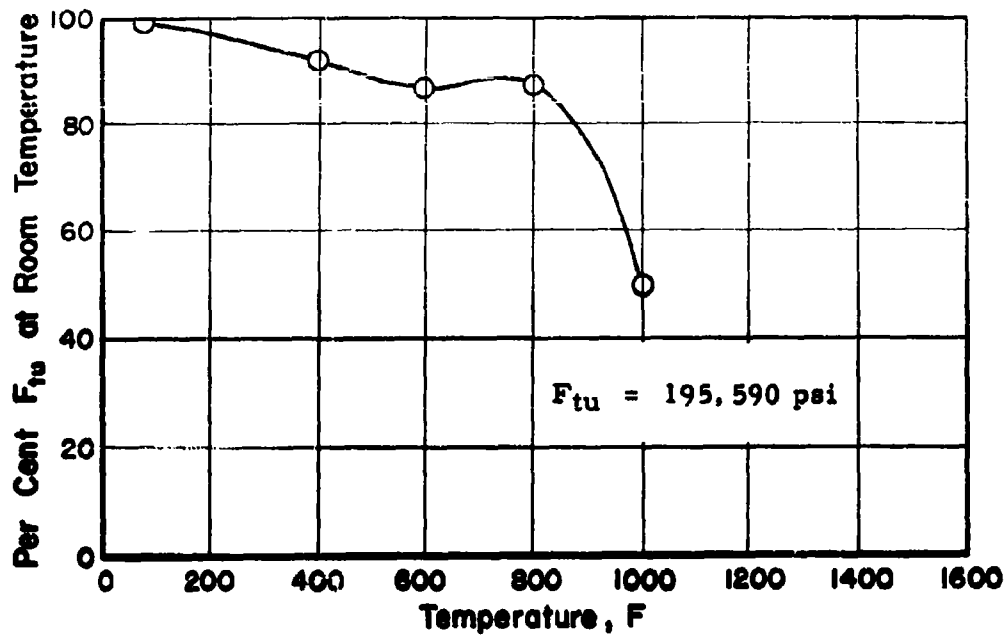


FIGURE 23. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF
Ph15-7Mo EXPOSED 1000 HOURS

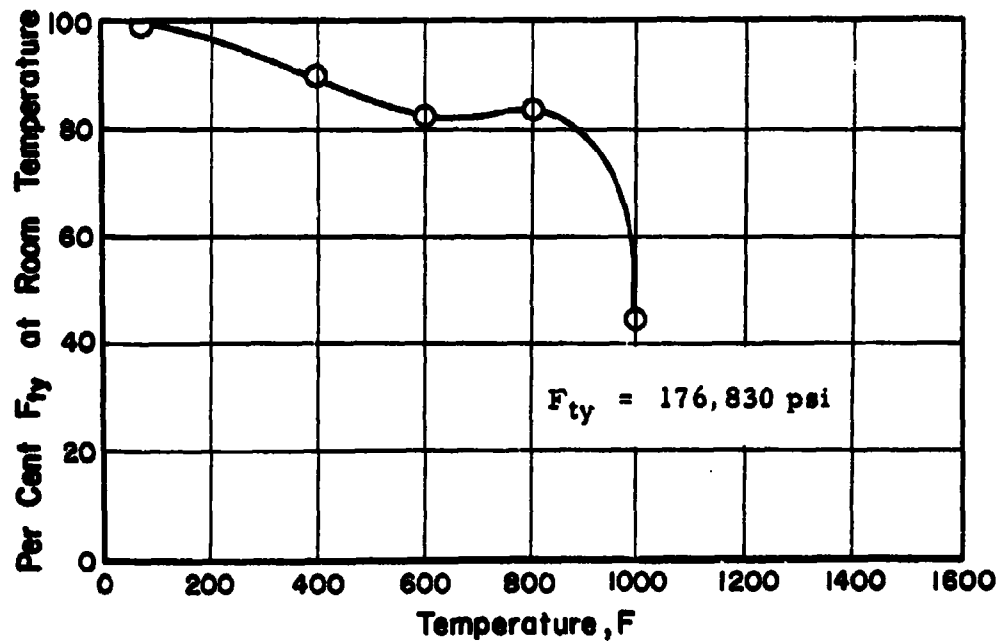


FIGURE 24. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF Ph15-7Mo
EXPOSED 1000 HOURS

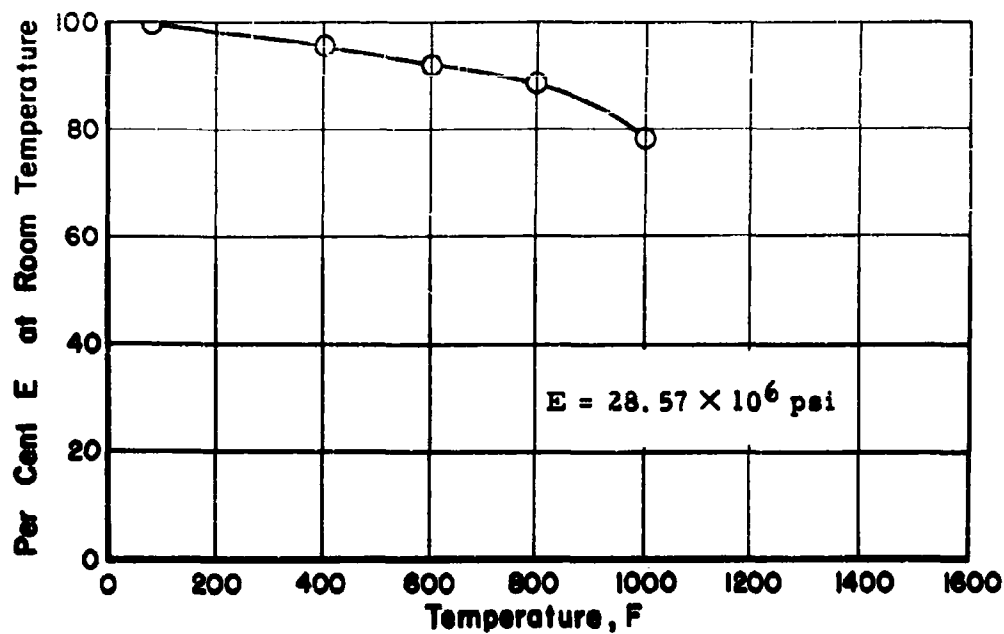


FIGURE 25. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF Ph15-7Mo
EXPOSED 0.5 HOURS

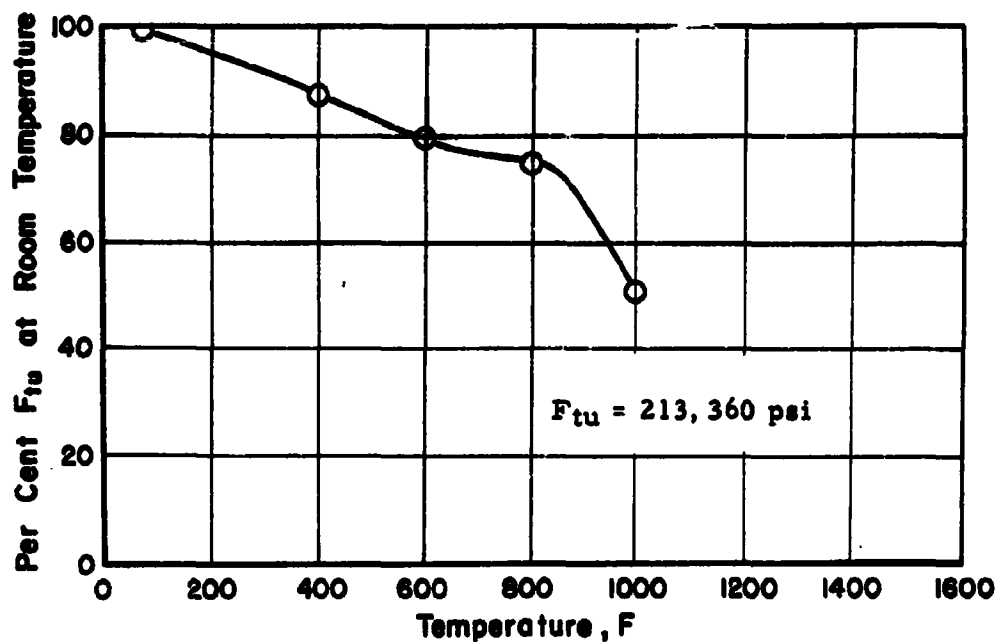


FIGURE 26. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF Ph15-7Mo EXPOSED 0.5 HOURS

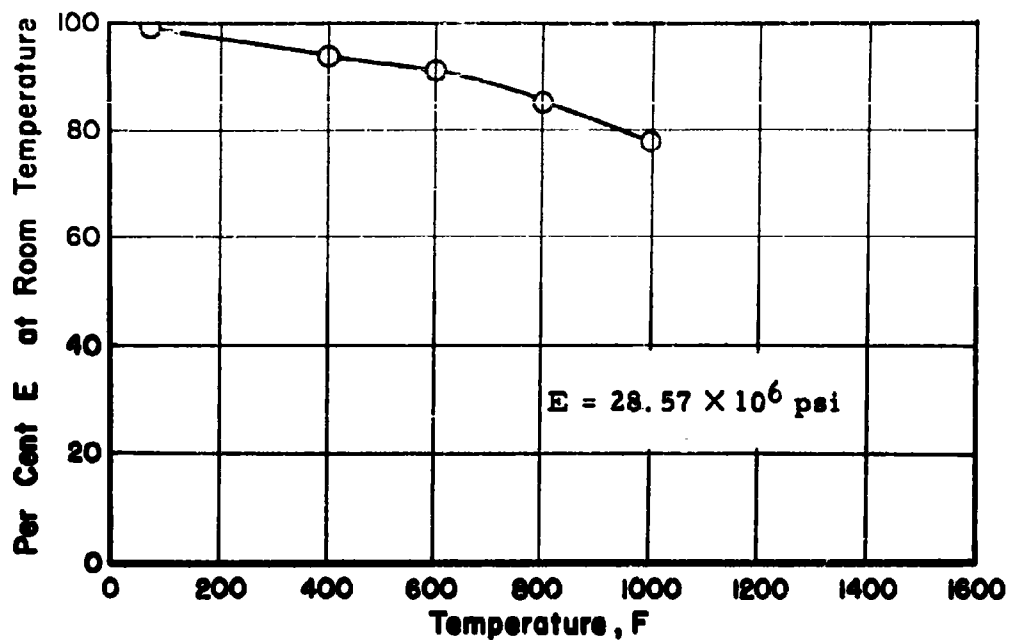


FIGURE 27. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF Ph15-7Mo
EXPOSED 10 HOURS

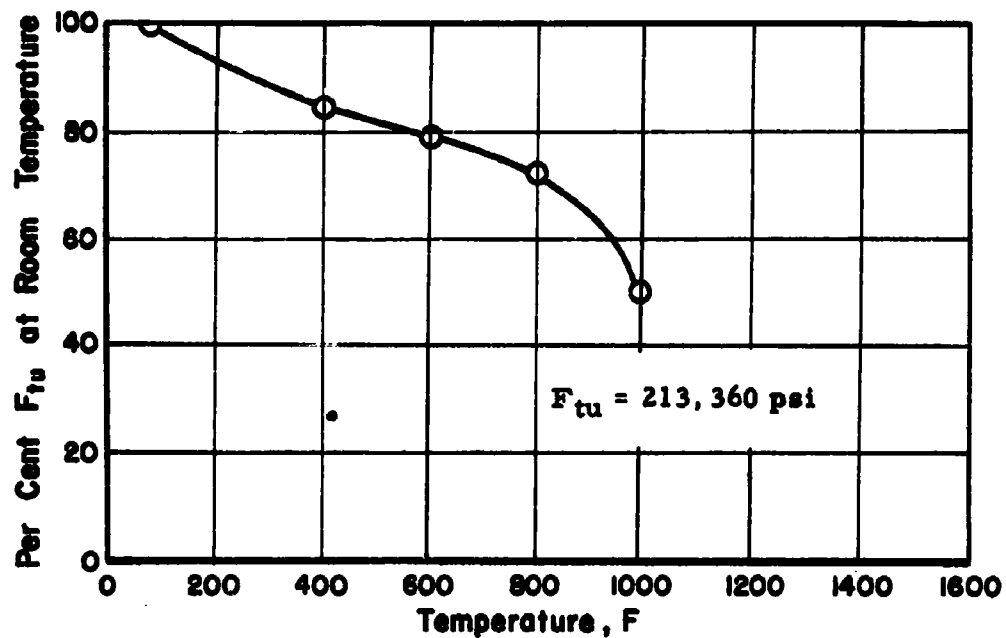


FIGURE 28. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF Ph15-7Mo EXPOSED 10 HOURS

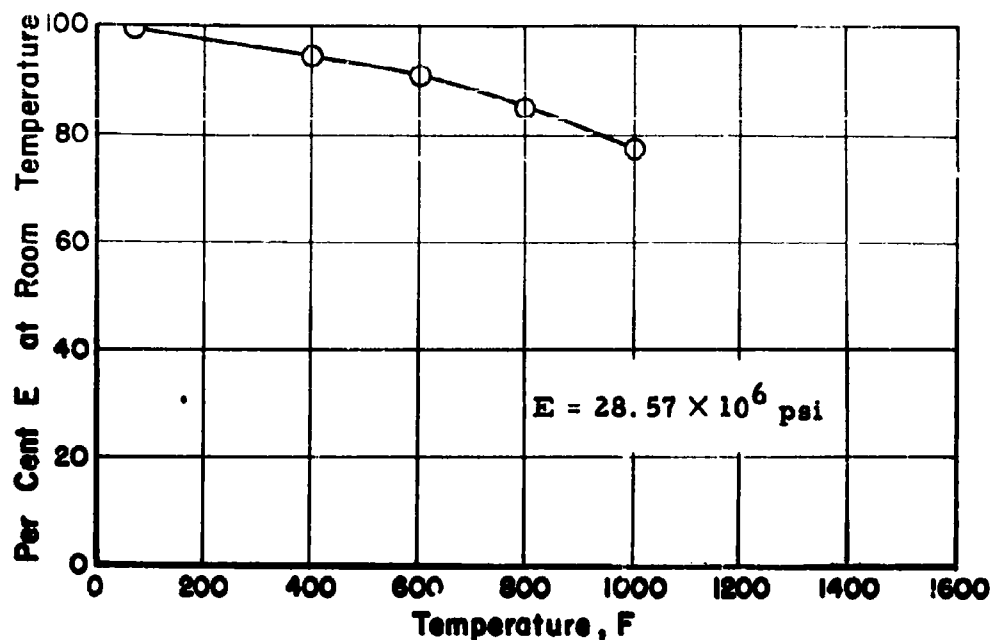


FIGURE 29. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF Ph15-7Mo
EXPOSED 100 HOURS

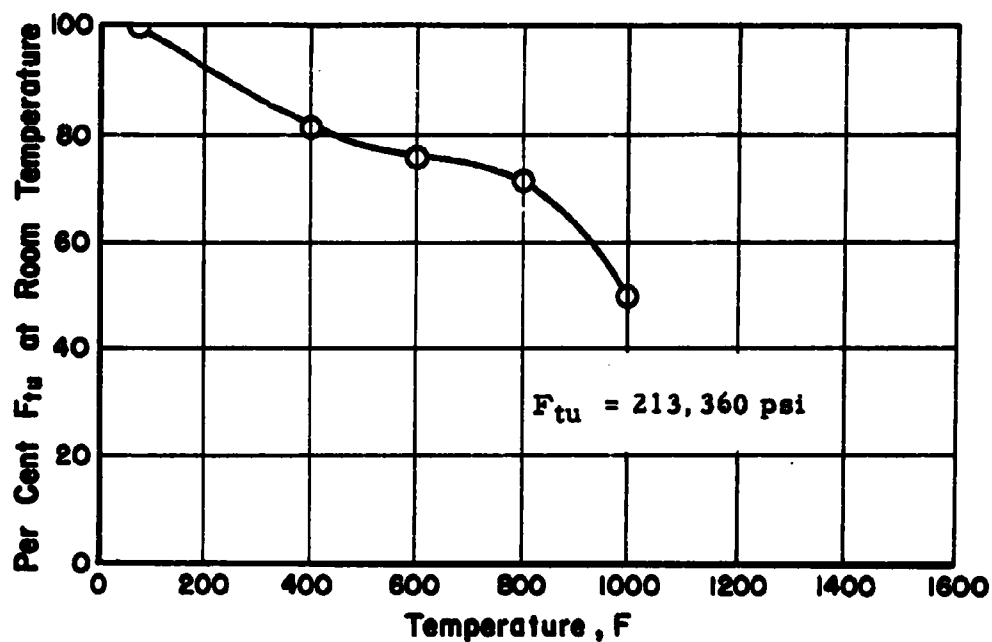


FIGURE 30. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF Ph15-7Mo EXPOSED 100 HOURS

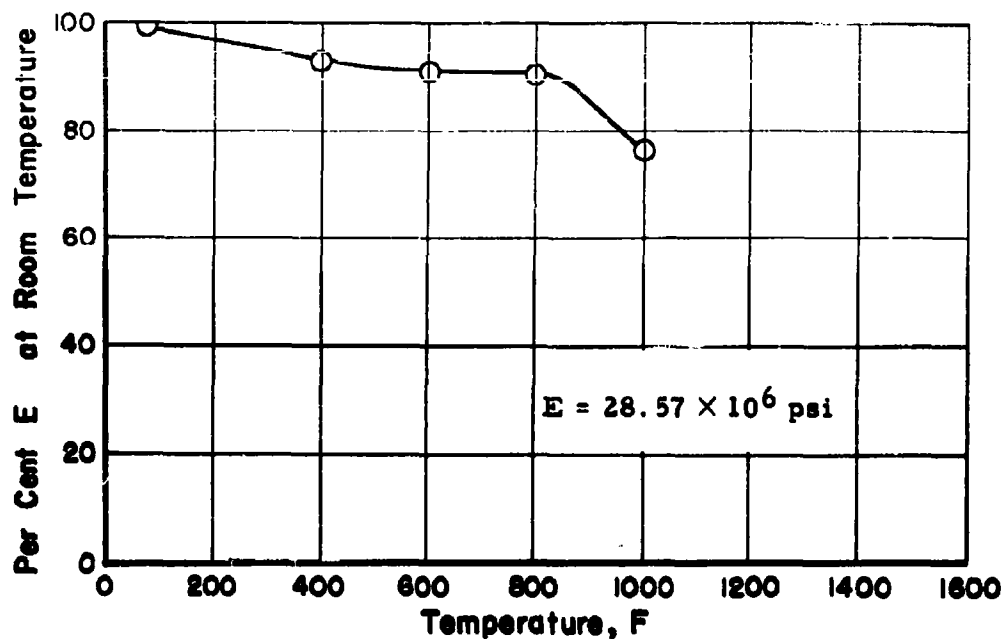


FIGURE 31. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF Ph15-7Mo
EXPOSED 1000 HOURS

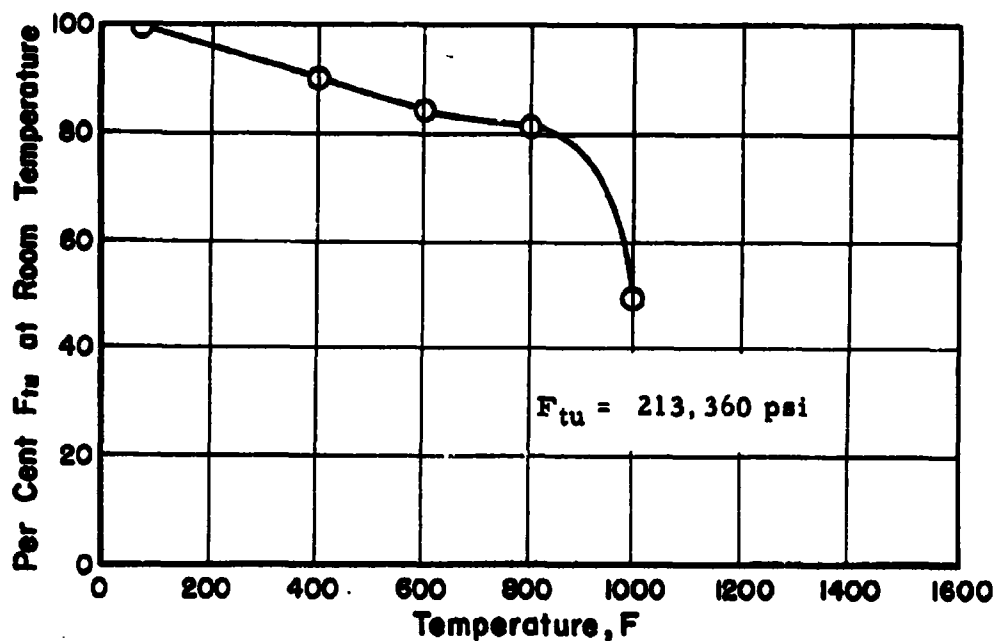


FIGURE 32. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF Ph15-7Mo EXPOSED 1000 HOURS

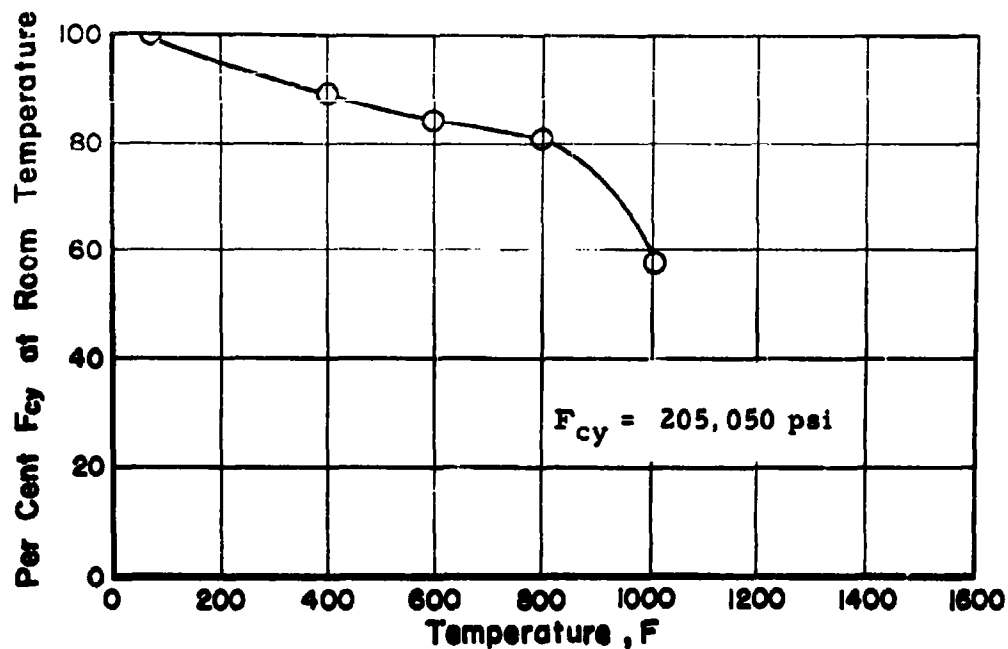


FIGURE 33. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
Ph15-7Mo EXPOSED 0.5 HOURS

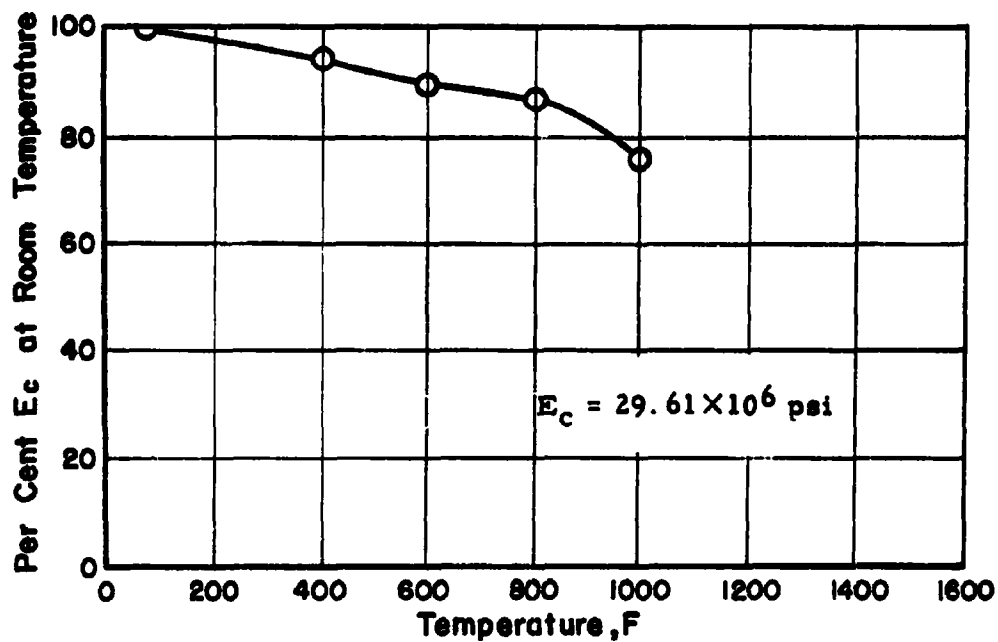


FIGURE 34. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF Ph15-7Mo EXPOSED 0.5 HOURS

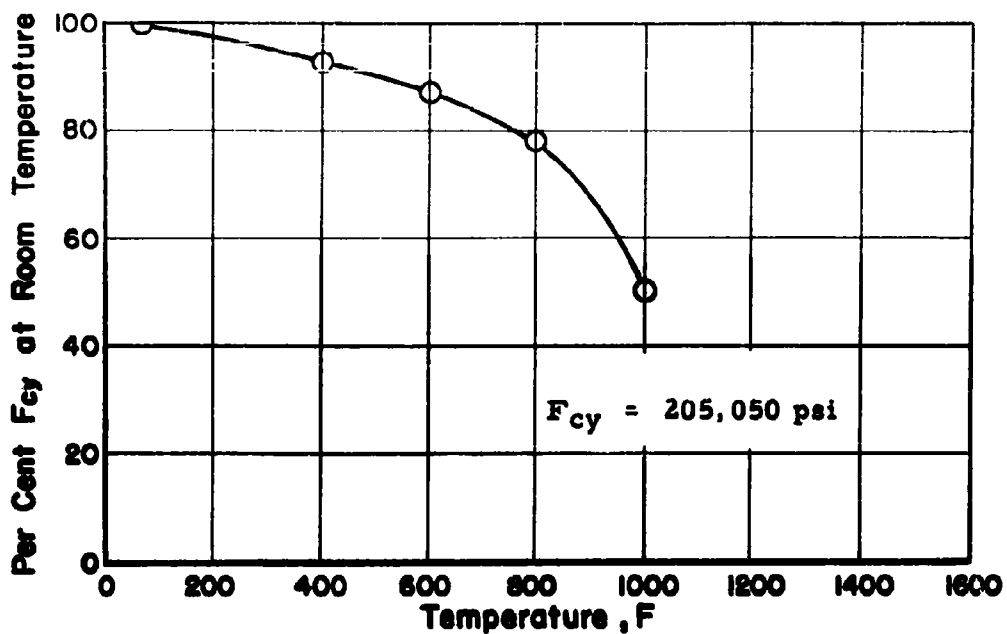


FIGURE 35. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
Ph15-7Mo EXPOSED 10 HOURS

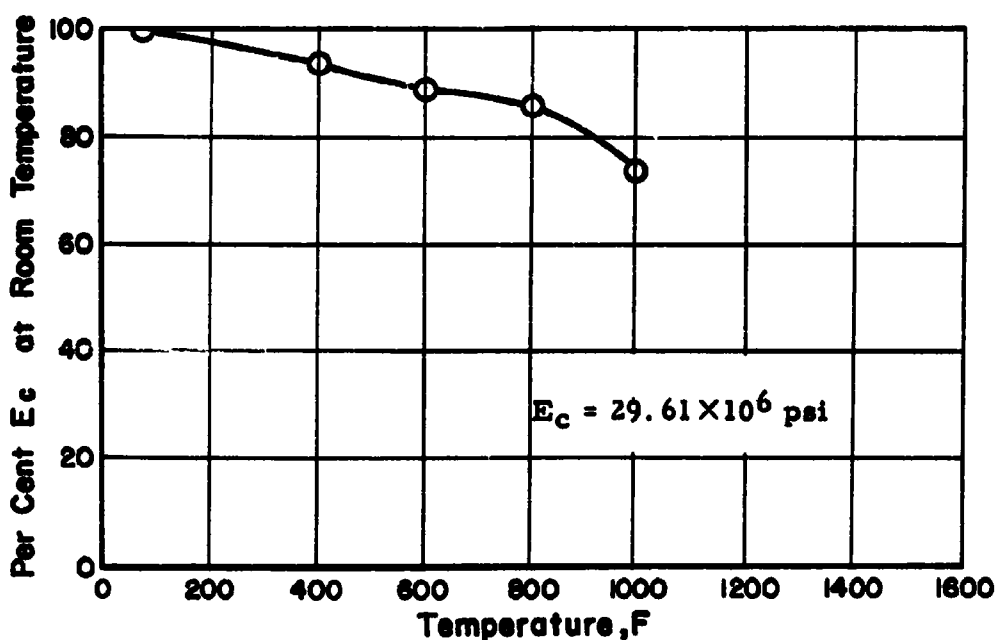


FIGURE 36. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF Ph15-7Mo EXPOSED 10 HOURS

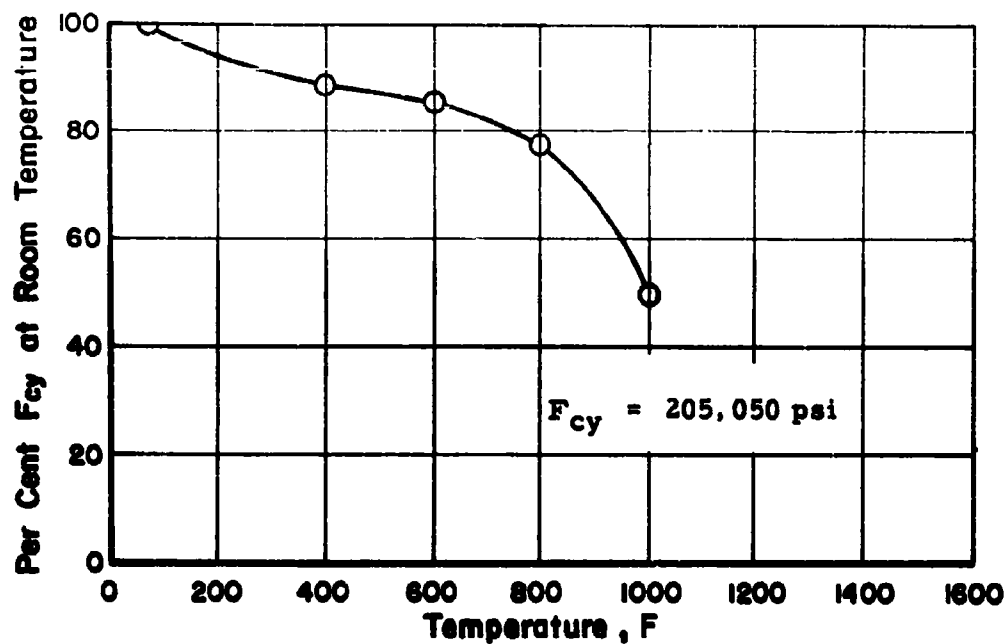


FIGURE 37. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
Ph15-7Mo EXPOSED 100 HOURS

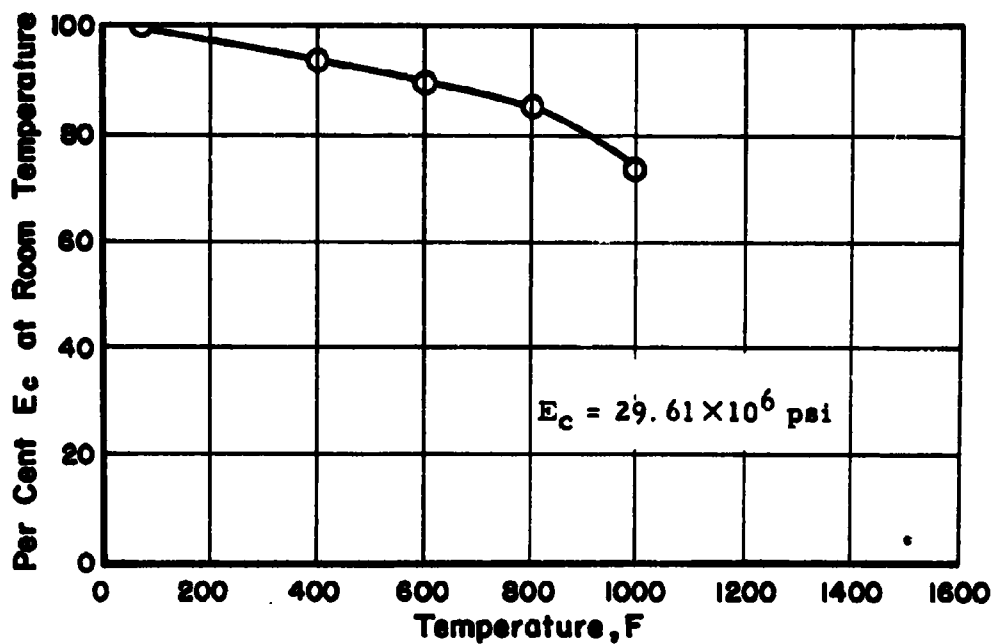


FIGURE 38. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF Ph15-7Mo EXPOSED 100 HOURS

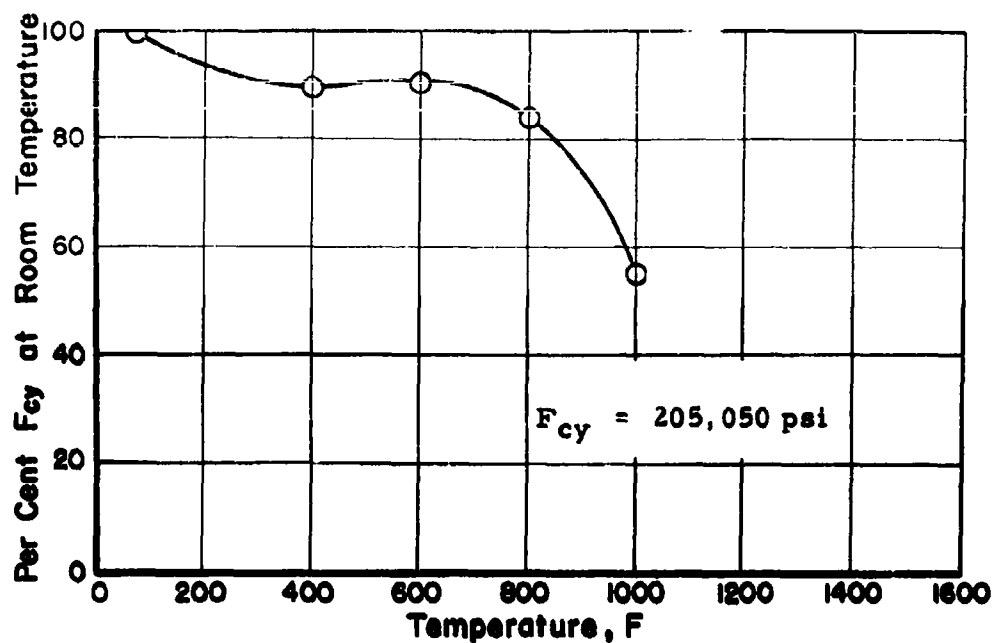


FIGURE 39. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
Ph15-7Mo EXPOSED 1000 HOURS

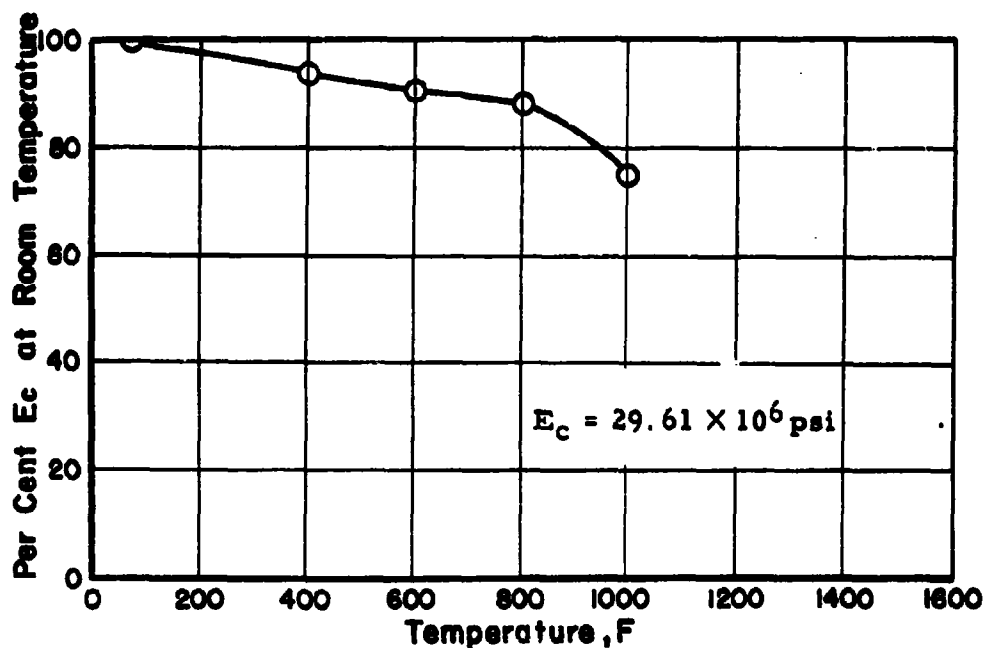


FIGURE 40. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF Ph15-7Mo EXPOSED 1000 HOURS

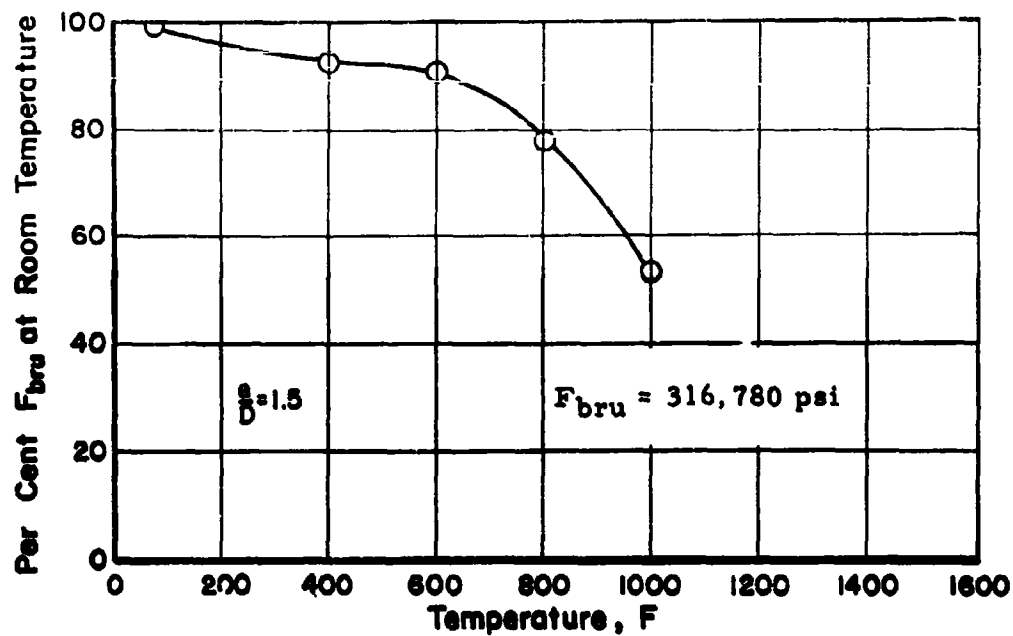


FIGURE 41. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

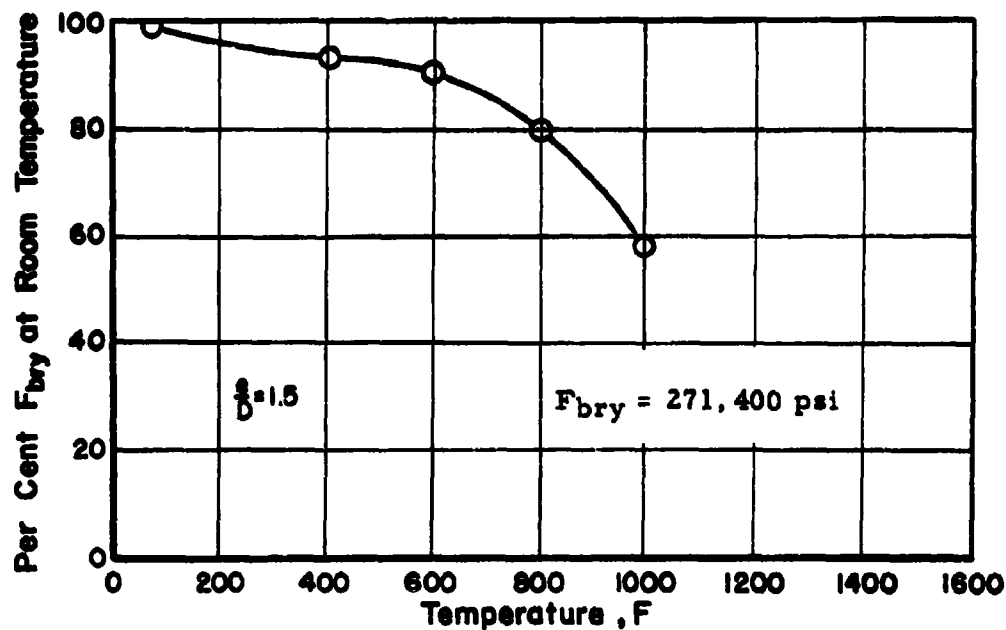


FIGURE 42. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS

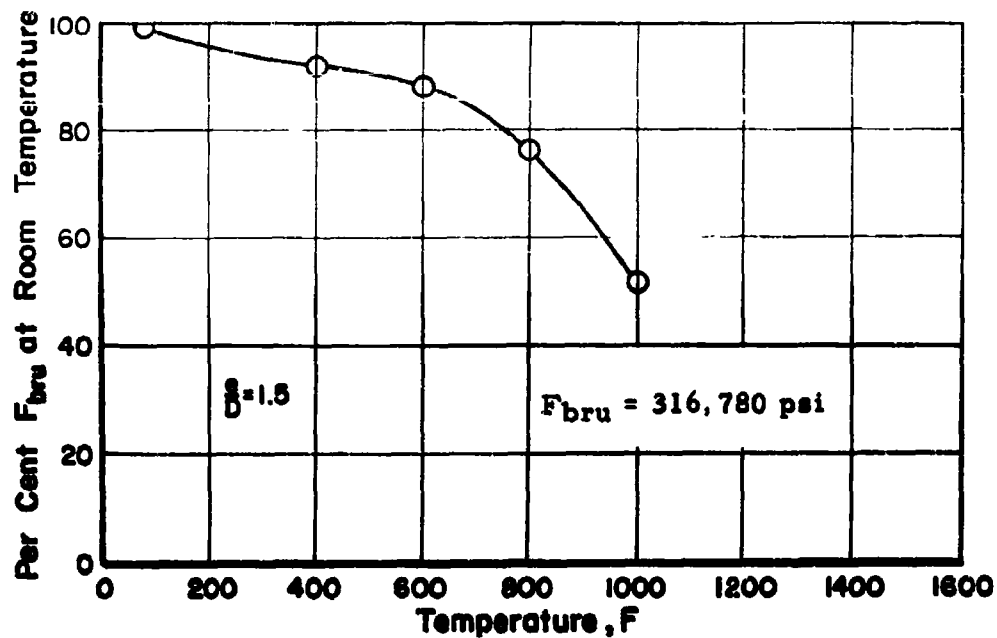


FIGURE 43. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

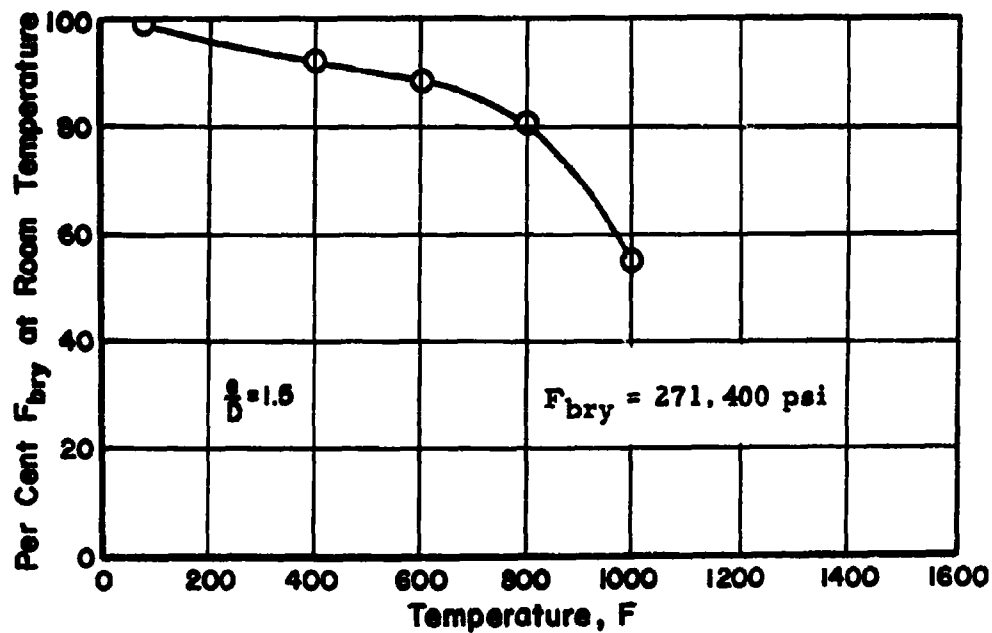


FIGURE 44. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS

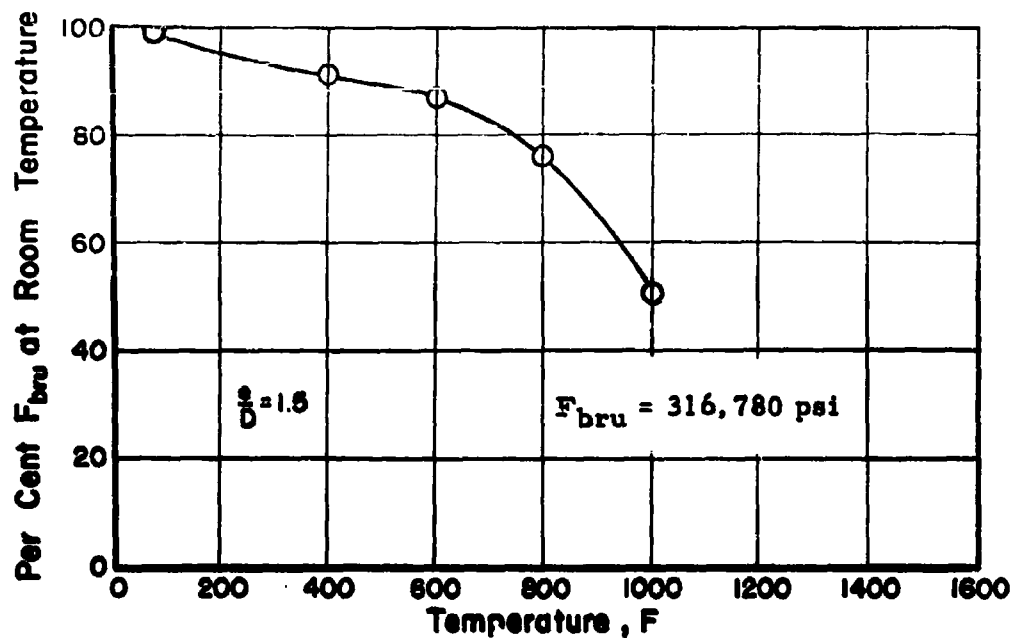


FIGURE 45. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

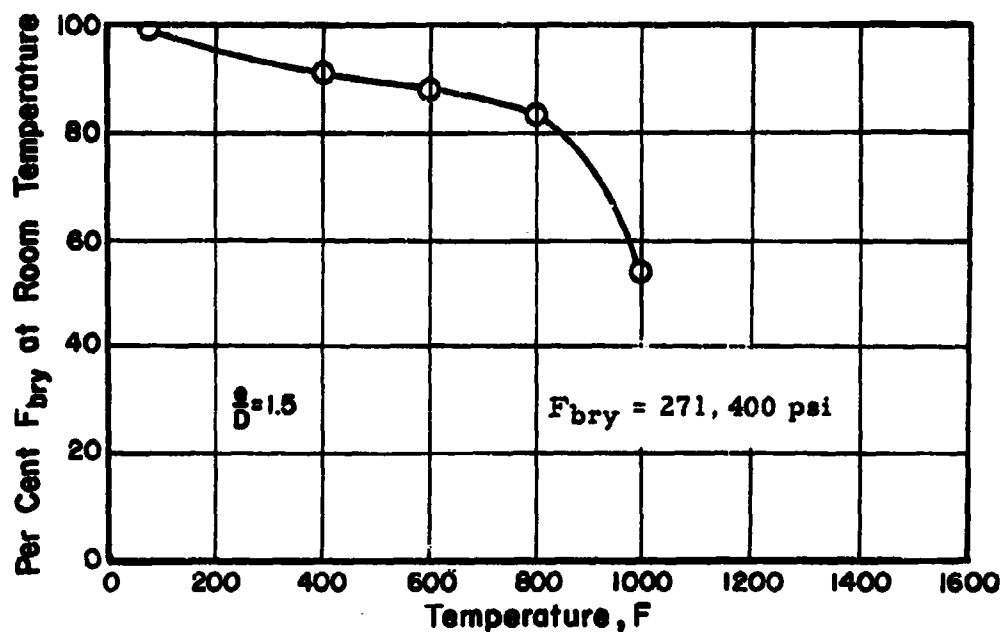


FIGURE 46. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

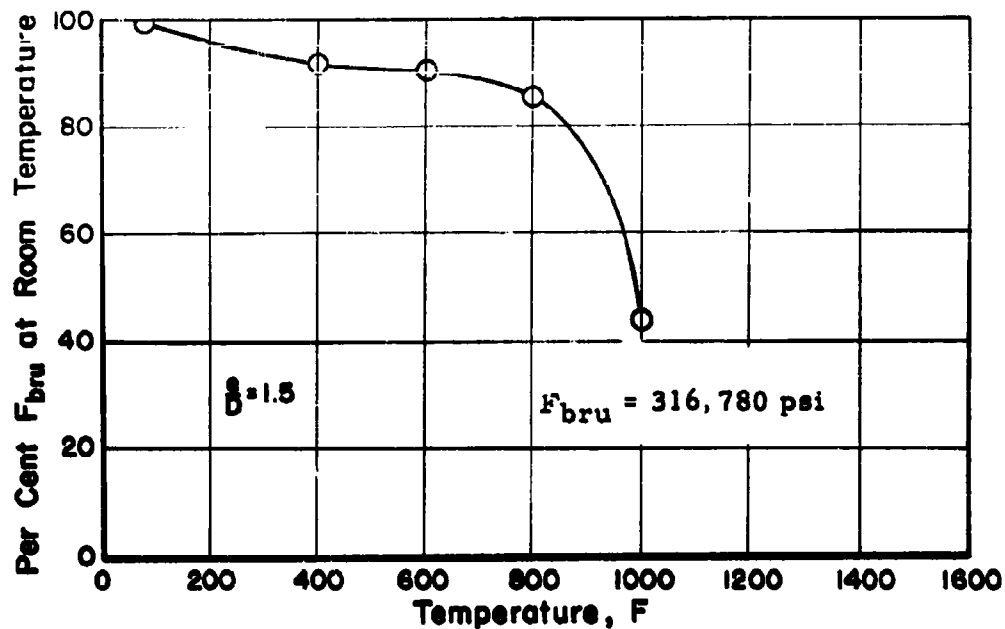


FIGURE 47. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

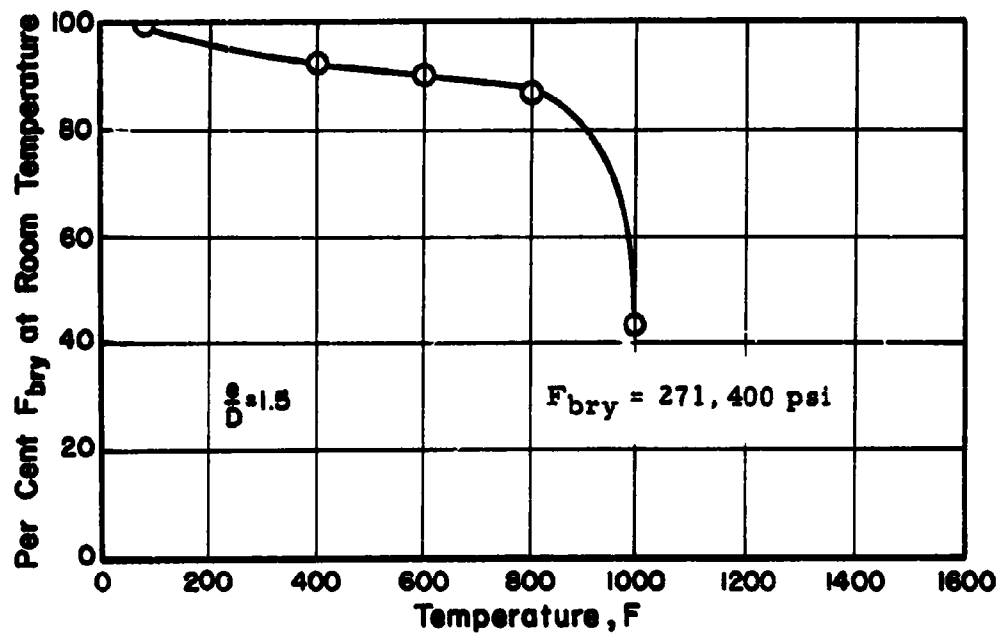


FIGURE 48. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS

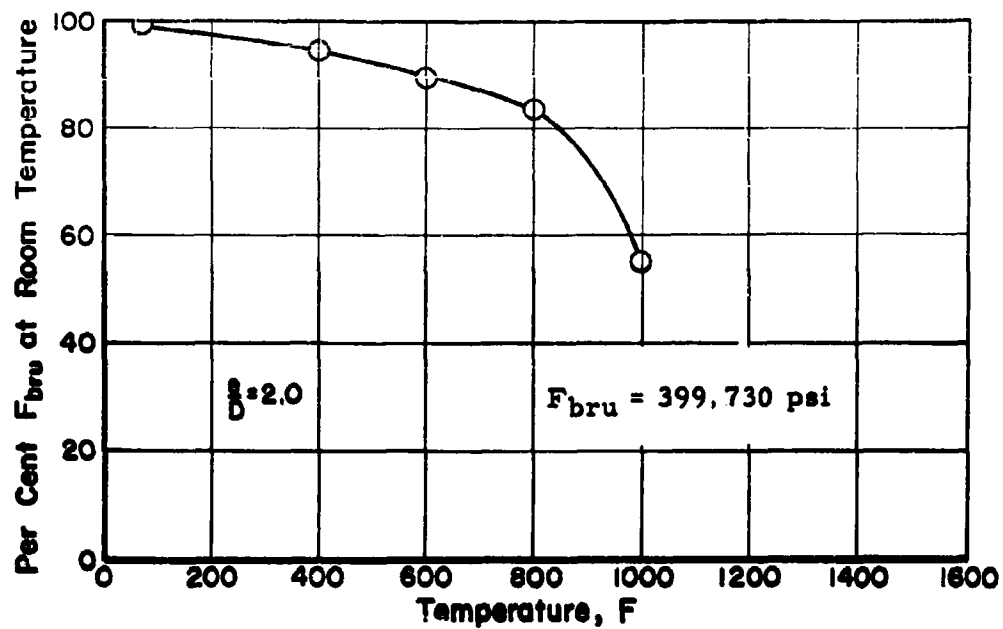


FIGURE 49. EFFECT OF TEMPERATURE ON
ULTIMATE BEARING STRENGTH OF
Ph15-7Mo EXPOSED 0.5 HOURS

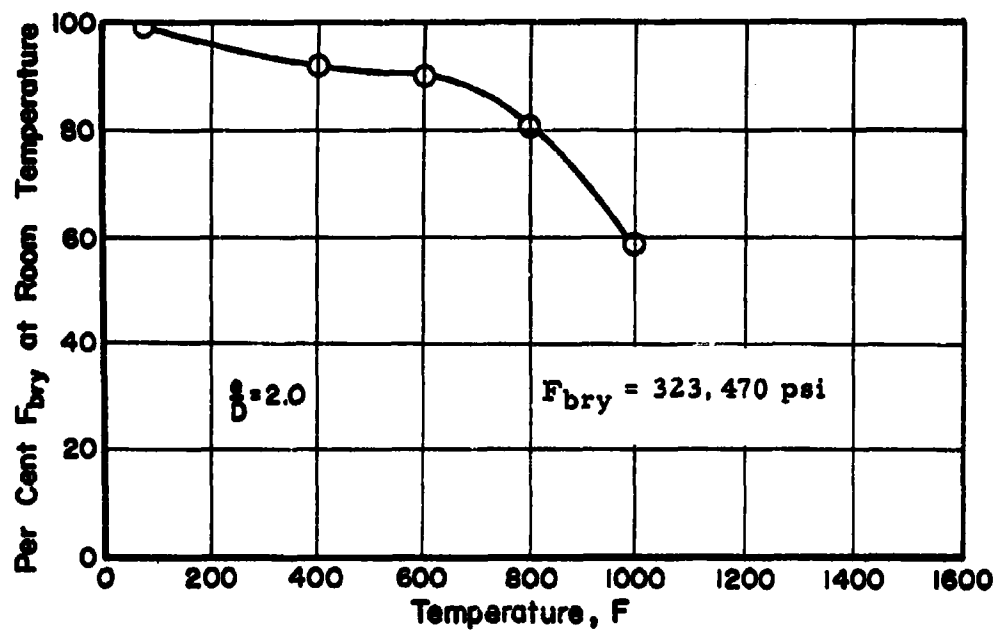


FIGURE 50. EFFECT OF TEMPERATURE ON
BEARING YIELD STRENGTH OF Ph15-7Mo
EXPOSED 0.5 HOURS

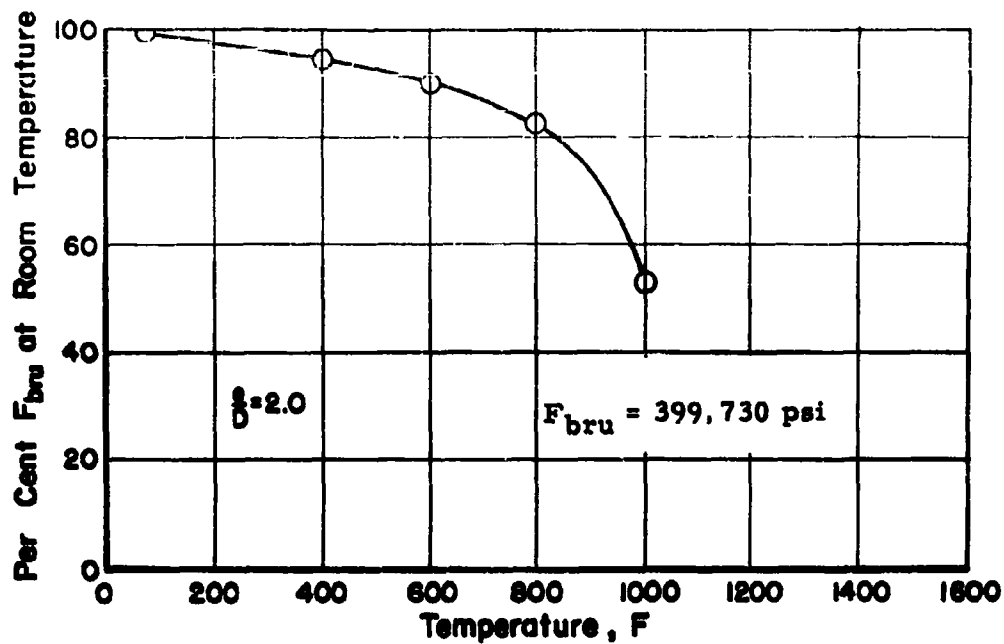


FIGURE 51. EFFECT OF TEMPERATURE ON
 ULTIMATE BEARING STRENGTH OF
 Ph15-7Mo EXPOSED 10 HOURS

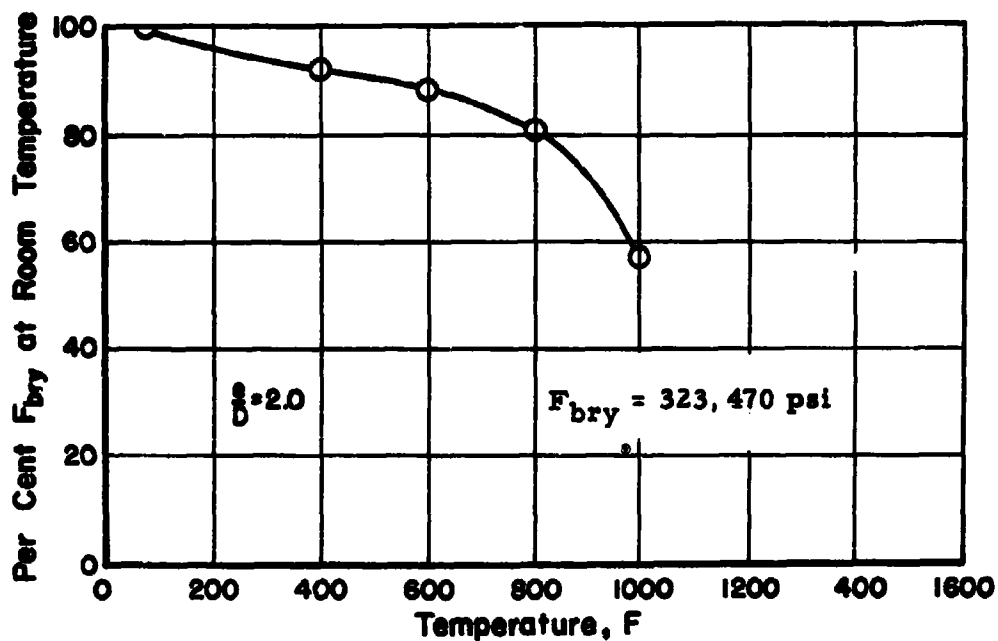


FIGURE 52. EFFECT OF TEMPERATURE ON
 BEARING YIELD STRENGTH OF Ph15-7Mo
 EXPOSED 10 HOURS

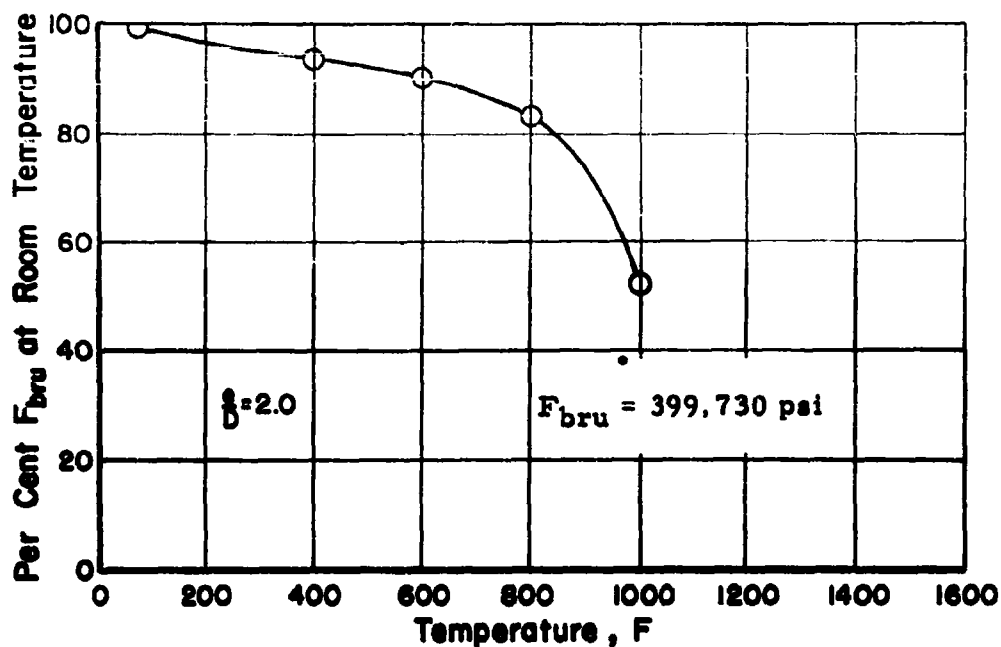


FIGURE 53. EFFECT OF TEMPERATURE ON
ULTIMATE BEARING STRENGTH OF
Ph15-7Mo EXPOSED 100 HOURS

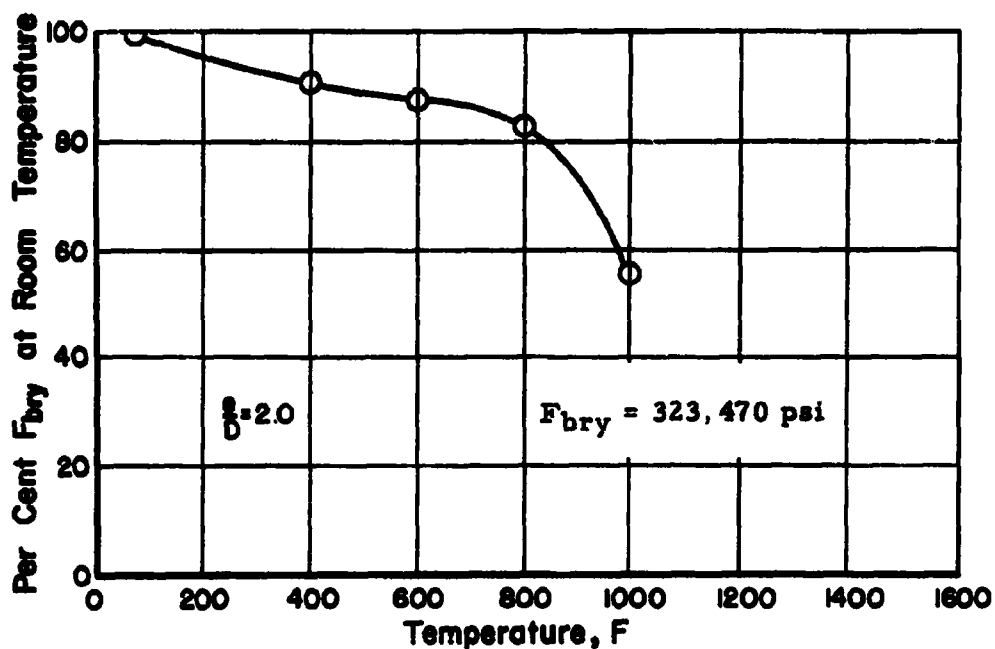


FIGURE 54. EFFECT OF TEMPERATURE ON
BEARING YIELD STRENGTH OF Ph15-7Mo
EXPOSED 100 HOURS

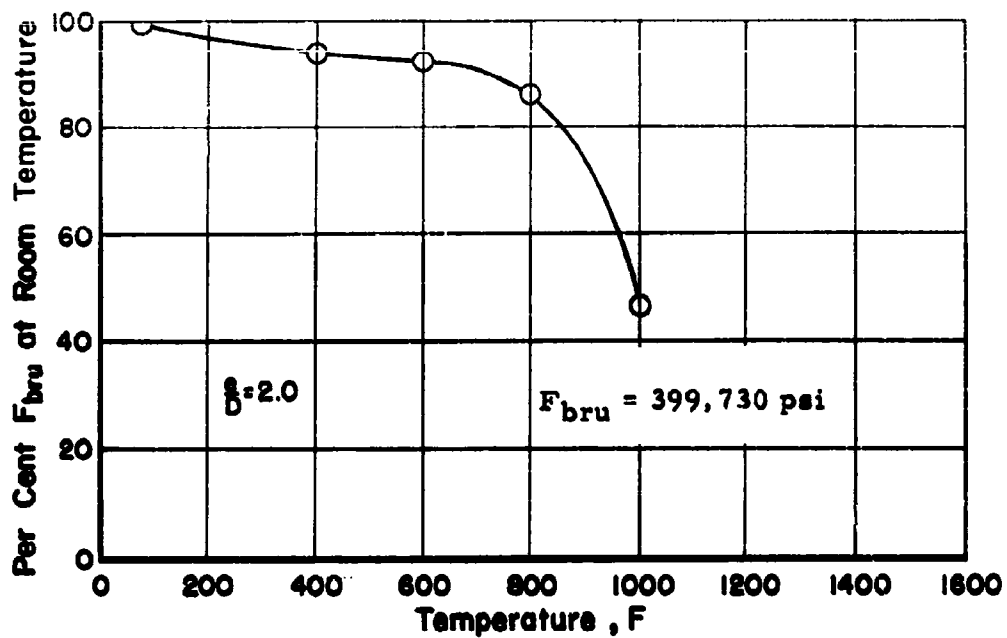


FIGURE 55. EFFECT OF TEMPERATURE ON
ULTIMATE BEARING STRENGTH OF
Ph15-7Mo EXPOSED 1000 HOURS

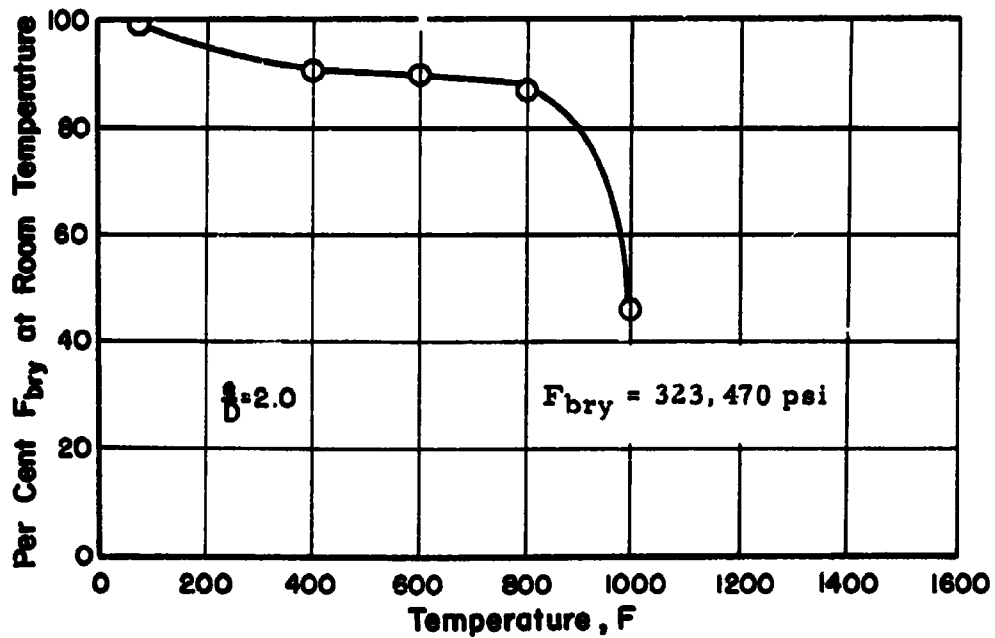


FIGURE 56. EFFECT OF TEMPERATURE ON
BEARING YIELD STRENGTH OF Ph15-7Mo
EXPOSED 1000 HOURS

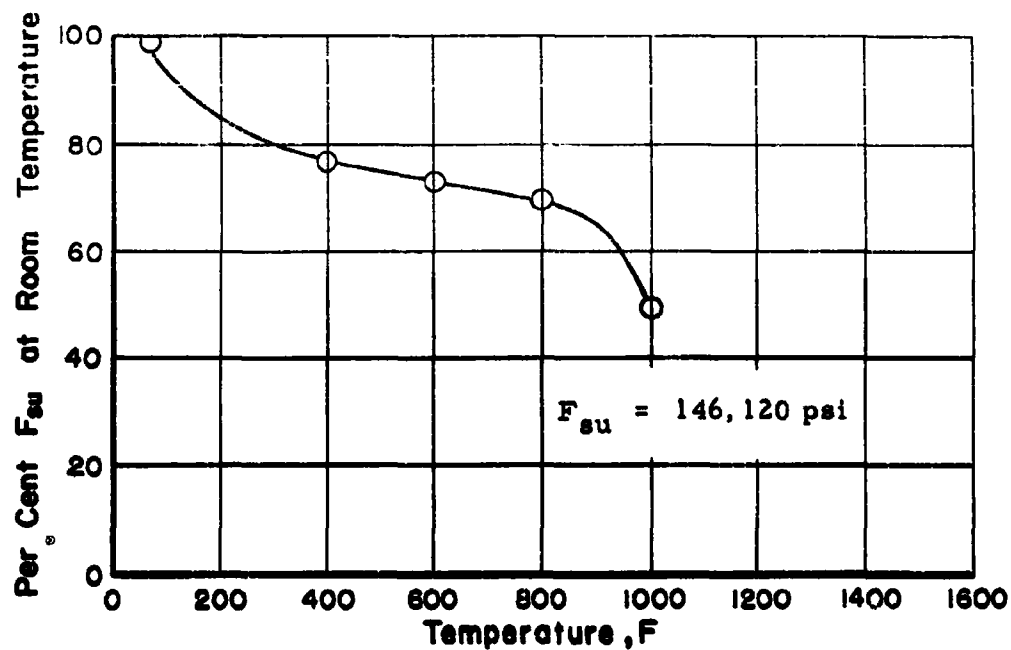


**FIGURE 57. EFFECT OF TEMPERATURE
ON ULTIMATE SHEAR STRENGTH OF
Ph15-7Mo EXPOSED 0.5 HOURS**

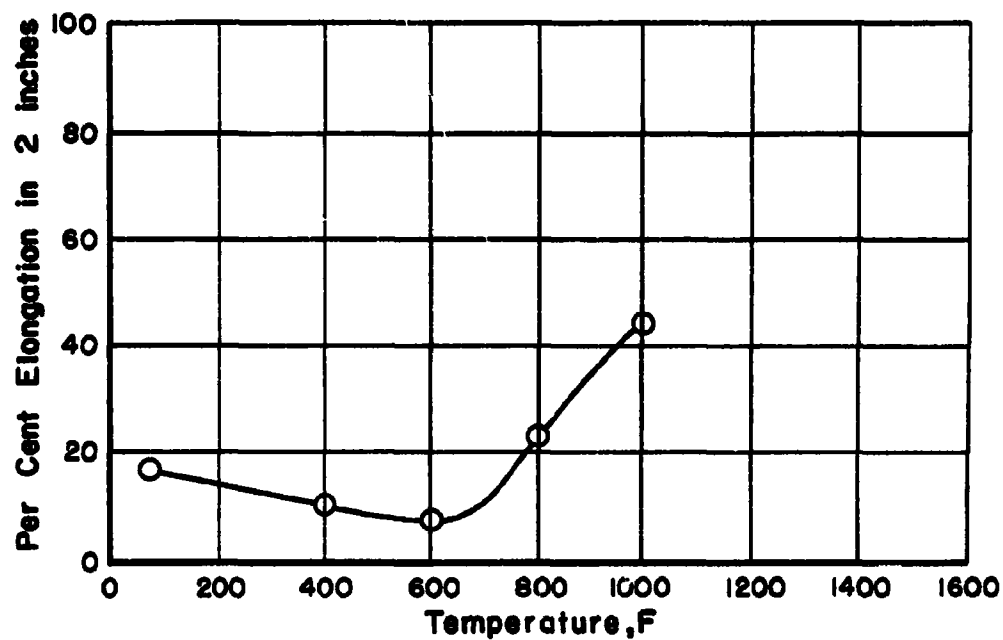


**FIGURE 58. EFFECT OF TEMPERATURE
ON ELONGATION OF Ph15-7Mo
EXPOSED 0.5 HOURS**

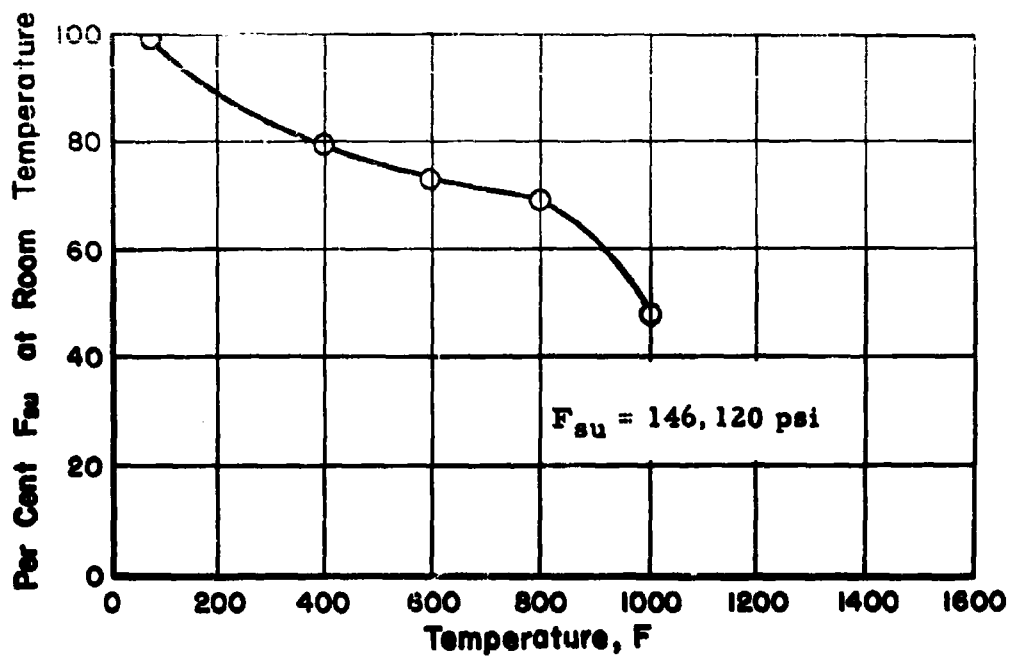


FIGURE 59. EFFECT OF TEMPERATURE
ON ULTIMATE SHEAR STRENGTH OF
Ph15-7Mo EXPOSED 10 HOURS

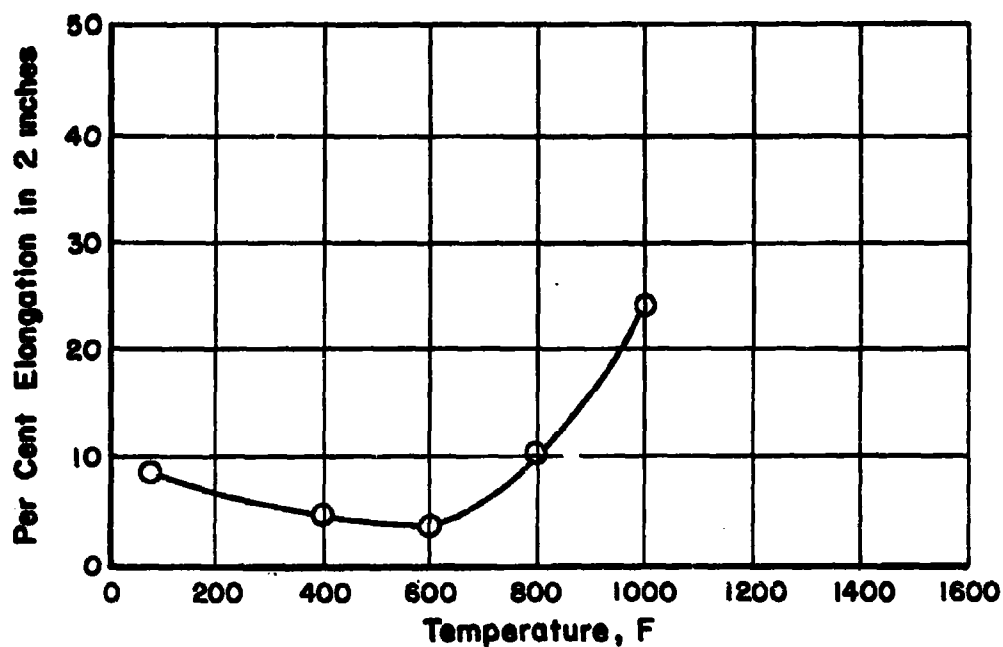


FIGURE 60. EFFECT OF TEMPERATURE ON
ELONGATION OF Ph15-7Mo EXPOSED
10 HOURS

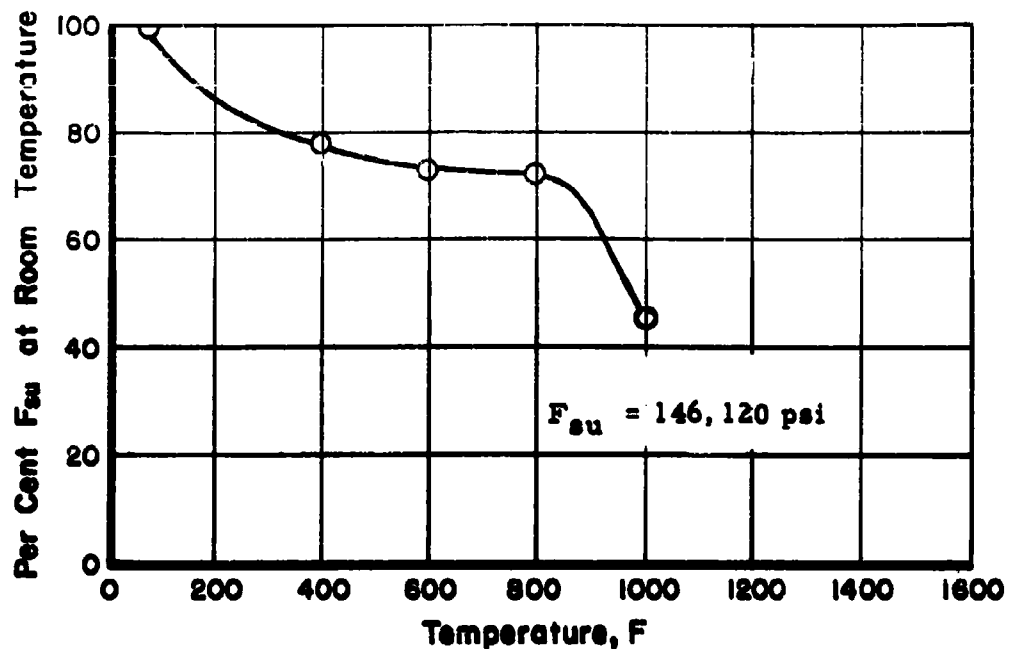


FIGURE 61. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS

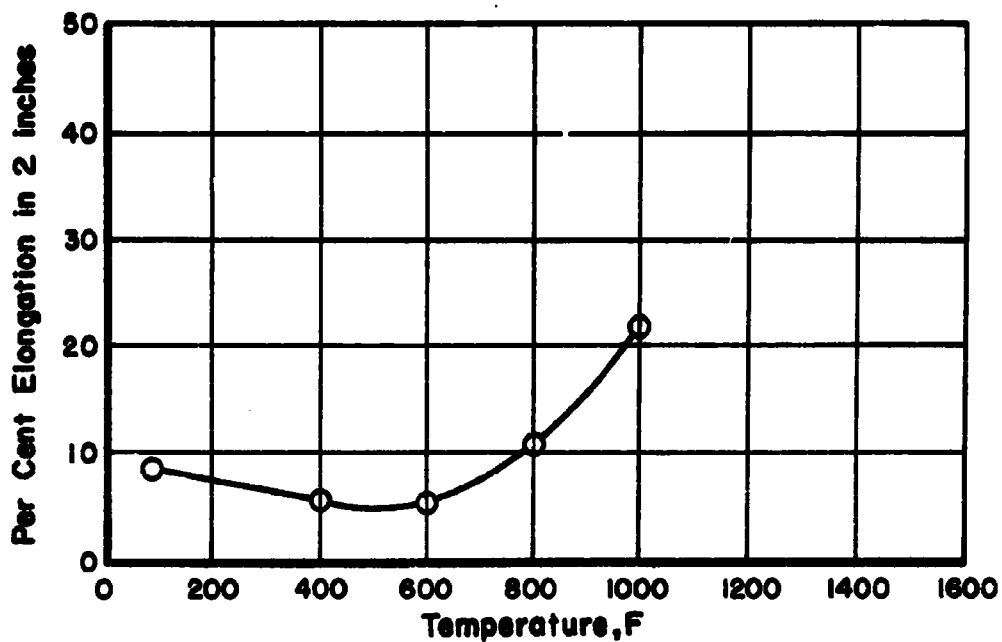


FIGURE 62. EFFECT OF TEMPERATURE ON ELONGATION OF Ph15-7Mo EXPOSED 100 HOURS

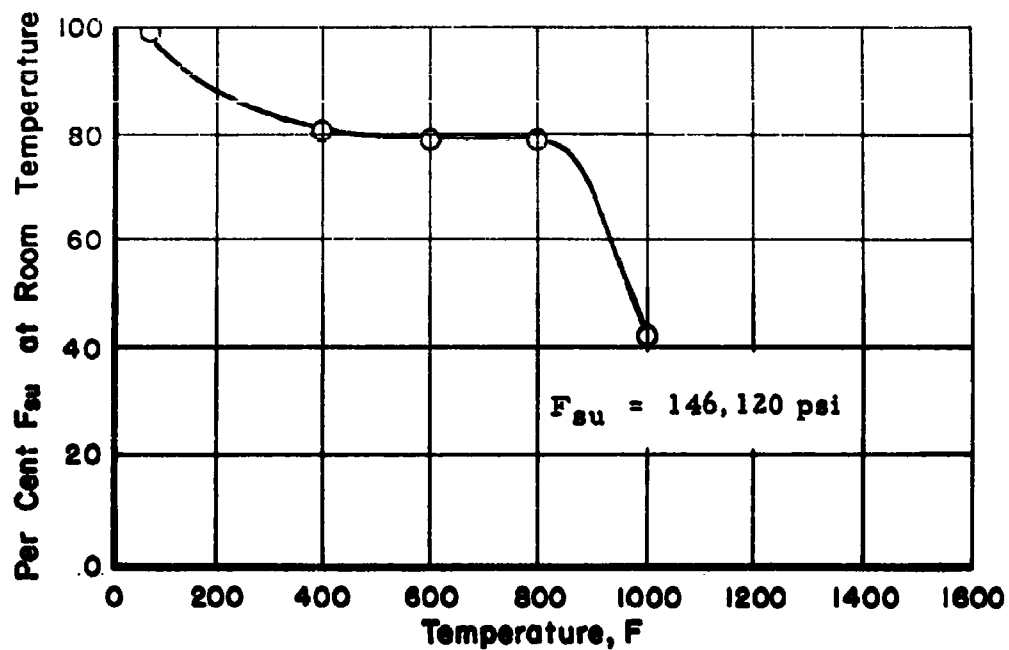


FIGURE 63. EFFECT OF TEMPERATURE
ON ULTIMATE SHEAR STRENGTH OF
Ph15-7Mo EXPOSED 1000 HOURS

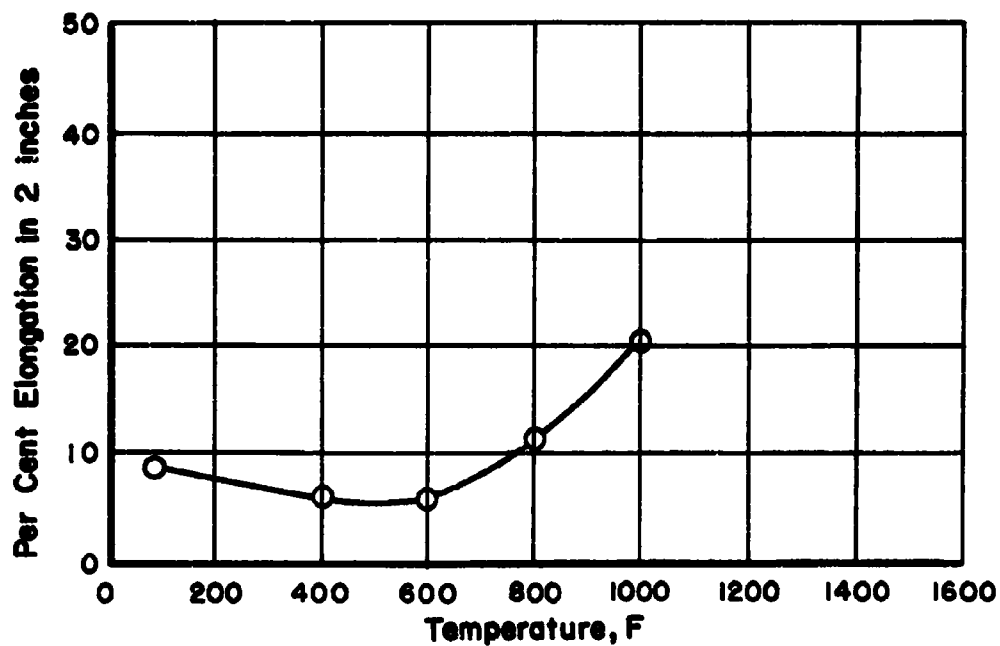


FIGURE 64. EFFECT OF TEMPERATURE ON
ELONGATION OF Ph15-7Mo EXPOSED
1000 HOURS

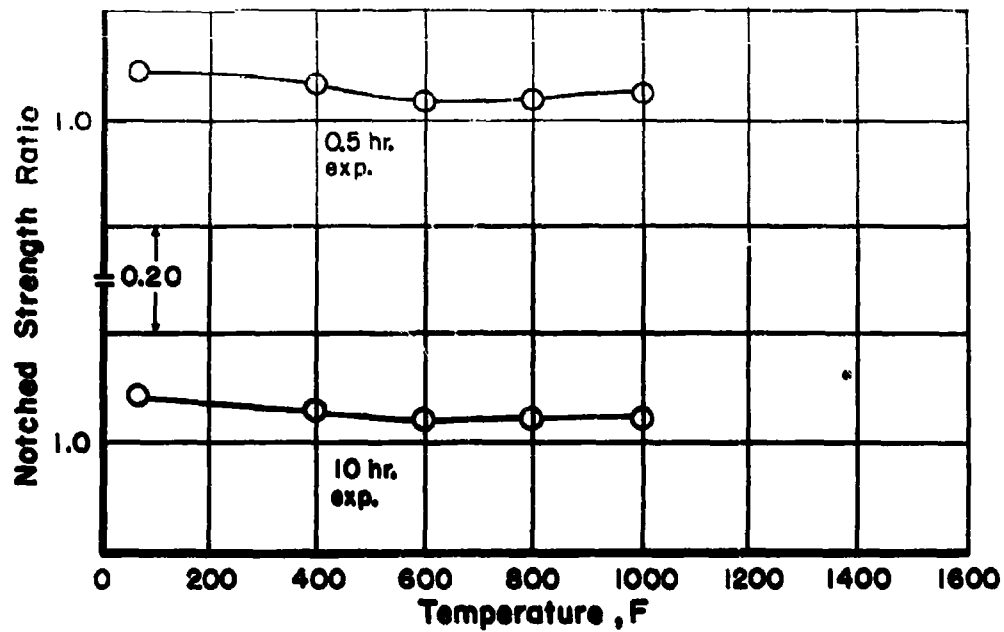


FIGURE 65. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF Ph15-7Mo EXPOSED 0.5 AND 10 HOURS

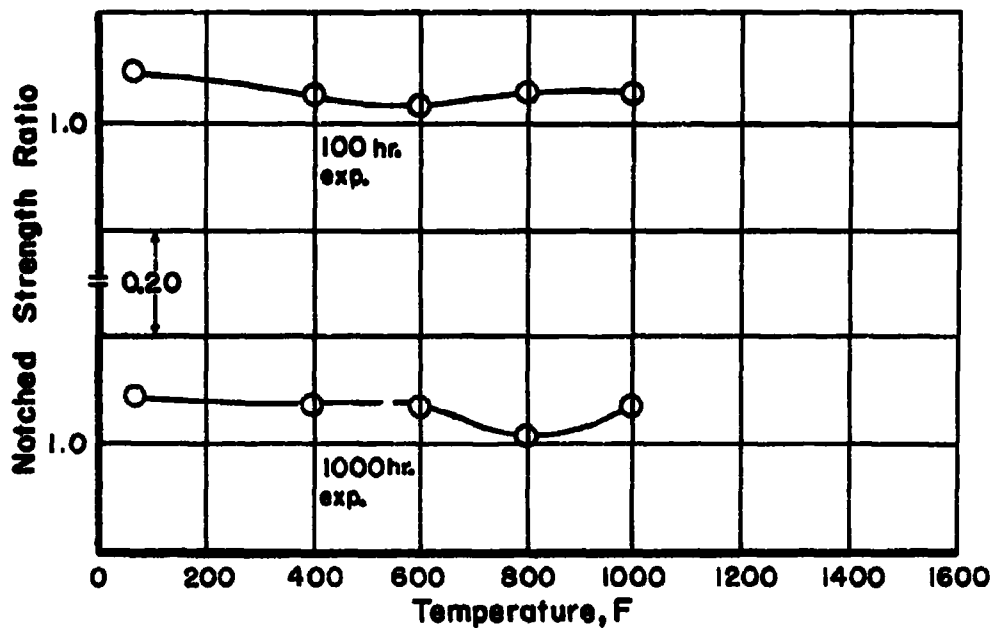


FIGURE 66. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF Ph15-7Mo EXPOSED 100 AND 1000 HOURS

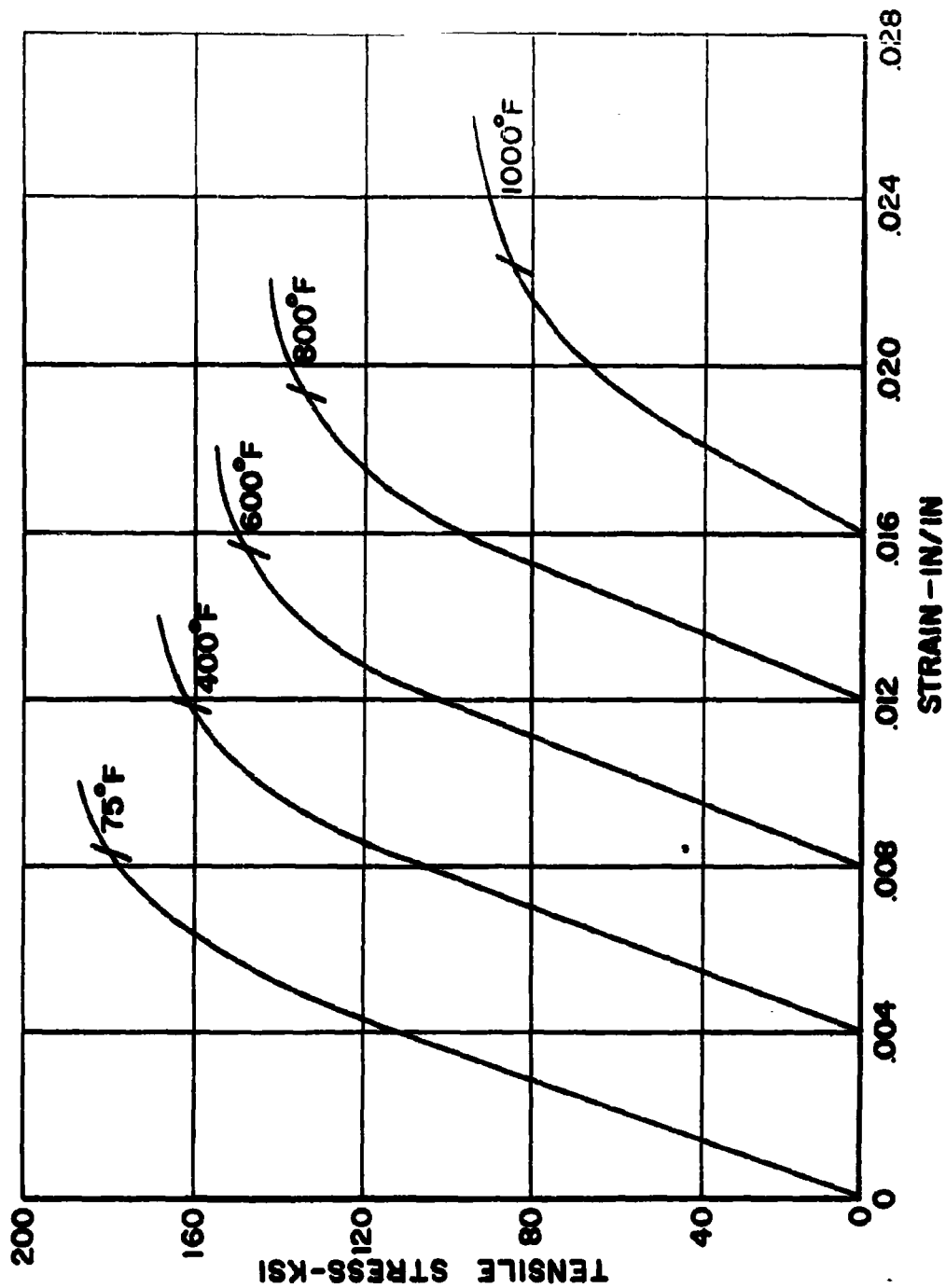


FIGURE 67. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 0.5 HOURS

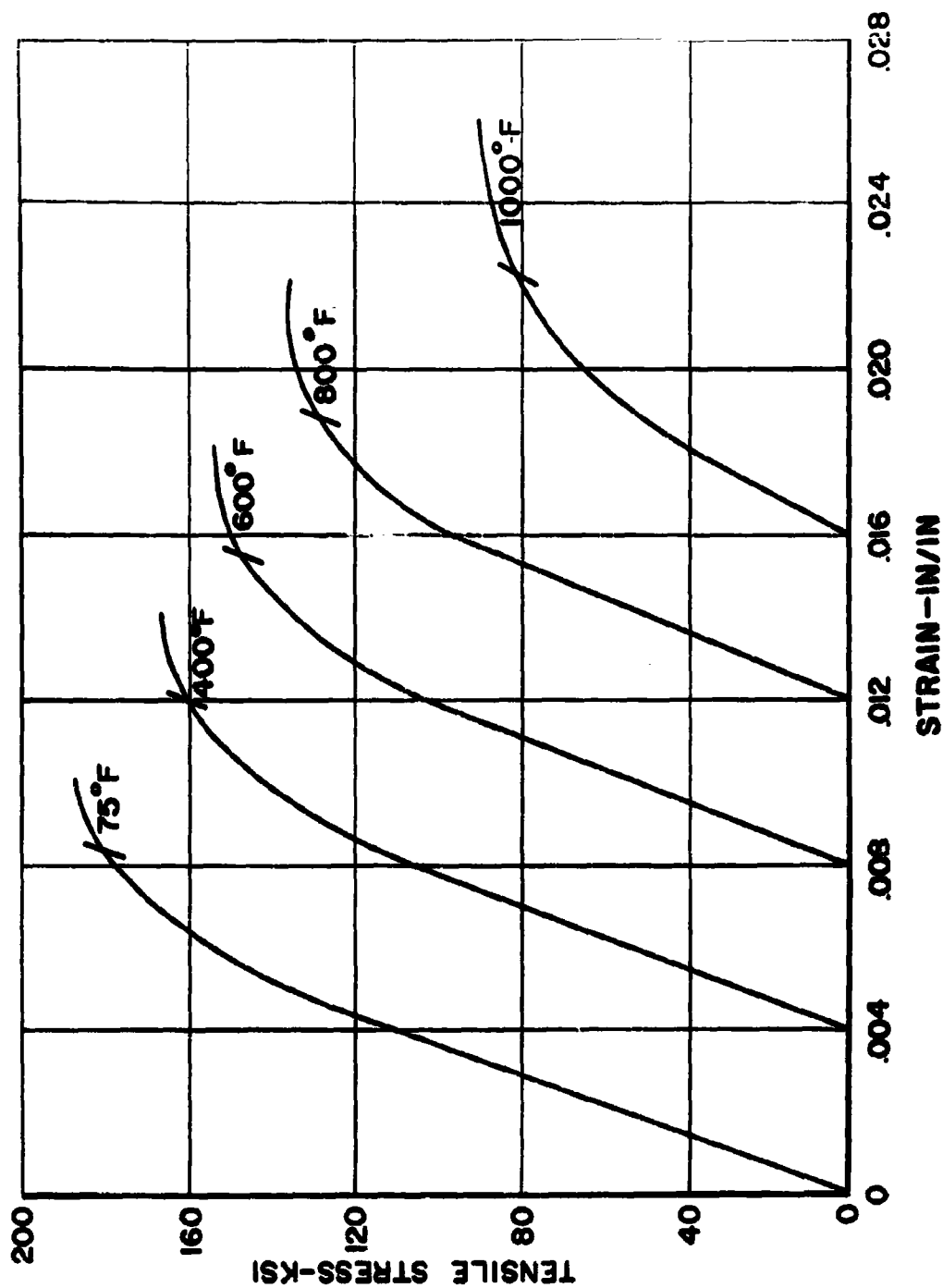


FIGURE 68. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 10 HOURS

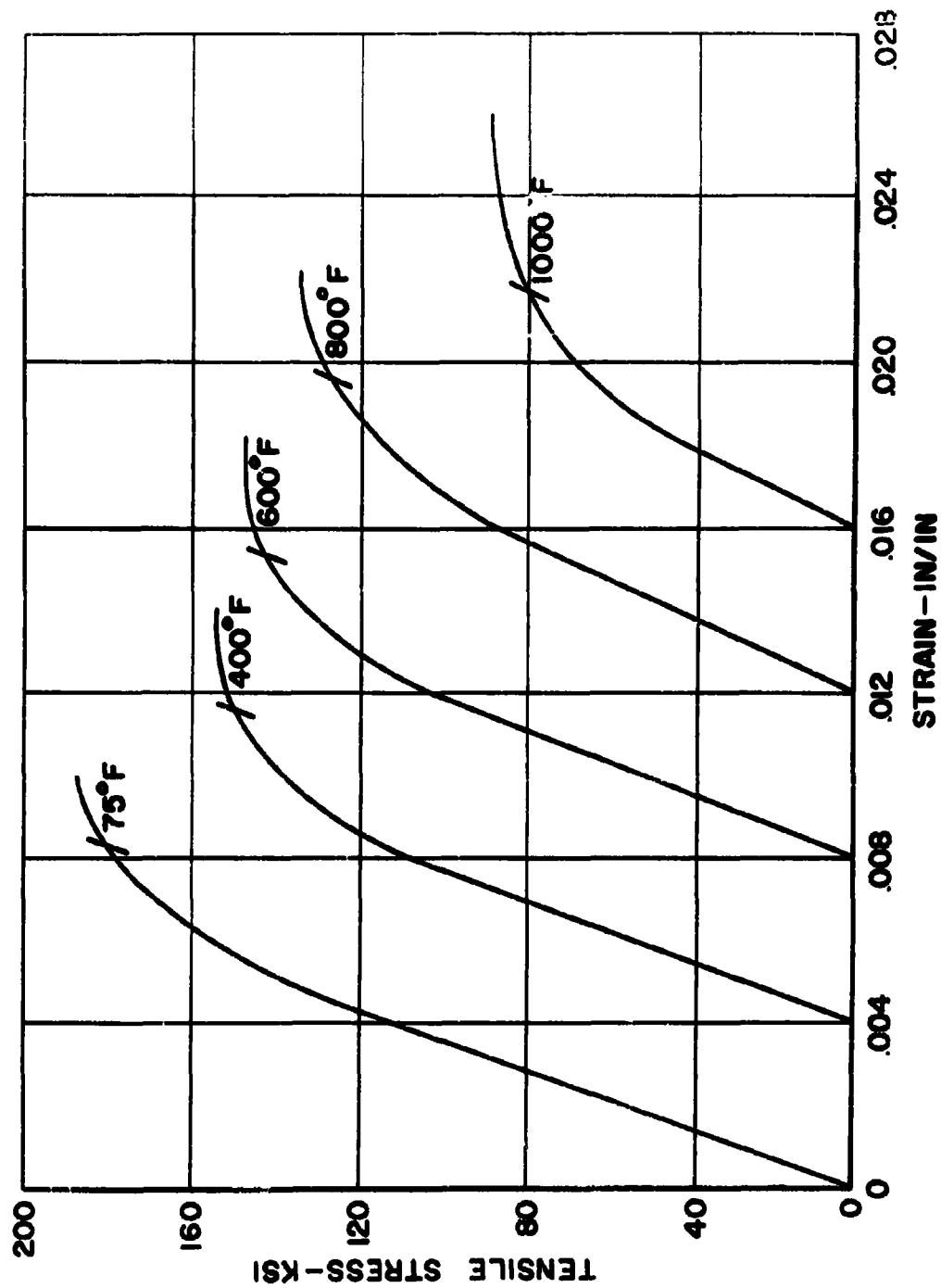


FIGURE 69. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 100 HOURS

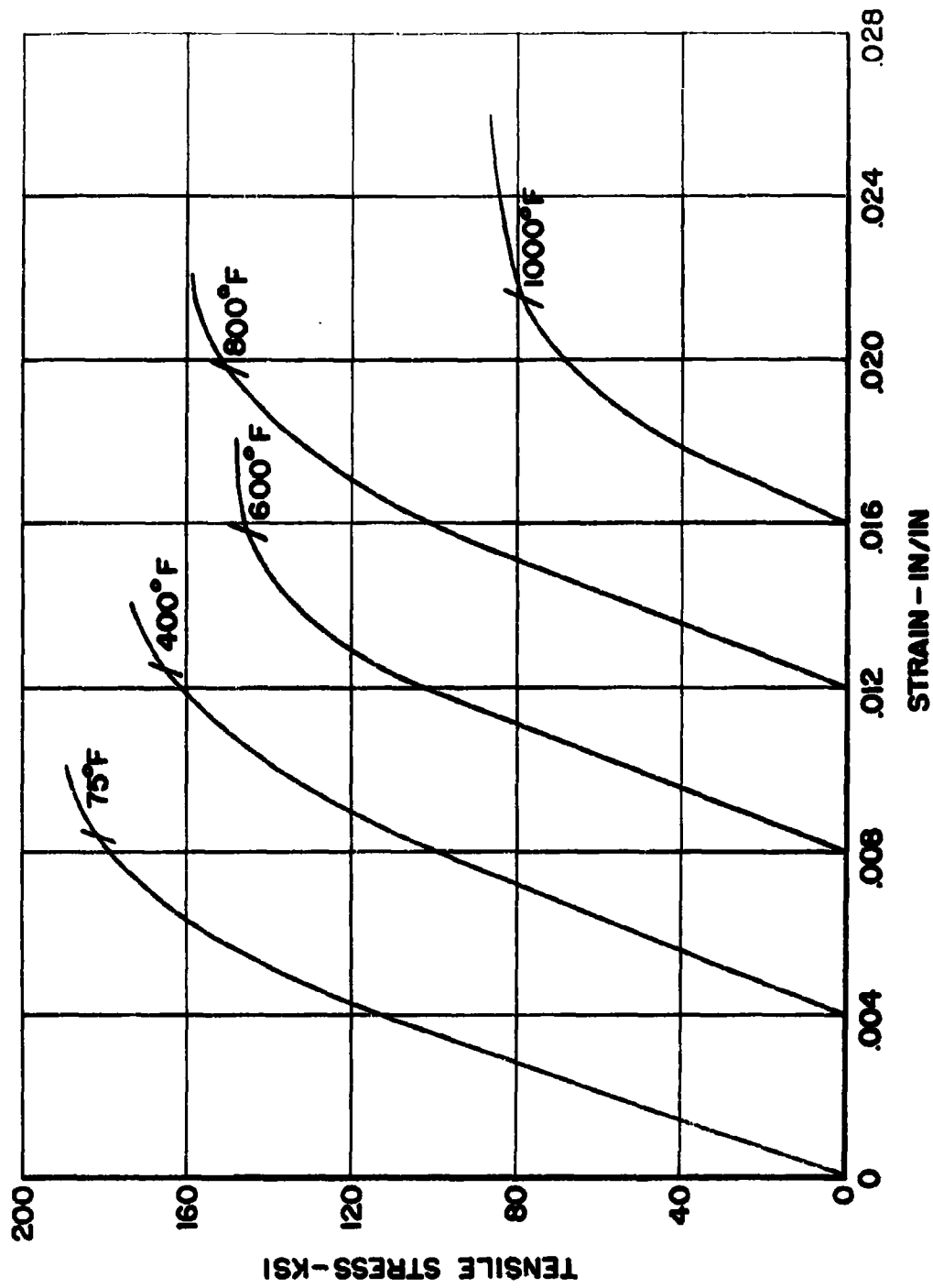


FIGURE 70. TENSILE STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 1000 HOURS

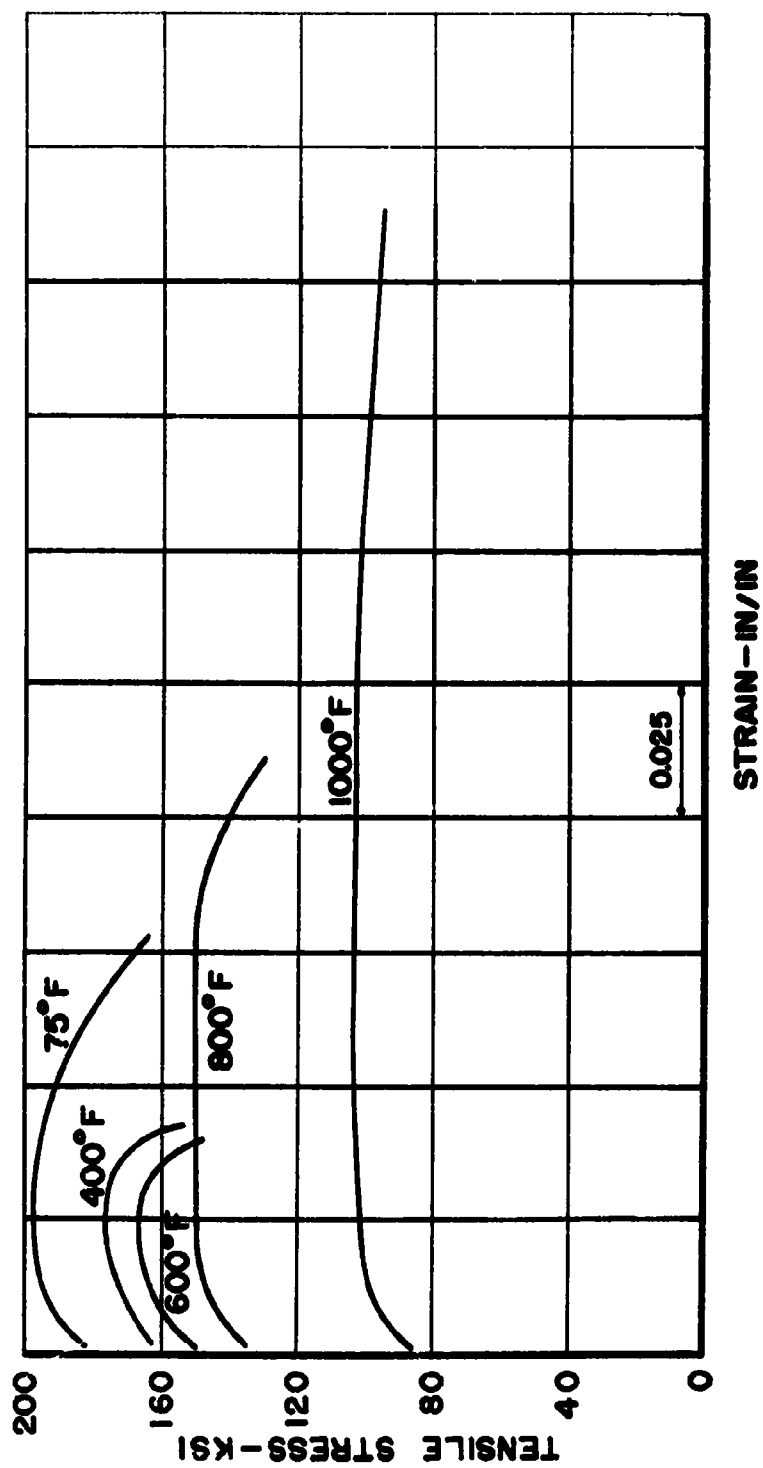


FIGURE 71. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 0.5 HOURS

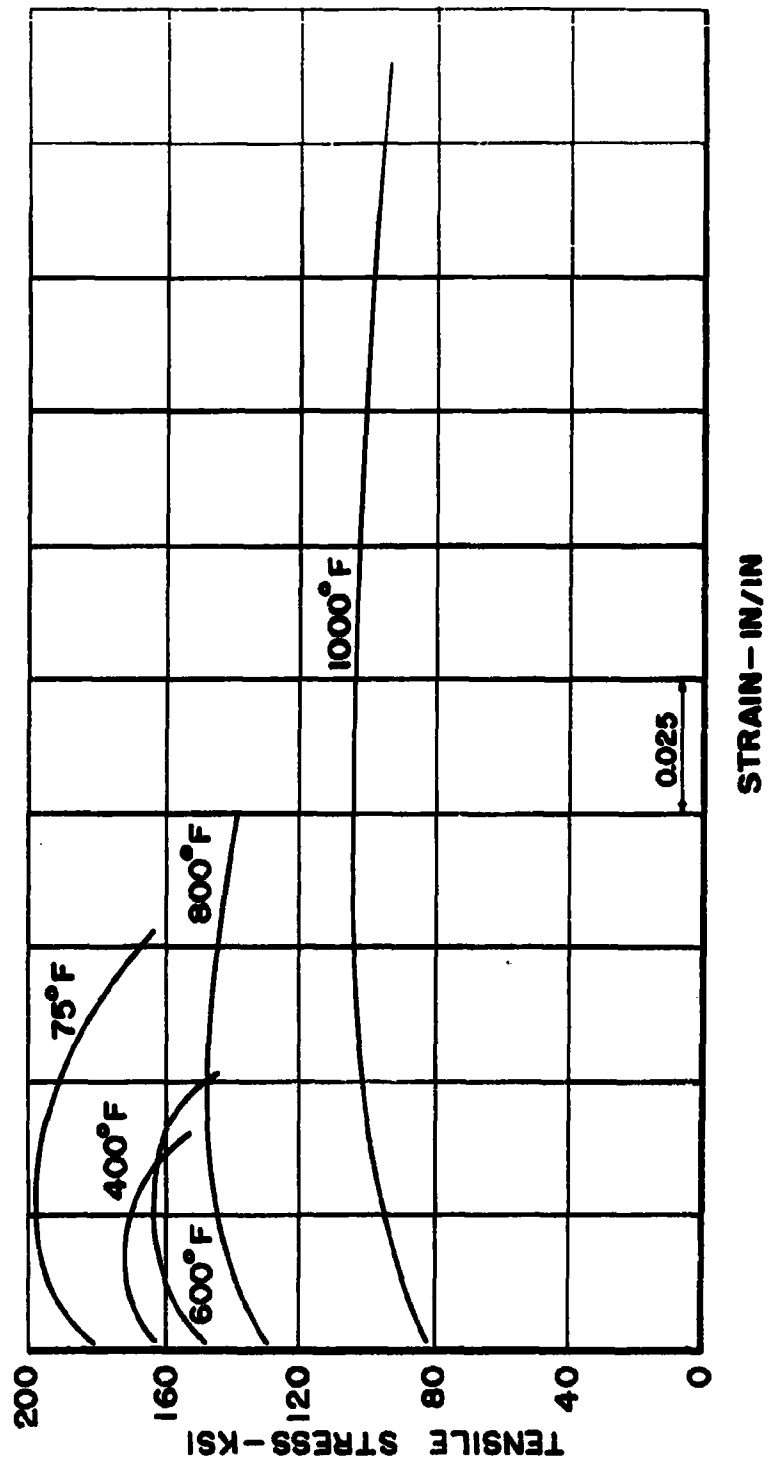


FIGURE 72. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 10 HOURS

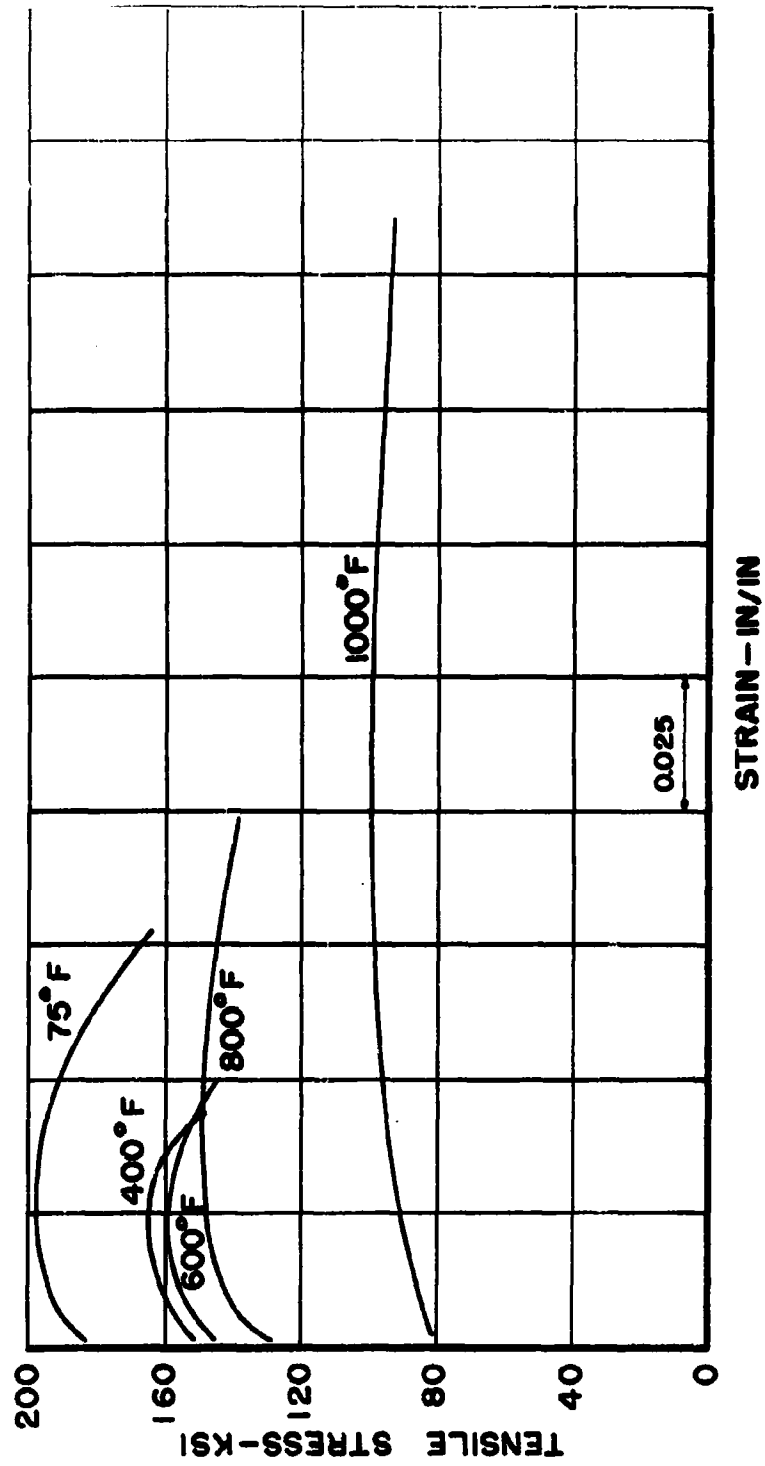


FIGURE 73. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo EXPOSED 100 HOURS

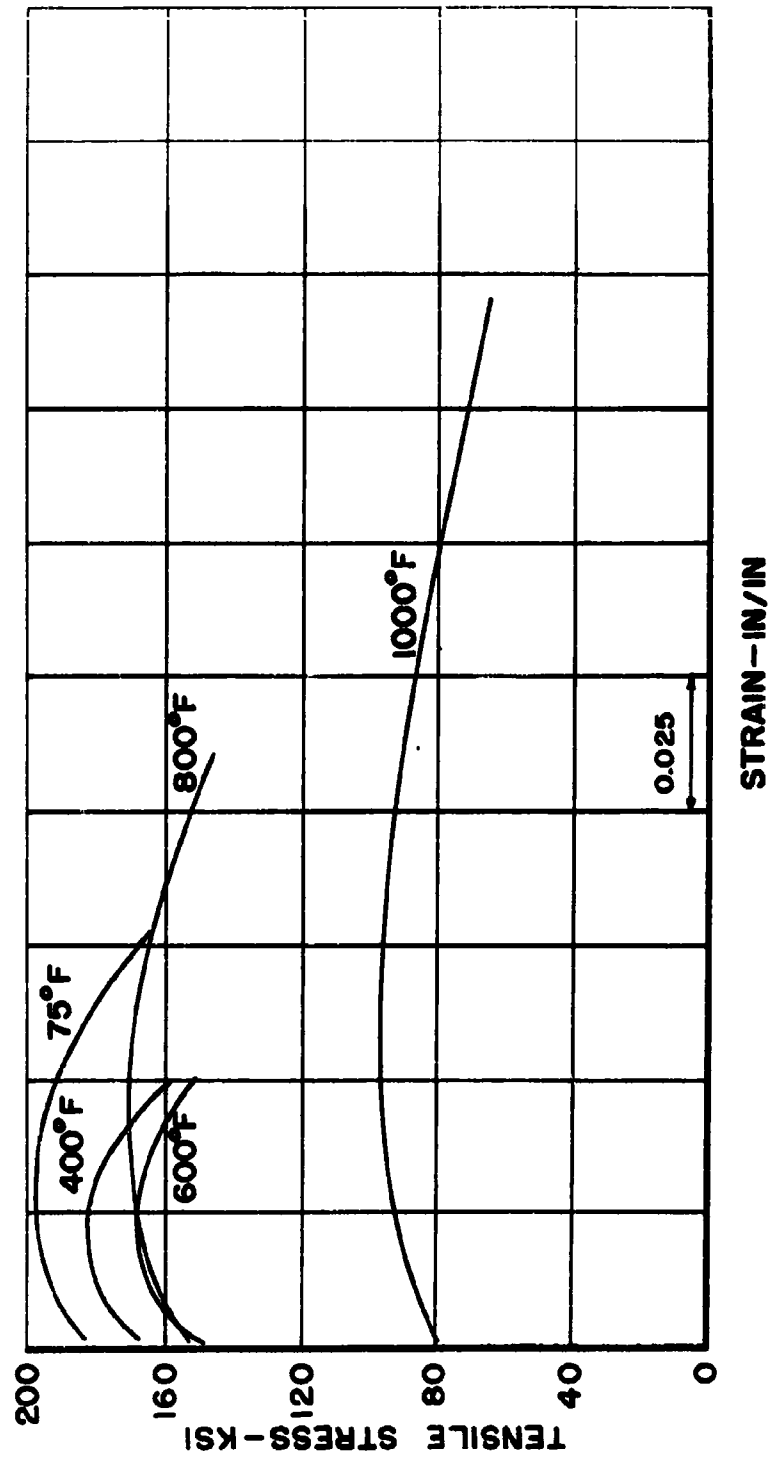


FIGURE 74. TENSILE POSTYIELD STRESS-STRAIN CURVES OF Ph15-7Mo
EXPOSED 1000 HOURS

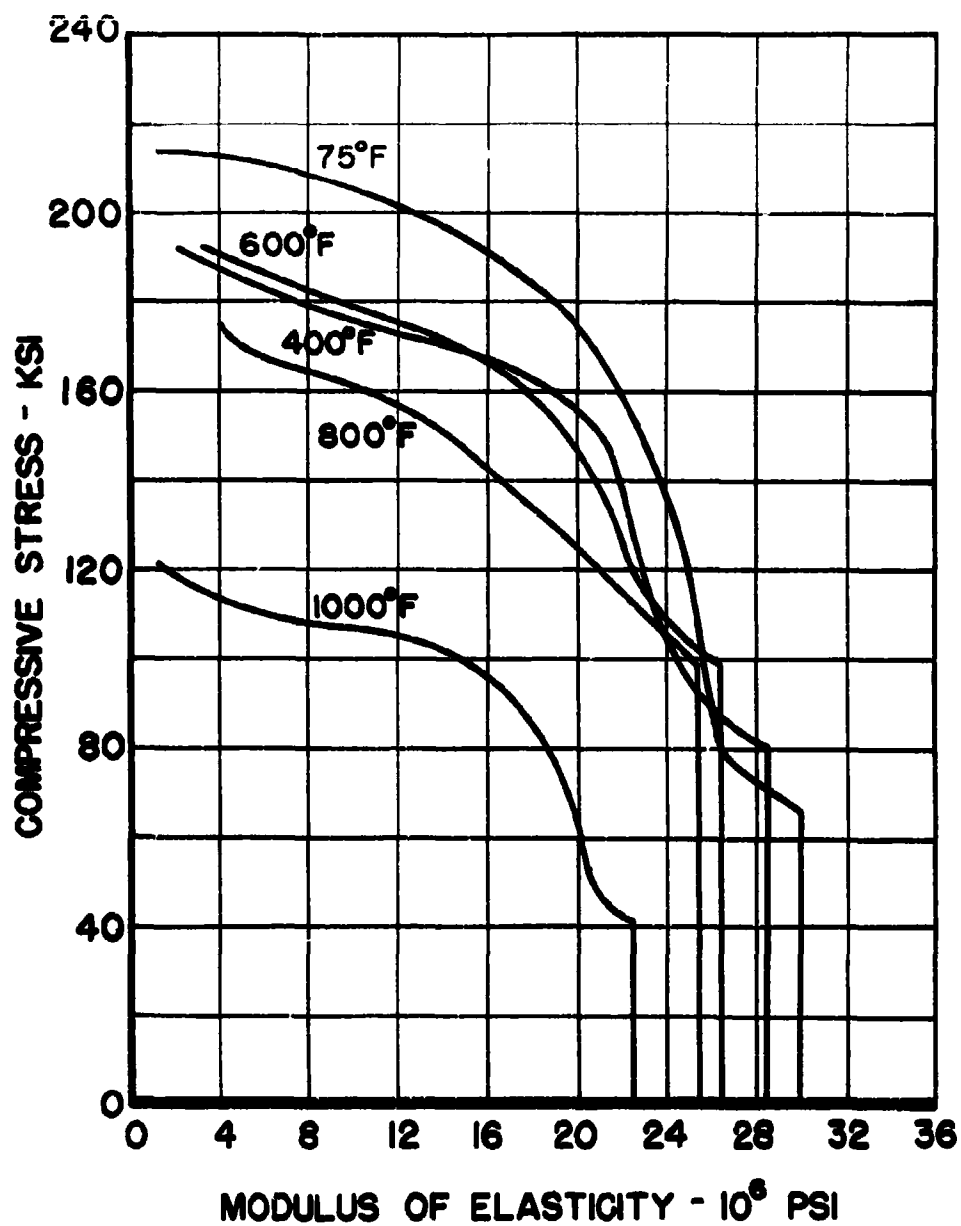


FIGURE 75. COMPRESSIVE TANGENT
MODULUS CURVES OF Ph15-7Mo
EXPOSED 0.5 HOURS

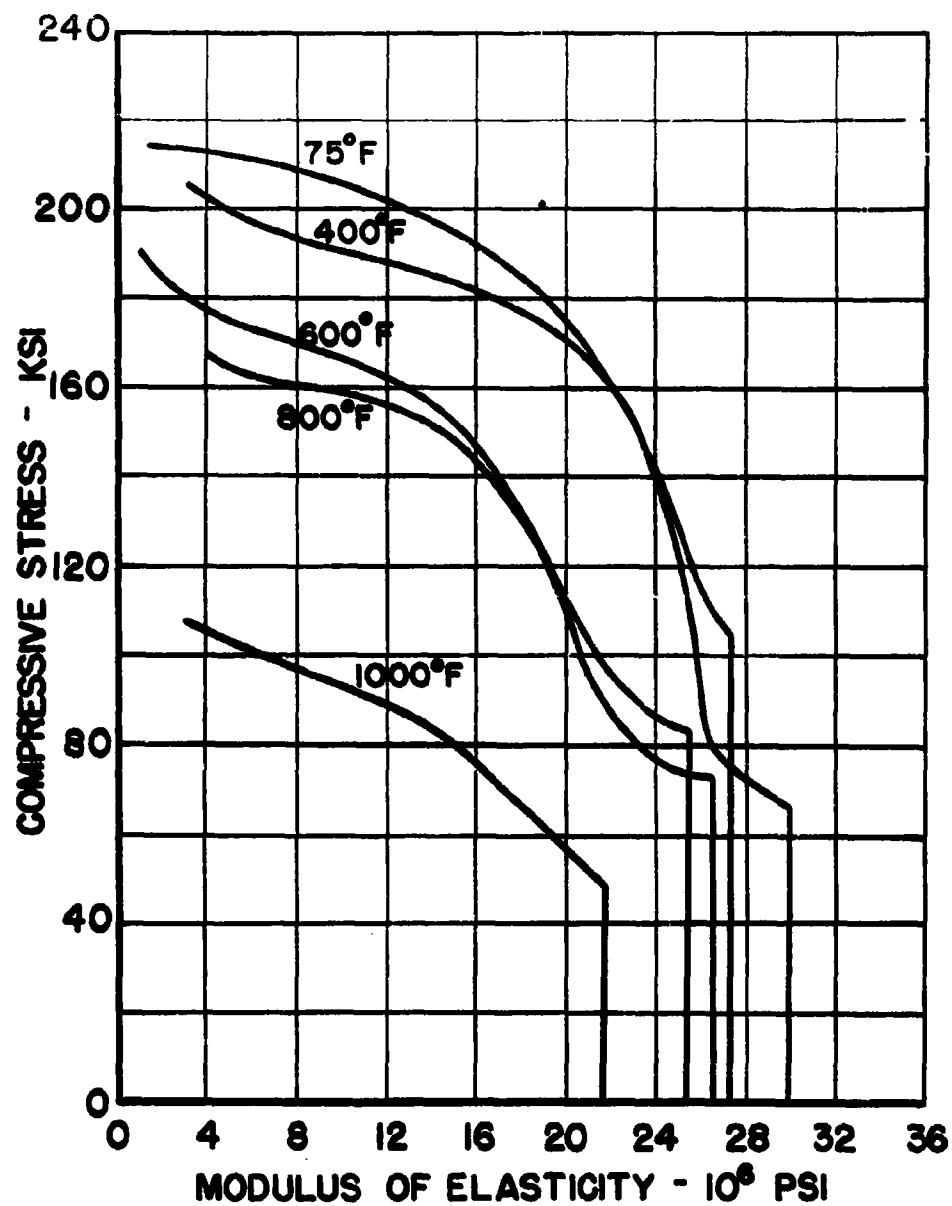


FIGURE 76. COMPRESSIVE TANGENT
MODULUS CURVES OF Ph15-7Mo
EXPOSED 10 HOURS

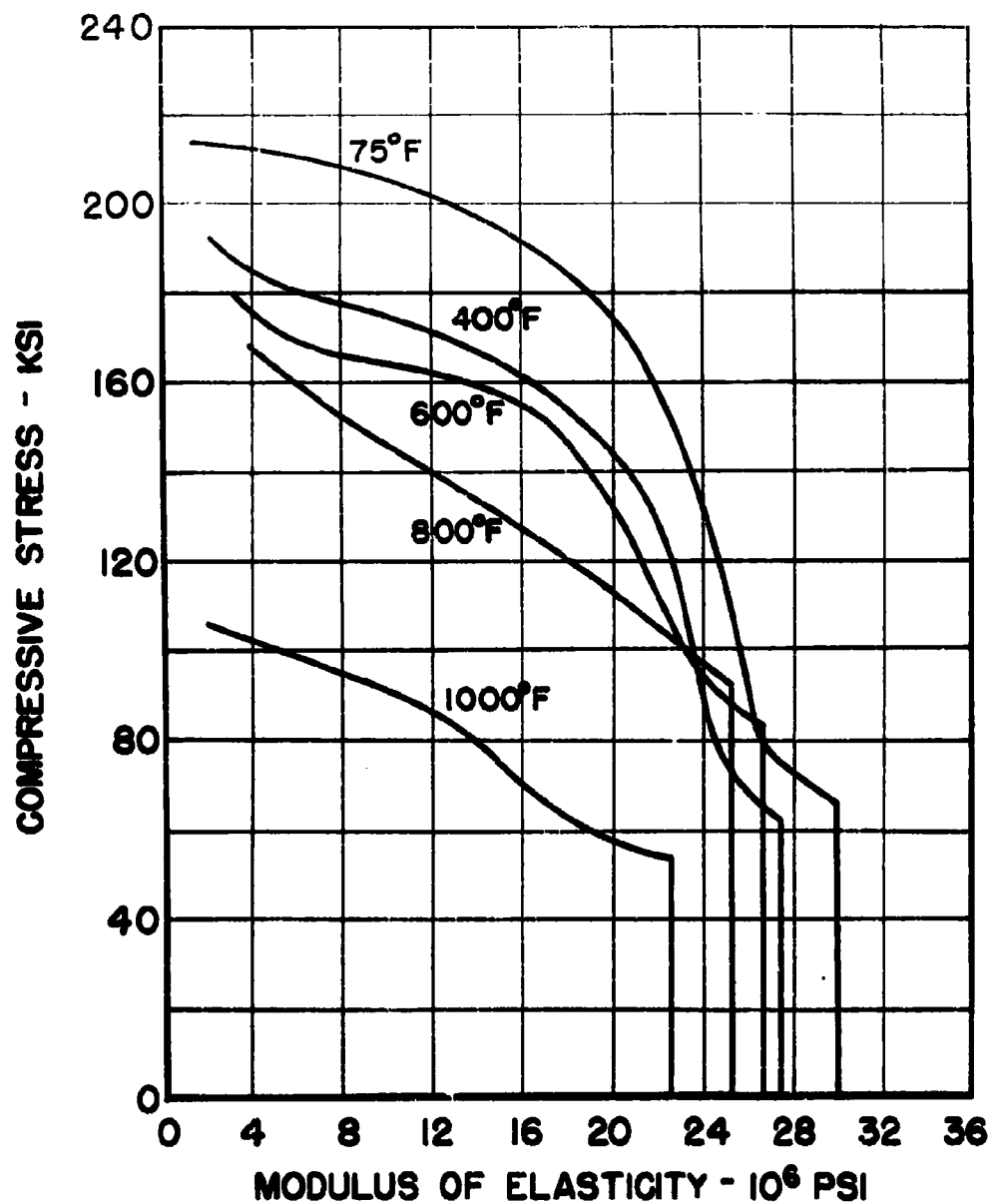


FIGURE 77. COMPRESSIVE TANGENT
MODULUS CURVES OF Ph15-7Mo
EXPOSED 100 HOURS

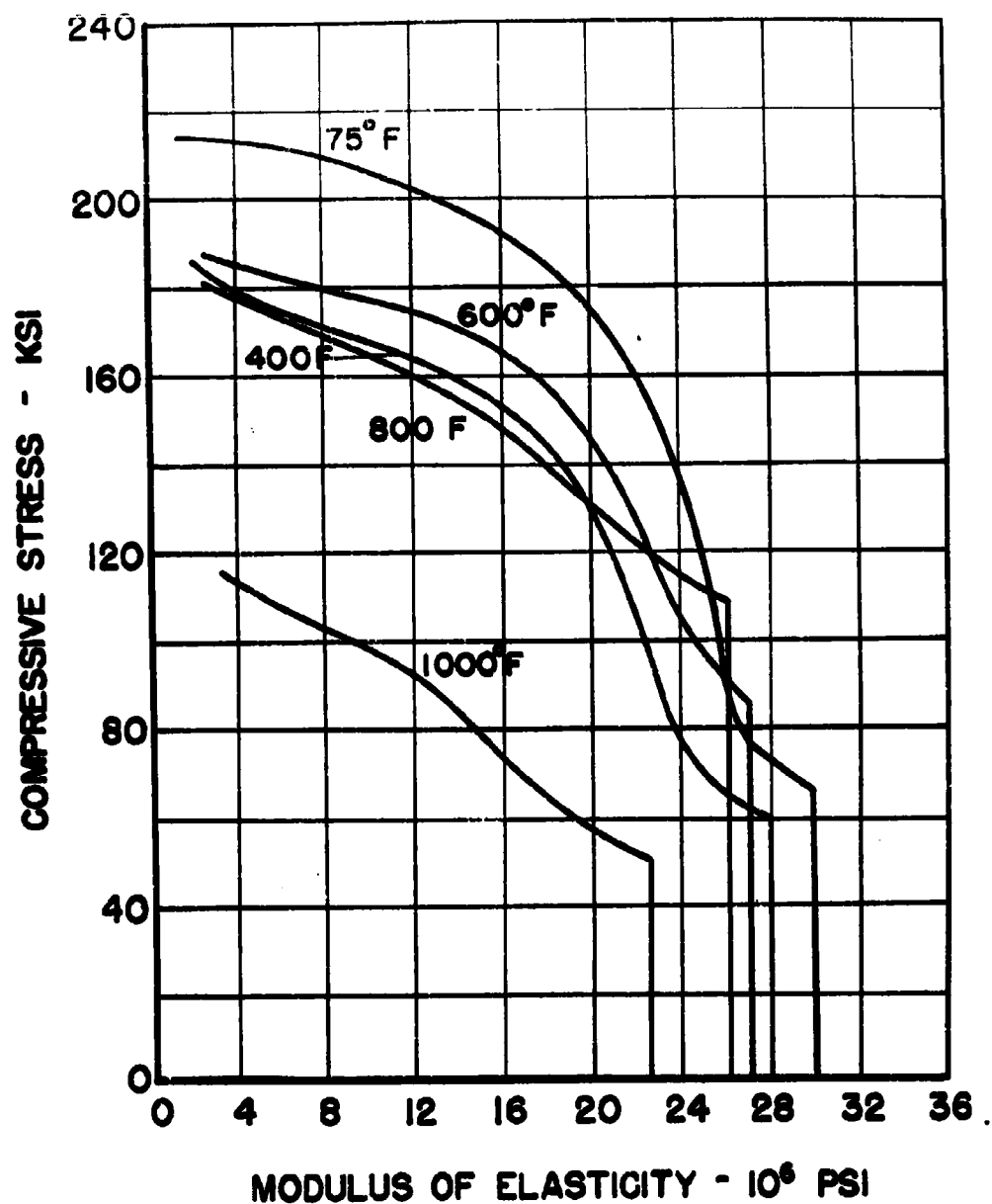


FIGURE 78. COMPRESSIVE TANGENT
MODULUS CURVES OF Ph15-7Mo
EXPOSED 1000 HOURS

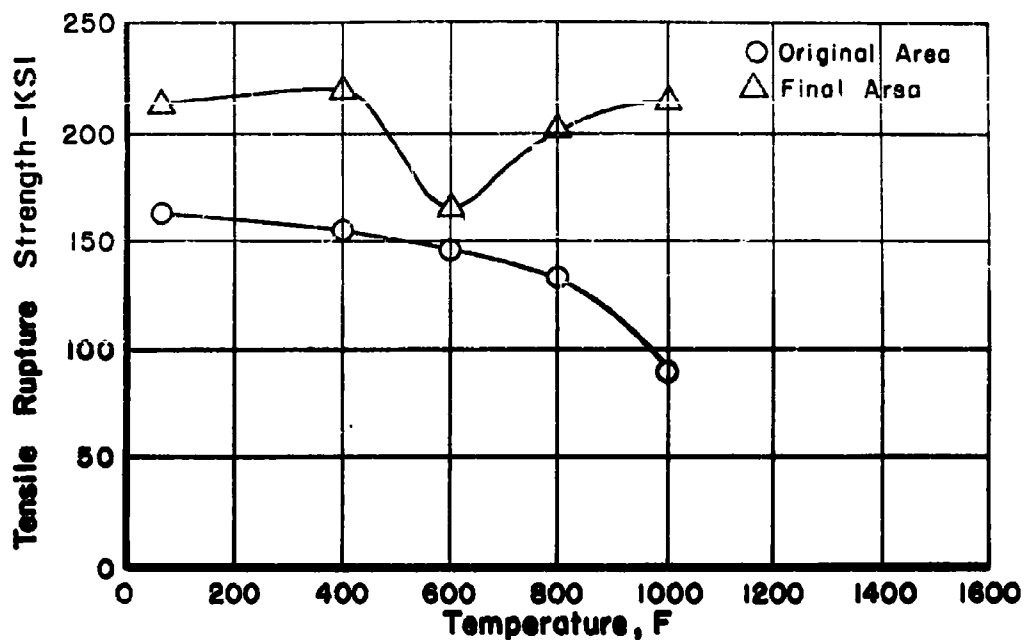


FIGURE 79. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

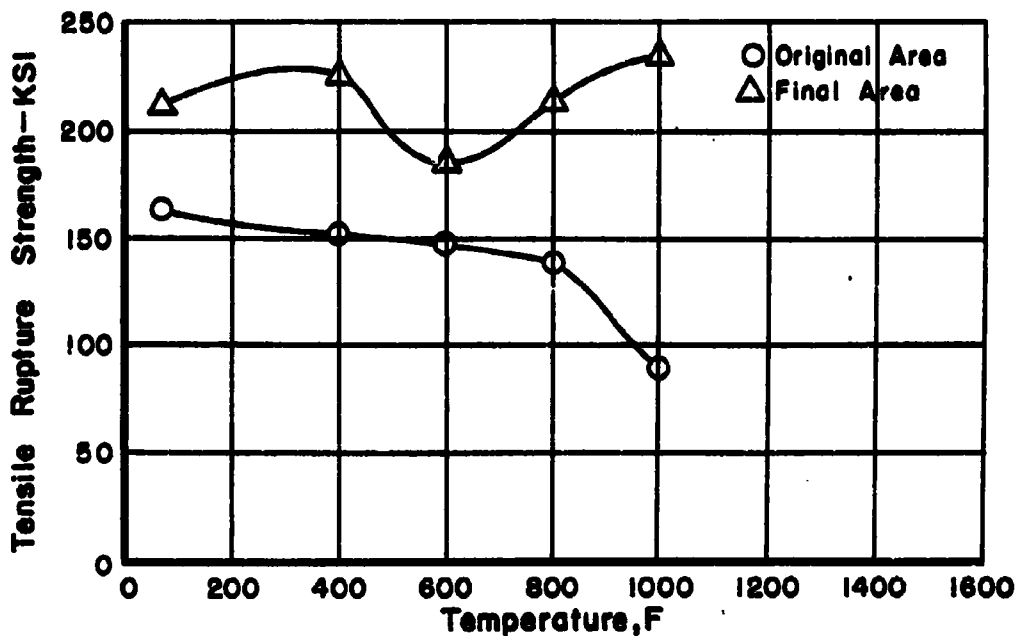


FIGURE 80. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

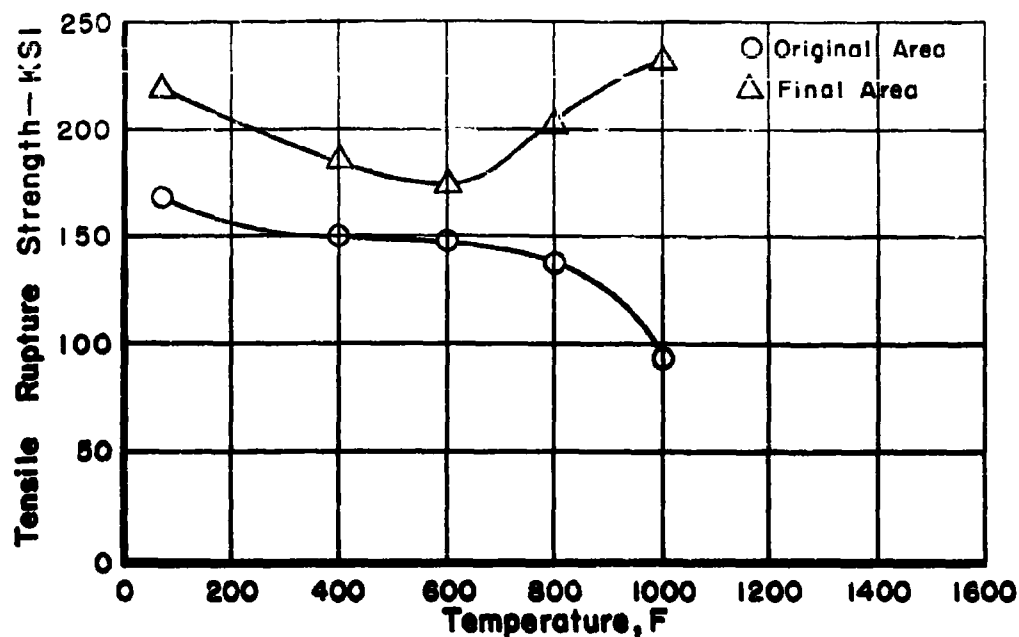


FIGURE 81. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

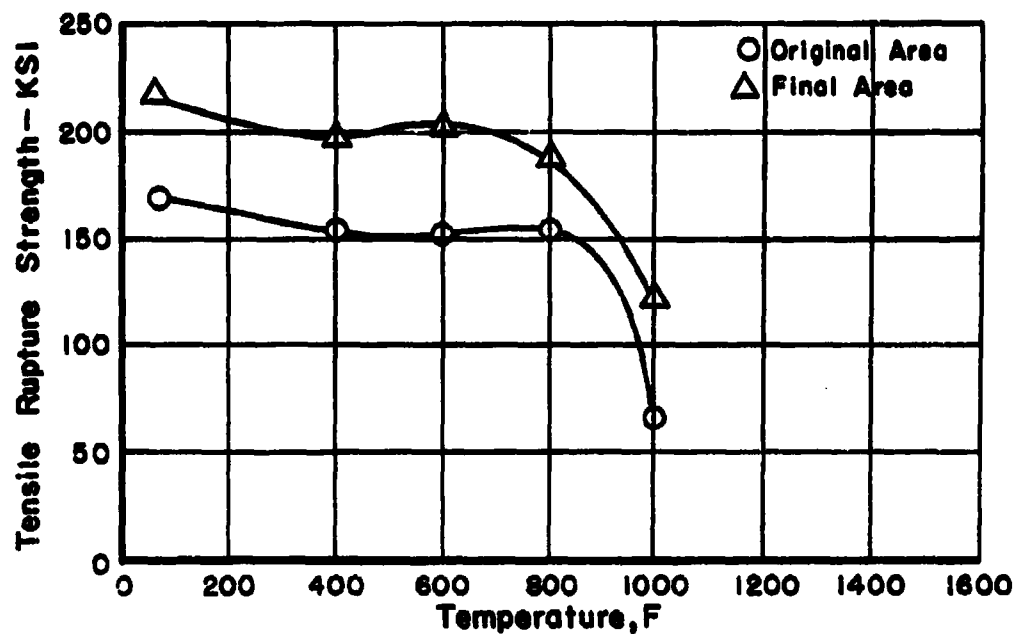


FIGURE 82. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF Ph15-7Mo EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX II

SUMMARY OF ROOM TEMPERATURE PROPERTIES OF AM 355

Form: 0.052 Inch Sheet

Condition: SCT 850

Properties:

Ultimate Tensile Strength	-	F_{tu}	=	219,950 psi
Tensile Yield Strength	-	F_{ty}	=	183,900 psi
Modulus of Elasticity	-	E	=	29.67×10^6 psi
Percent Elongation in 2 inches			=	13.4
Notched Tensile Strength	-	F_{tu}	=	250,690 psi
Compressive Yield Strength	-	F_{cy}	=	216,790 psi
Compressive Modulus of Elasticity	-	E_c	=	30.00×10^6 psi
Ultimate Bearing Strength				
(e/D = 1.5)	-	F_{bru}	=	386,270 psi
(e/D = 2.0)	-	F_{bru}	=	498,670 psi
Bearing Yield Strength				
(e/D = 1.5)	-	F_{bry}	=	321,870 psi
(e/D = 2.0)	-	F_{bry}	=	400,270 psi
Ultimate Shear Strength	-	F_{su}	=	137,620 psi

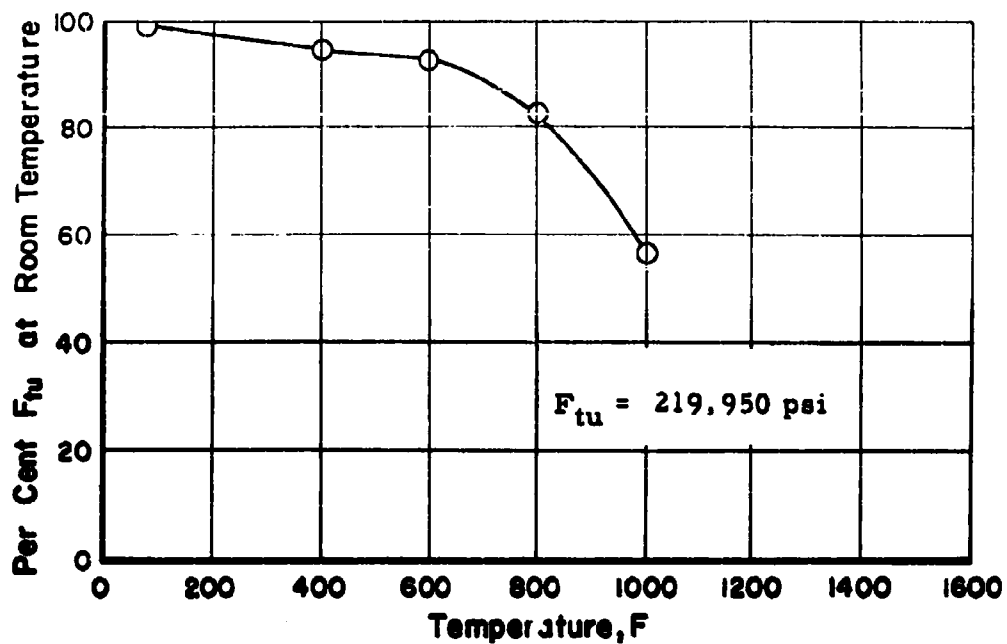


FIGURE 83. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF AM 355
EXPOSED 0.5 HOURS

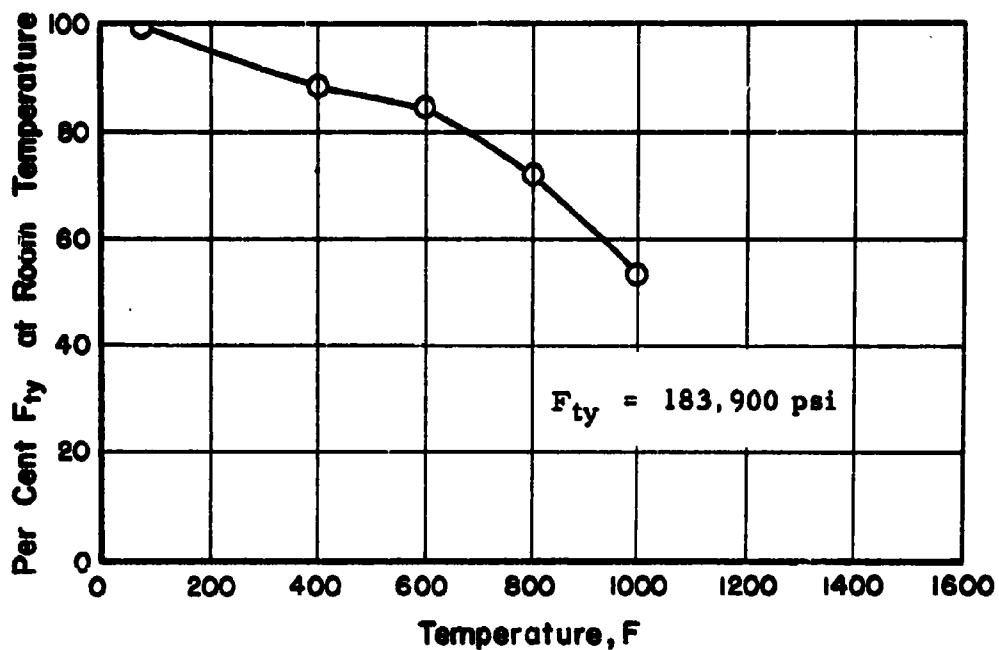


FIGURE 84. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF AM 355
EXPOSED 0.5 HOURS

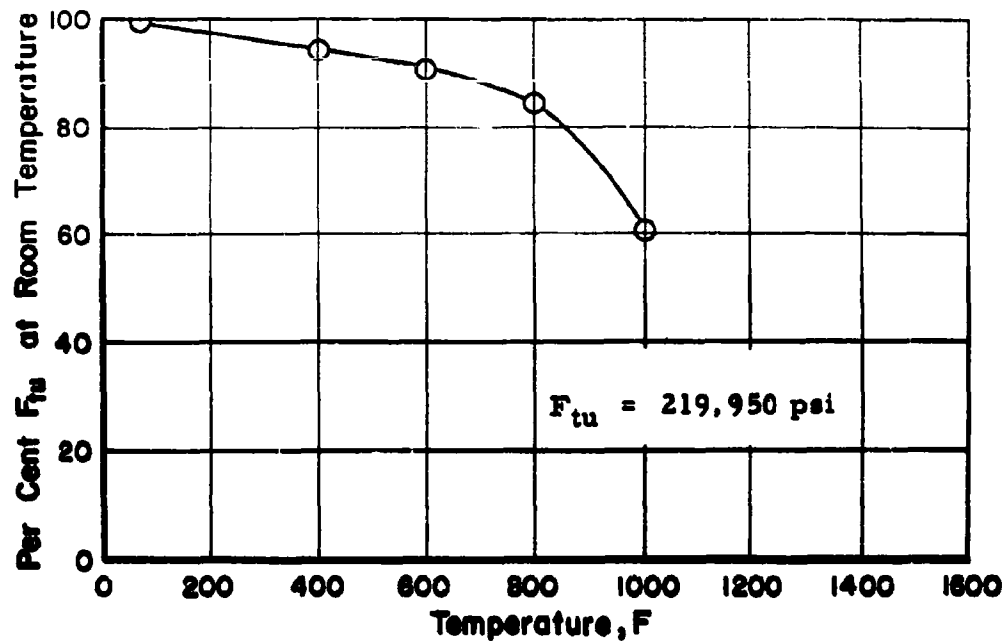


FIGURE 85. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF AM 355
EXPOSED 10 HOURS

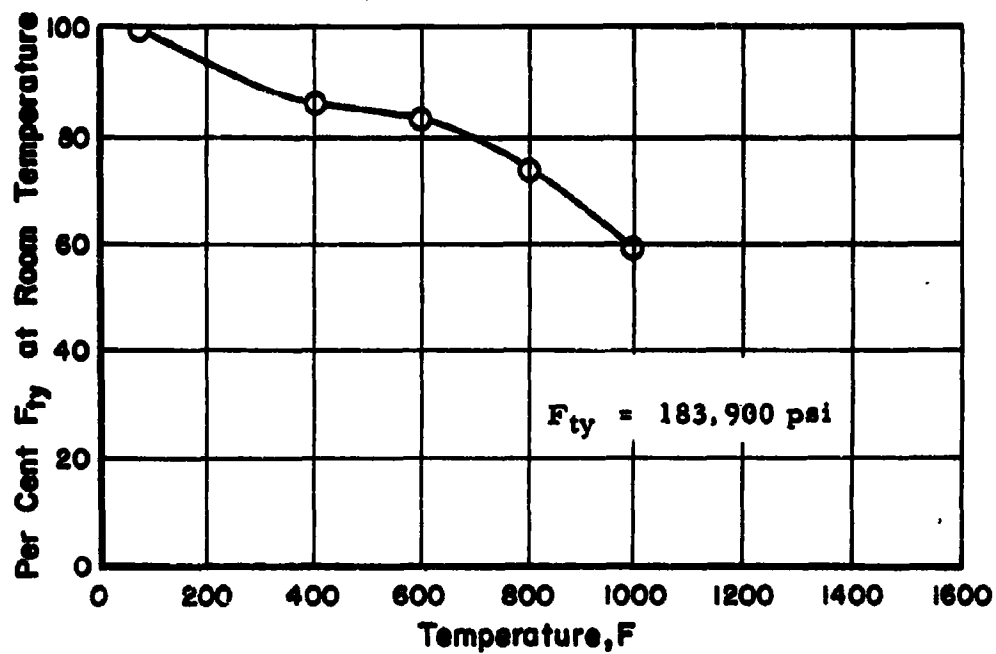


FIGURE 86. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF AM 355
EXPOSED 10 HOURS

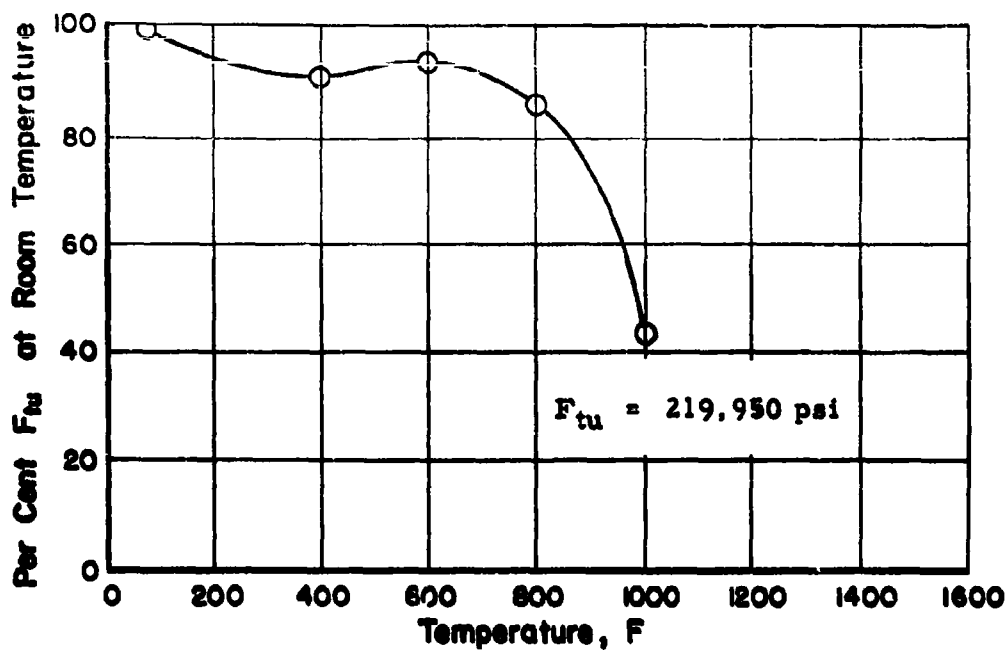


FIGURE 87. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF AM 355
EXPOSED 100 HOURS

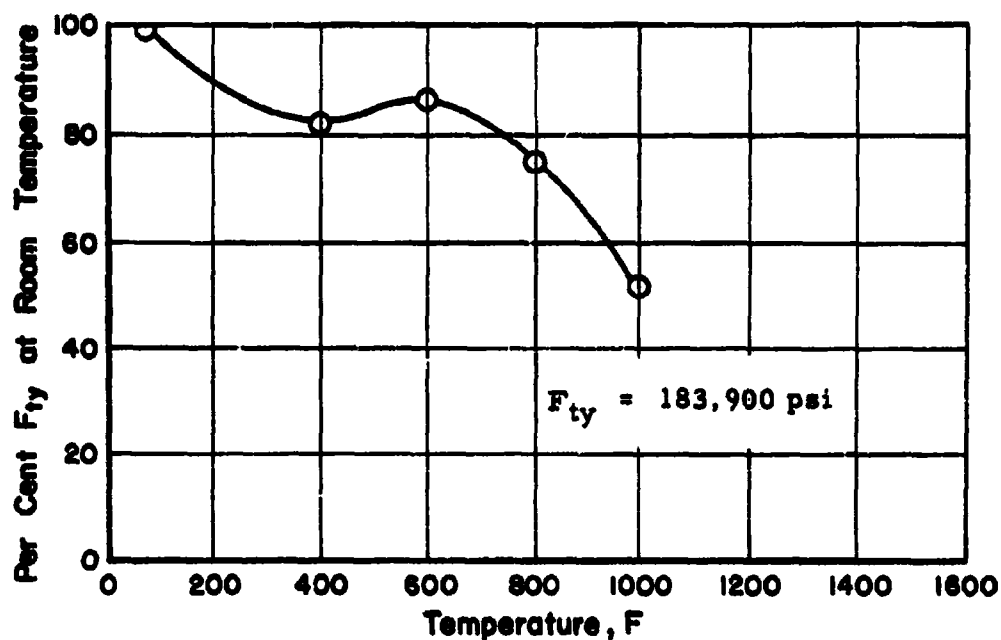


FIGURE 88. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF AM 355
EXPOSED 100 HOURS

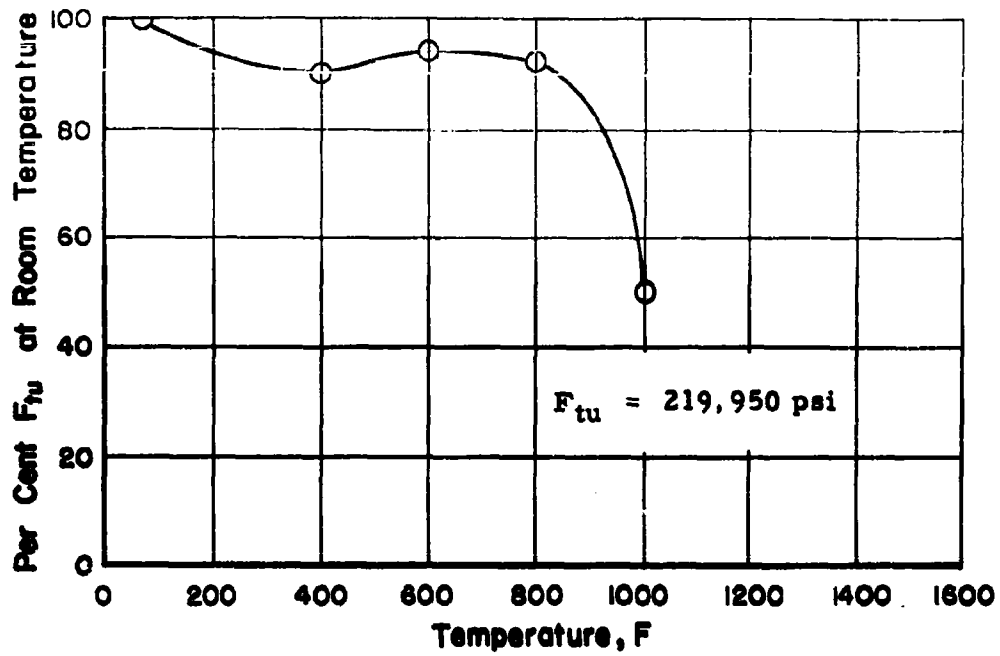


FIGURE 89. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF AM 355
EXPOSED 1000 HOURS

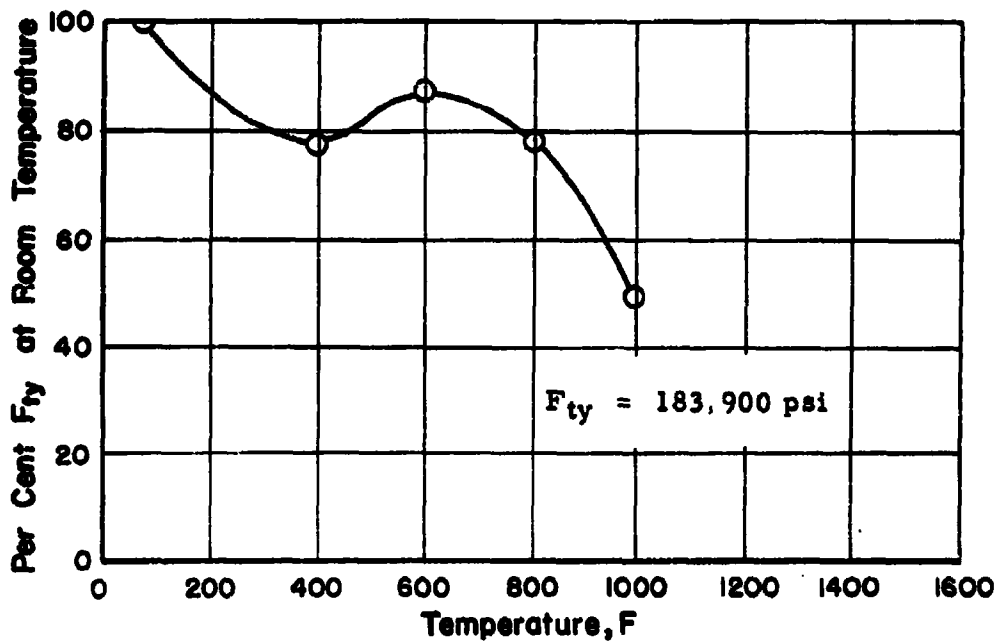


FIGURE 90. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF AM 355
EXPOSED 1000 HOURS

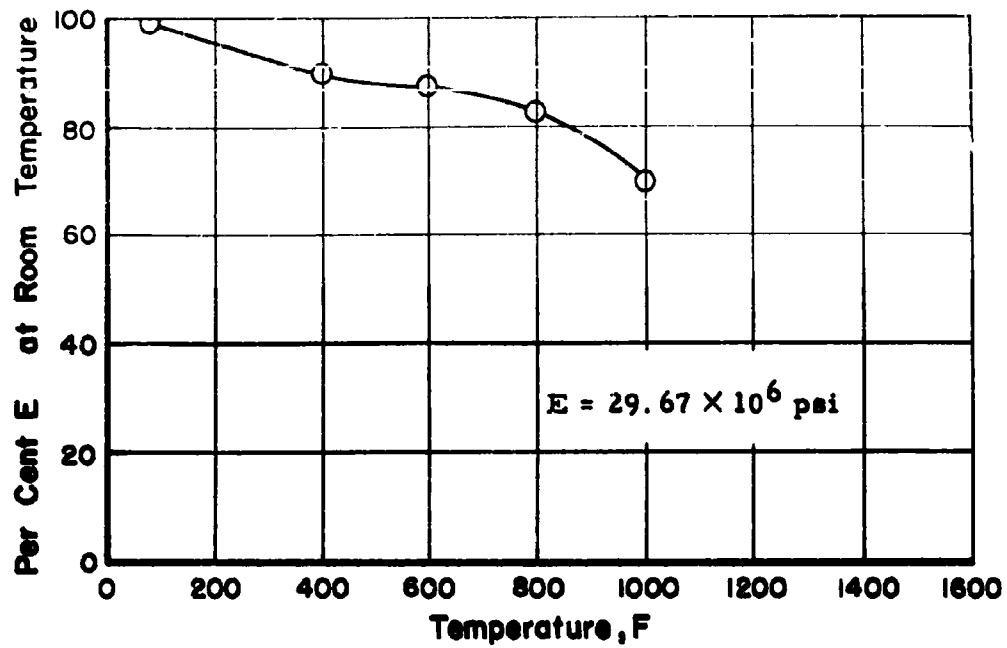


FIGURE 91. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 0.5 HOURS

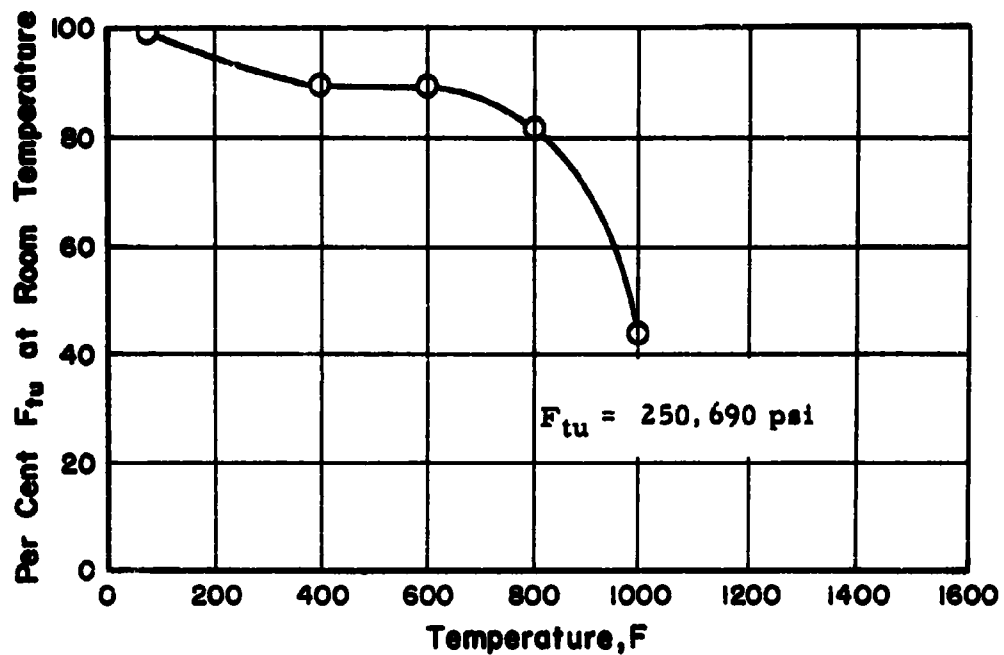


FIGURE 92. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 0.5 HOURS

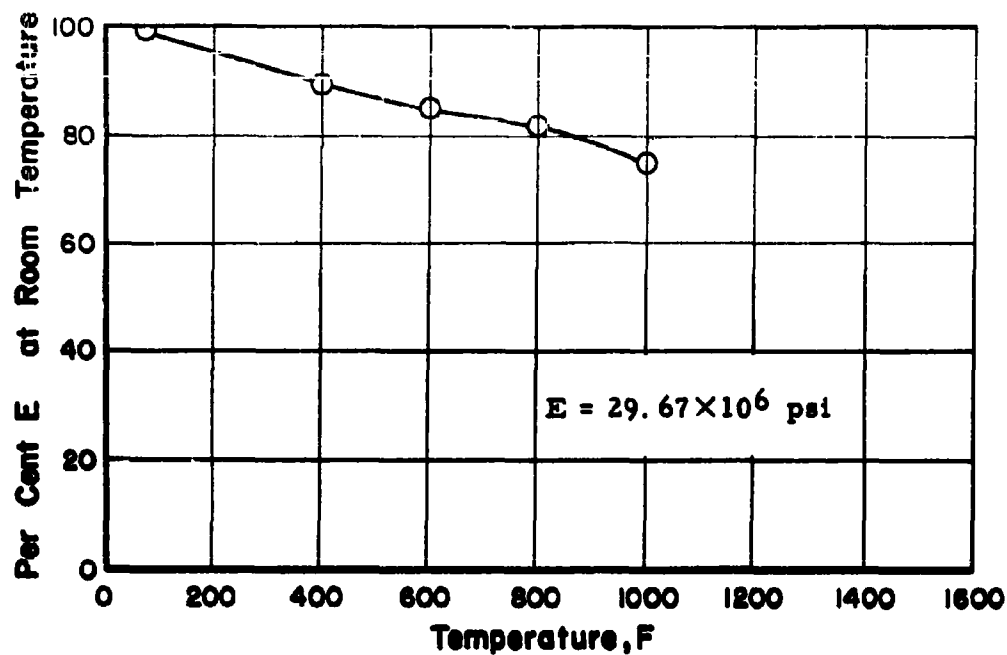


FIGURE 93. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 10 HOURS

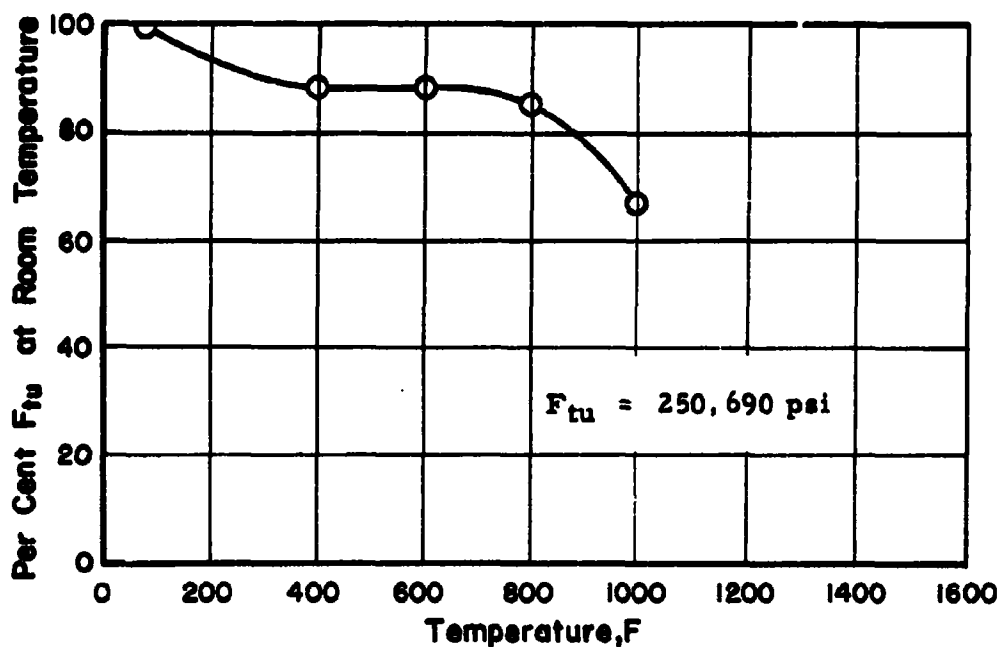


FIGURE 94. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 10 HOURS

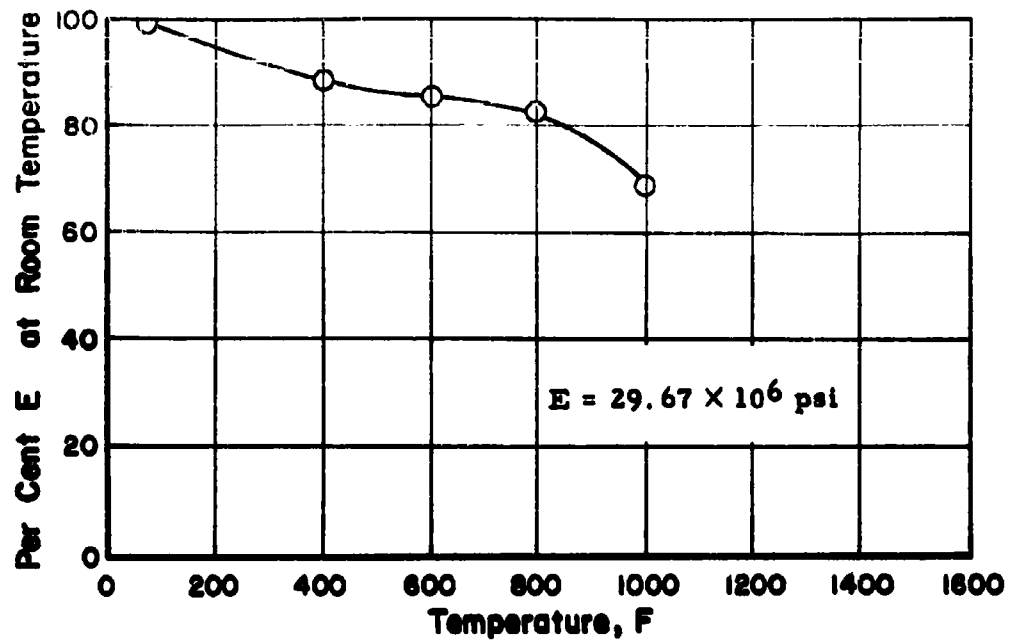


FIGURE 95. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 100 HOURS

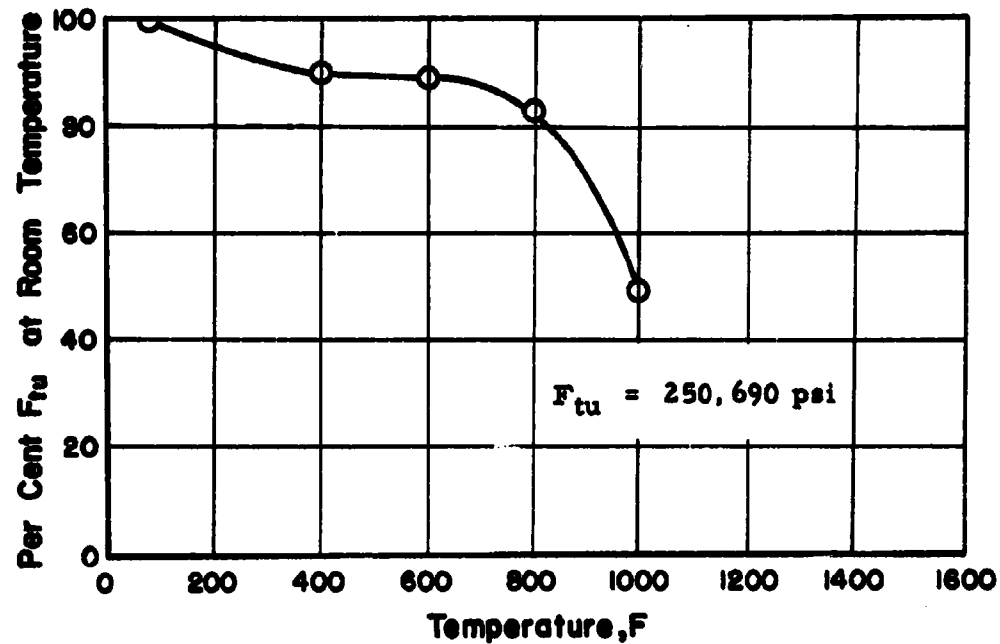


FIGURE 96. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 100 HOURS

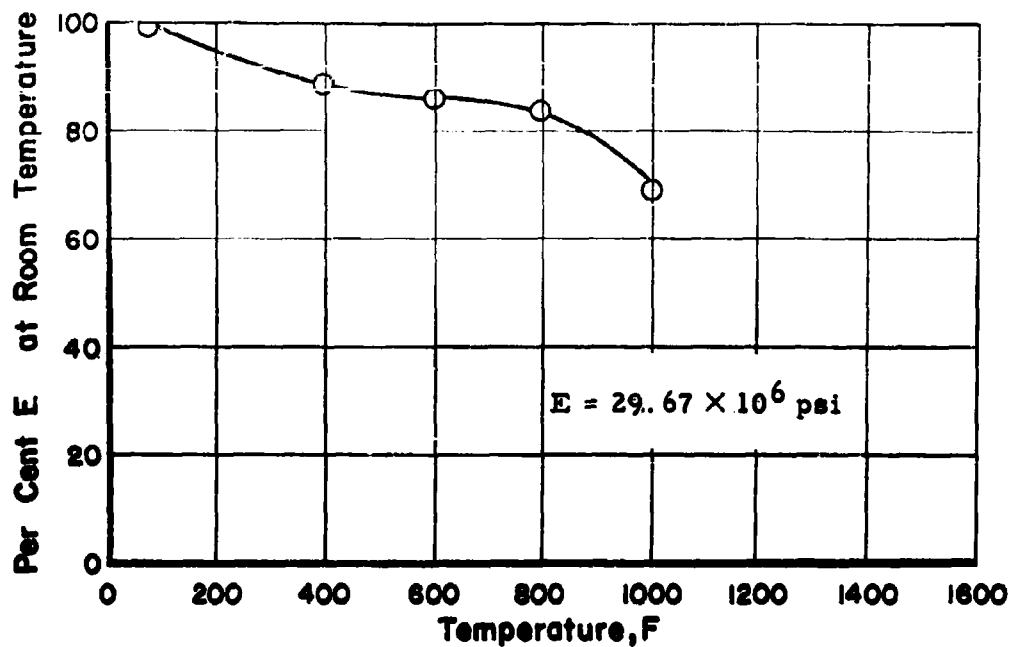


FIGURE 97. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF AM 355 EXPOSED 1000 HOURS

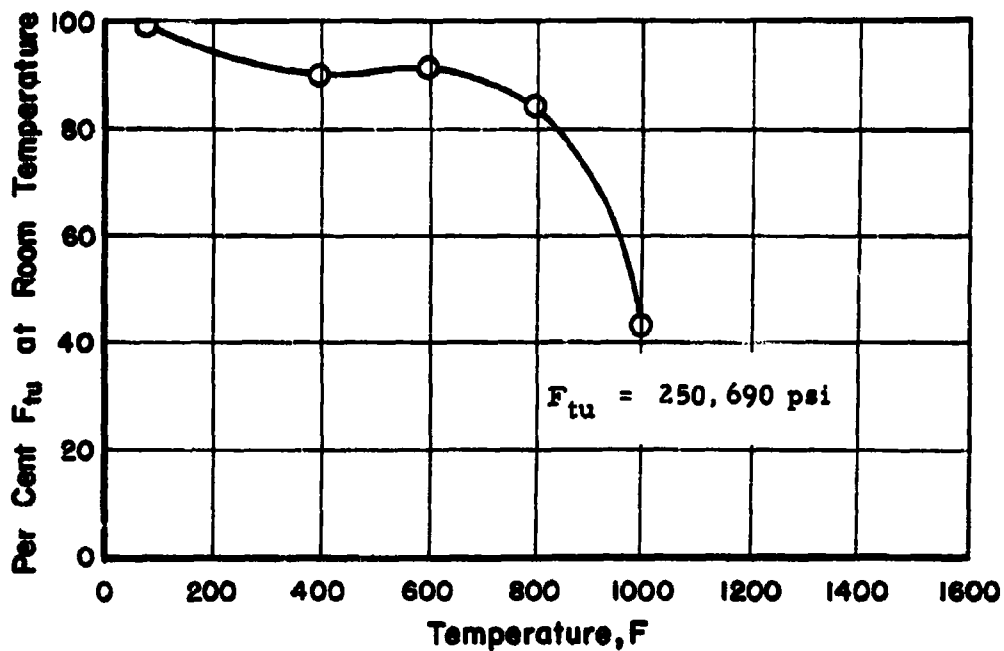


FIGURE 98. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF AM 355 EXPOSED 1000 HOURS

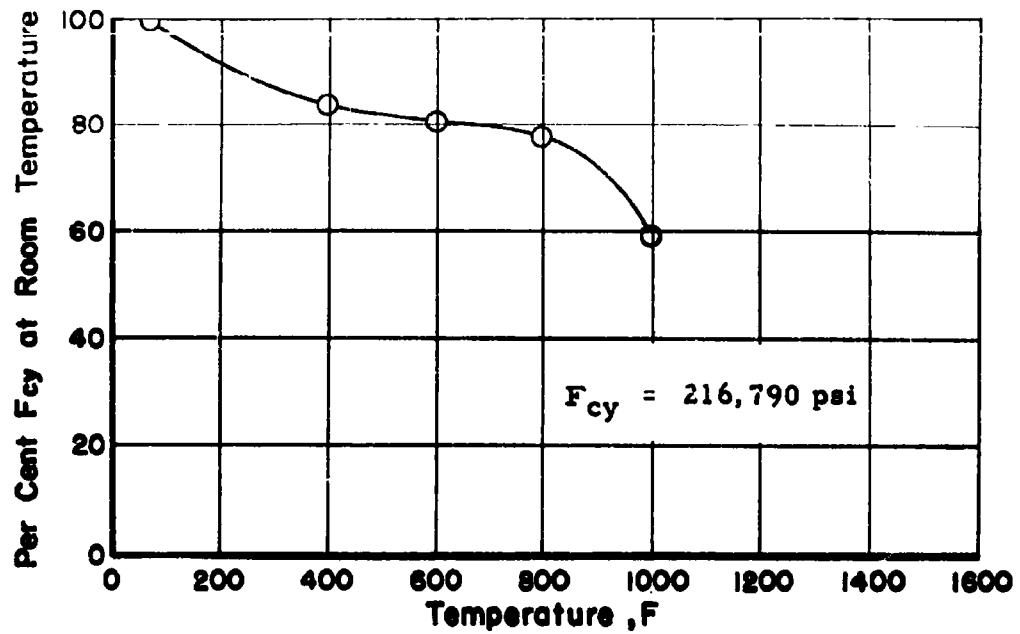


FIGURE 99. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
AM 355 EXPOSED 0.5 HOURS

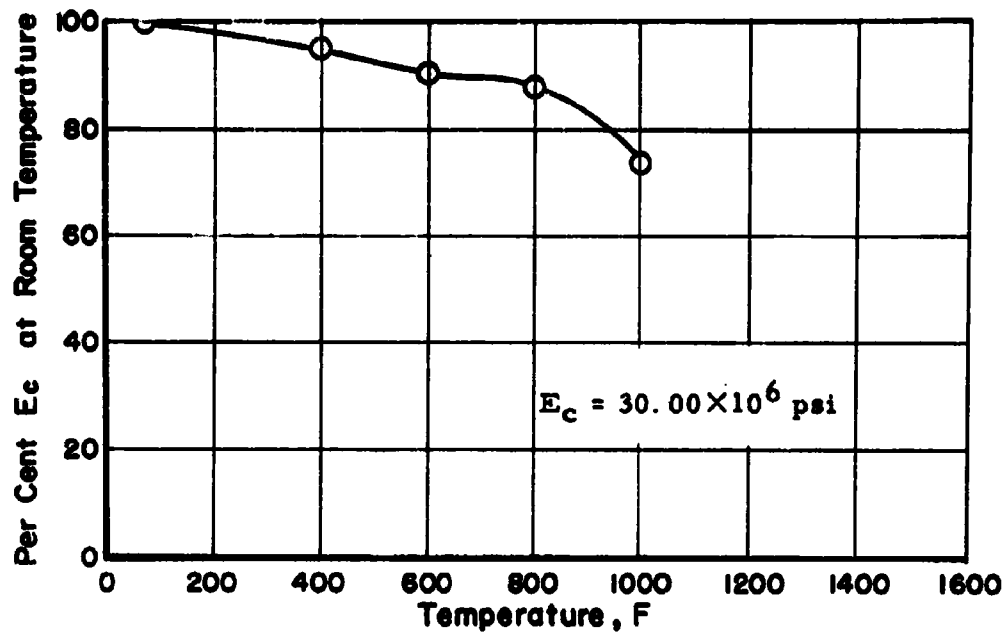


FIGURE 100. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF AM 355 EXPOSED 0.5 HOURS

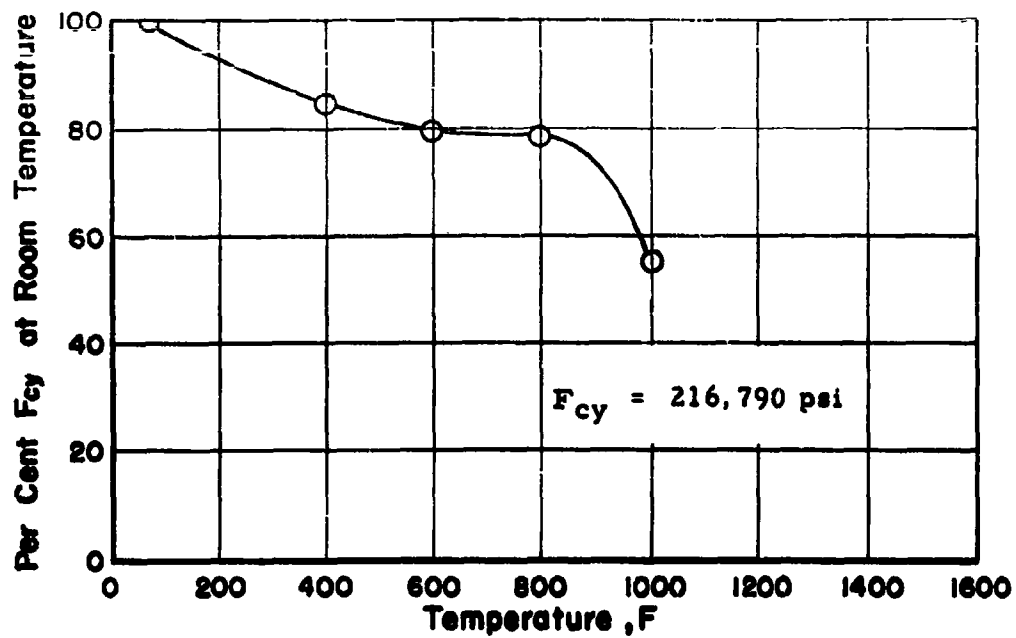


FIGURE 101. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
AM 355 EXPOSED 10 HOURS

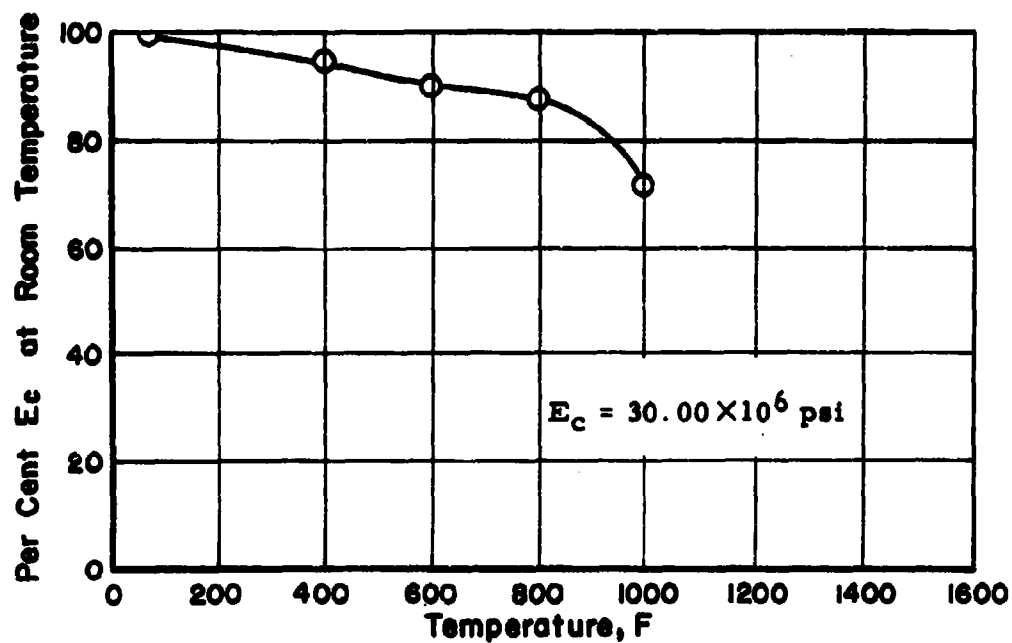


FIGURE 102. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF AM 355 EXPOSED 10 HOURS

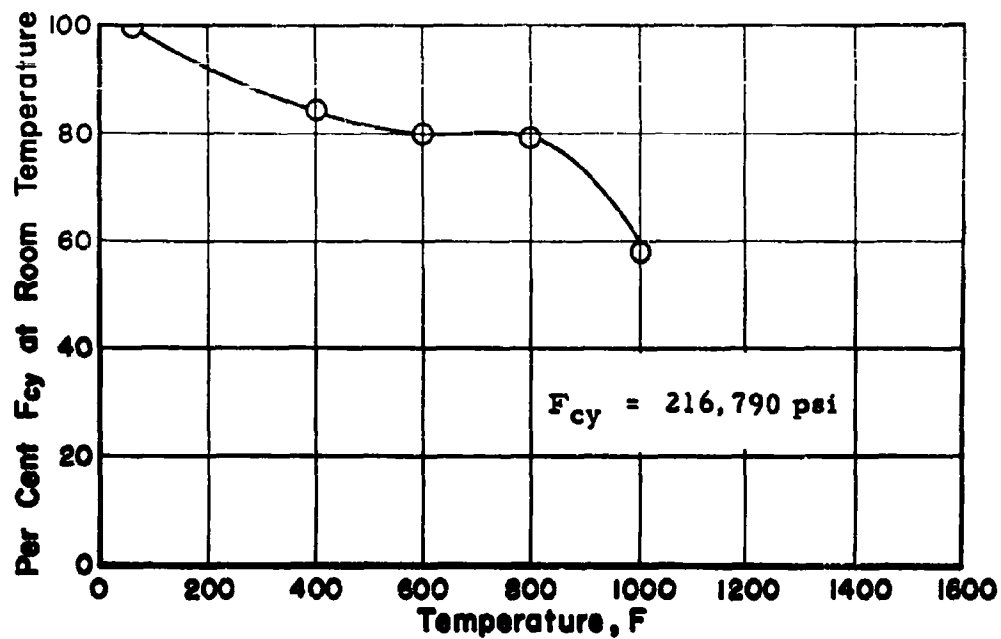


FIGURE 103. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
AM 355 EXPOSED 100 HOURS

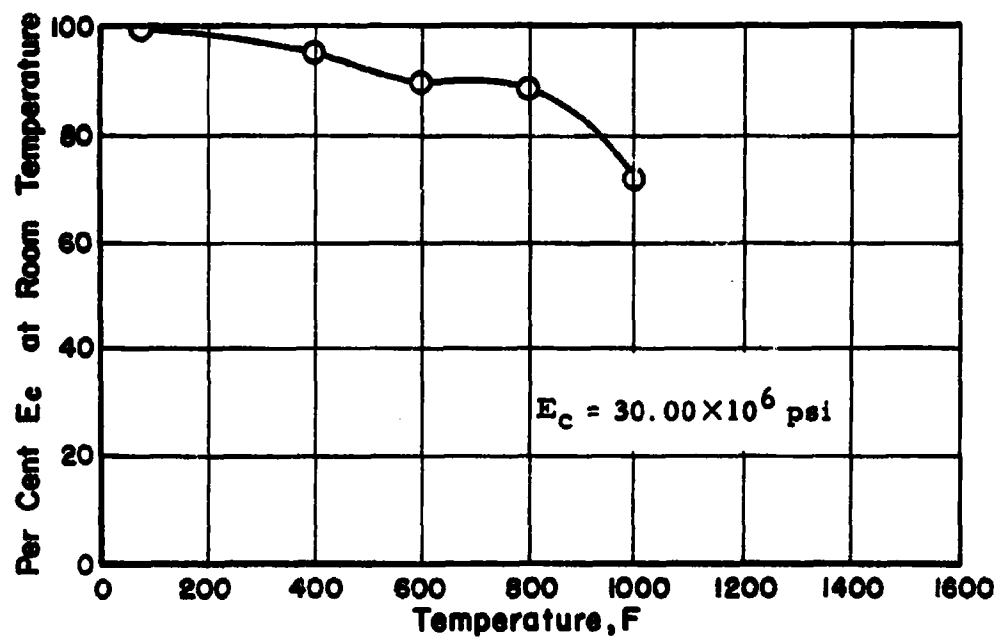


FIGURE 104. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF AM 355 EXPOSED 100 HOURS

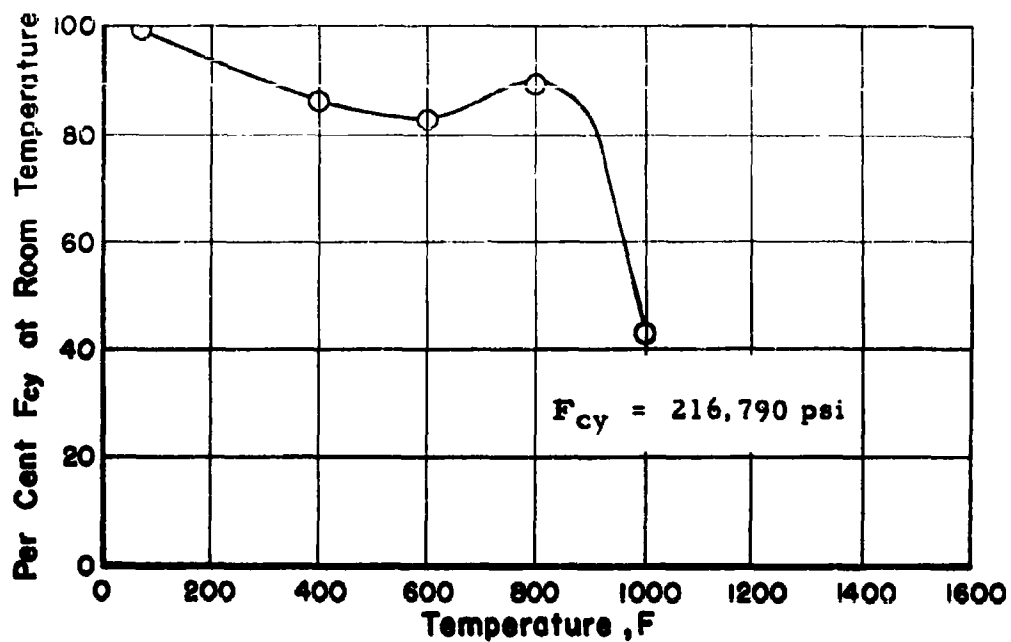


FIGURE 105. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF
AM 355 EXPOSED 1000 HOURS

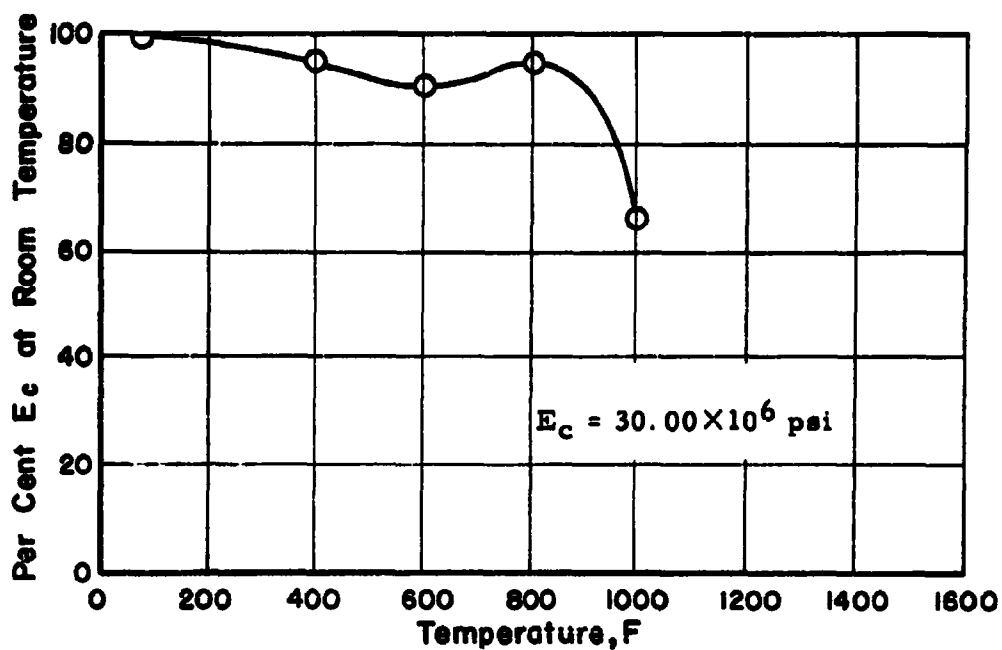


FIGURE 106. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY
OF AM 355 EXPOSED 1000 HOURS

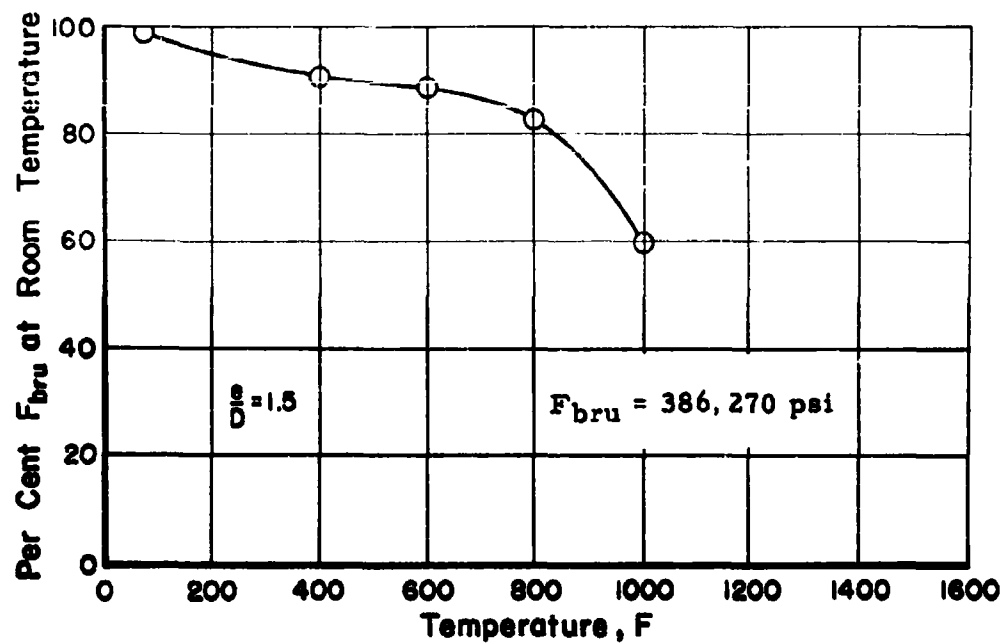


FIGURE 107. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 0.5 HOURS

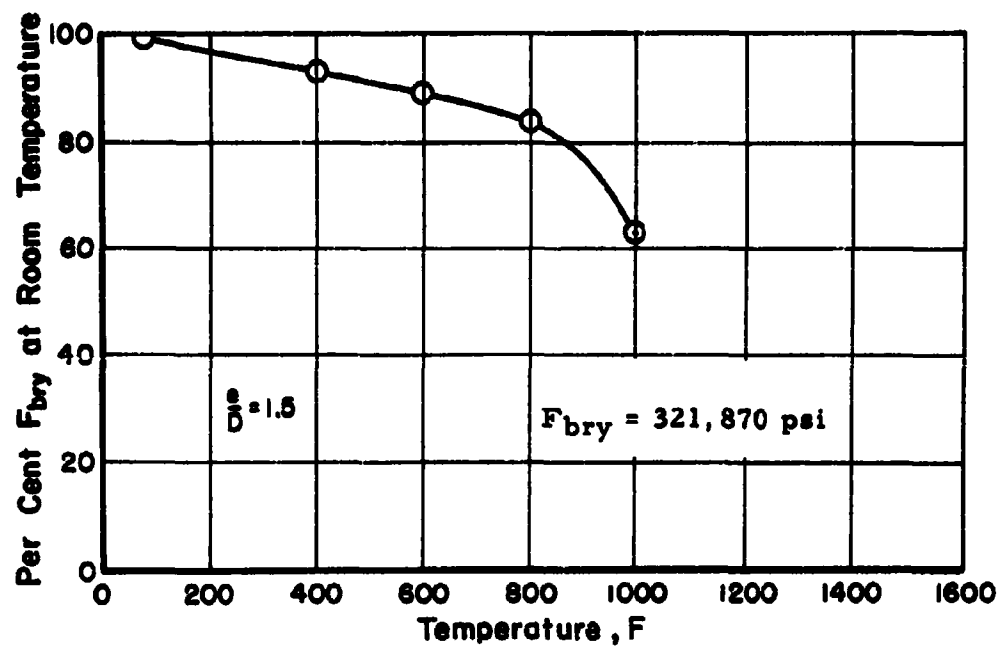


FIGURE 108. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 0.5 HOURS

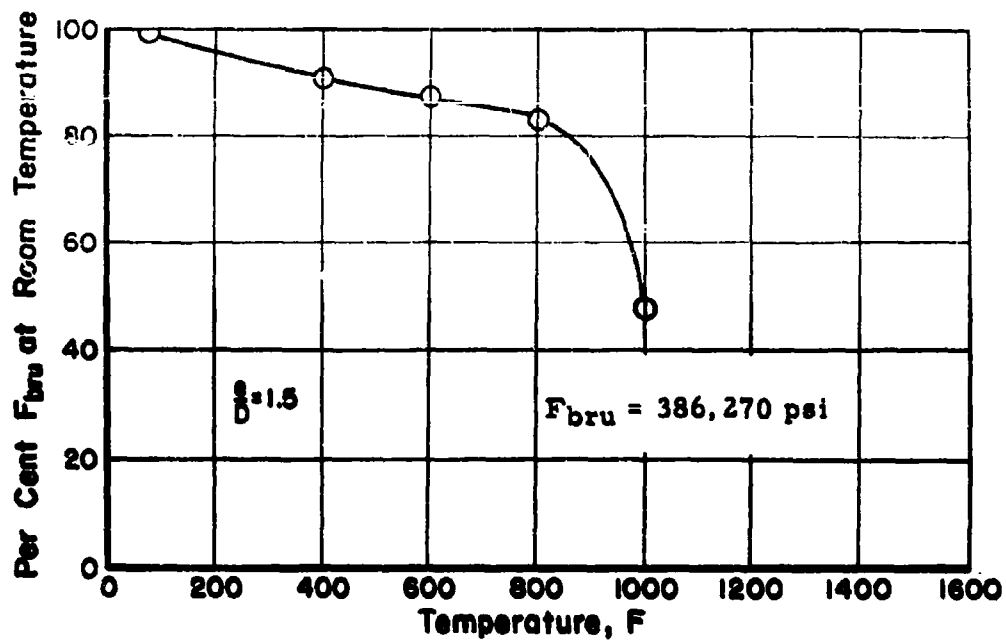


FIGURE 109. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 10 HOURS

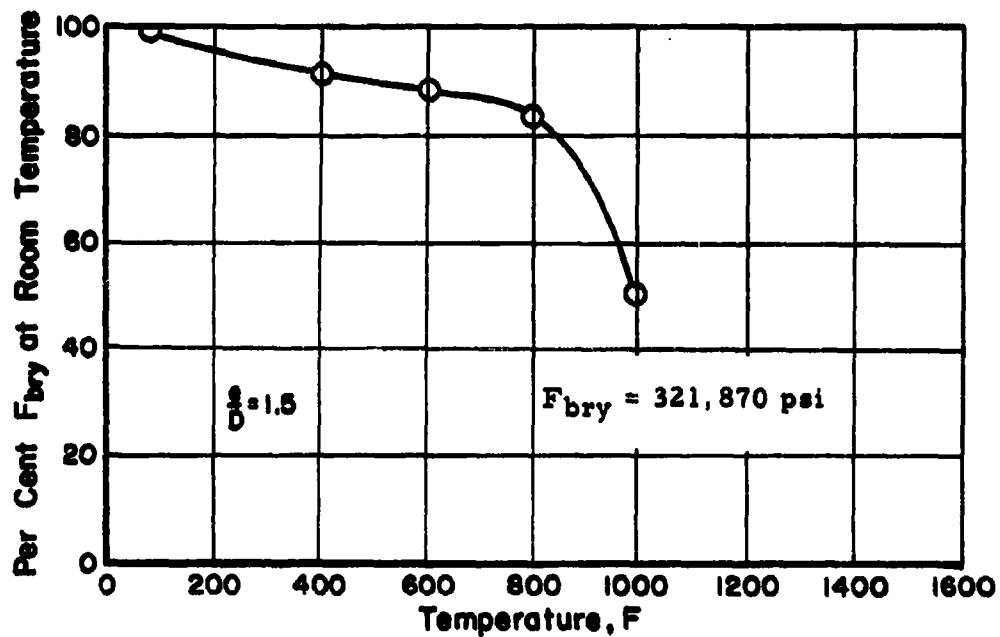


FIGURE 110. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 10 HOURS

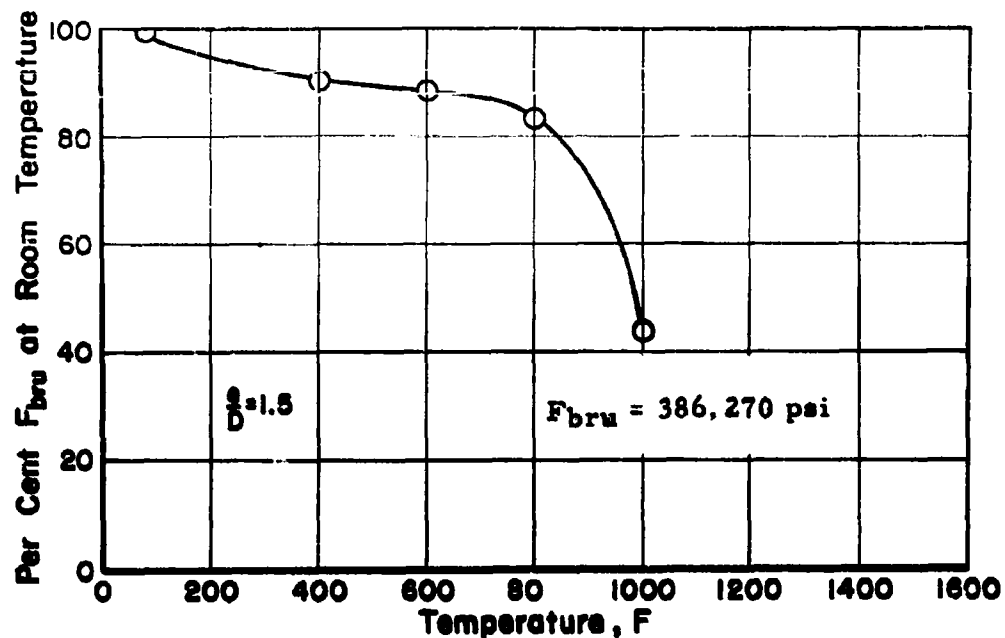


FIGURE 111. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 100 HOURS

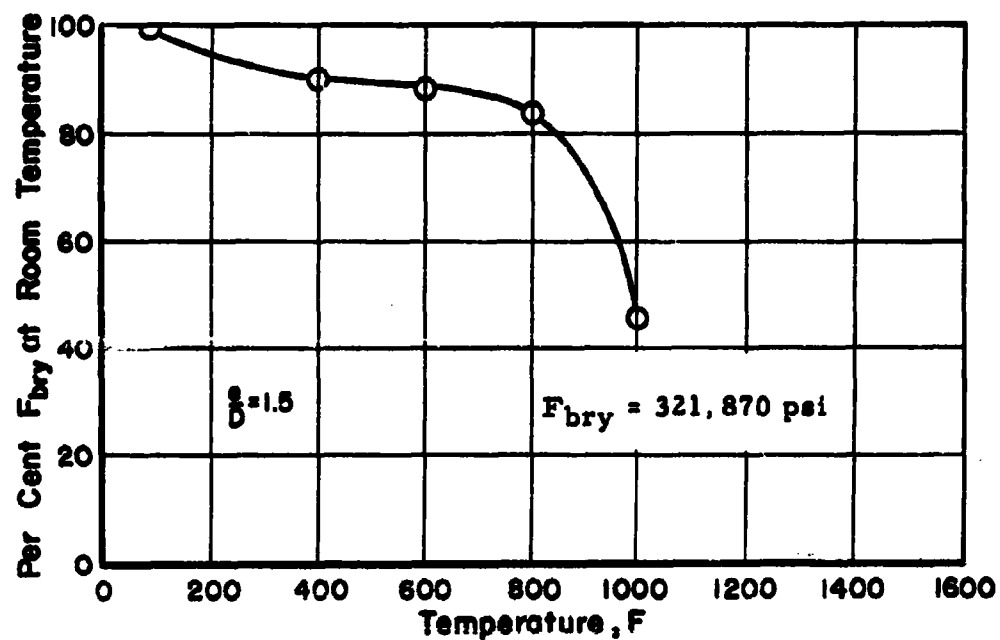


FIGURE 112. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 100 HOURS

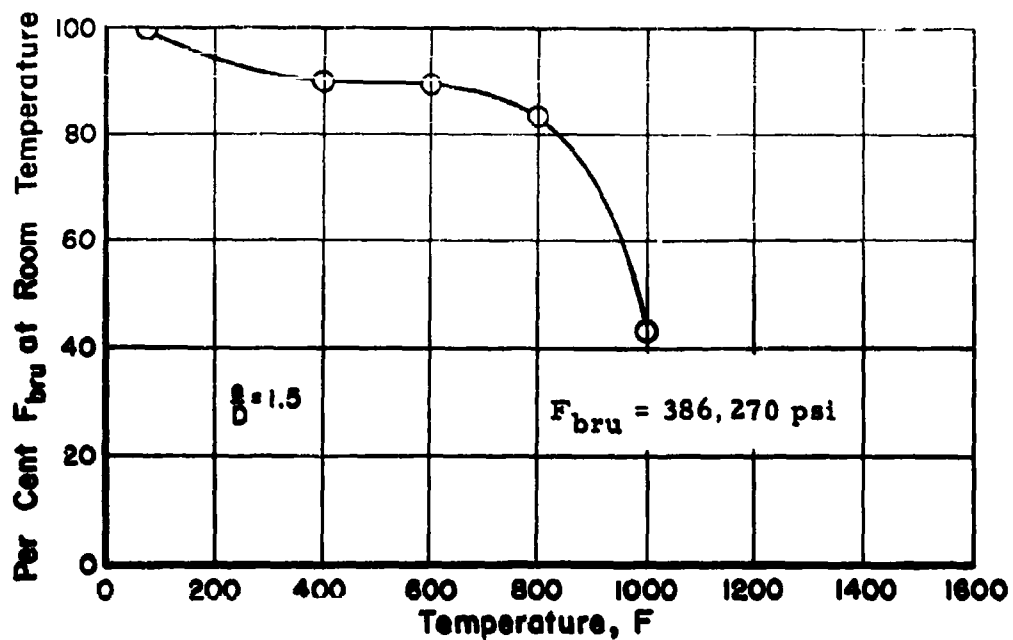


FIGURE 113. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 1000 HOURS

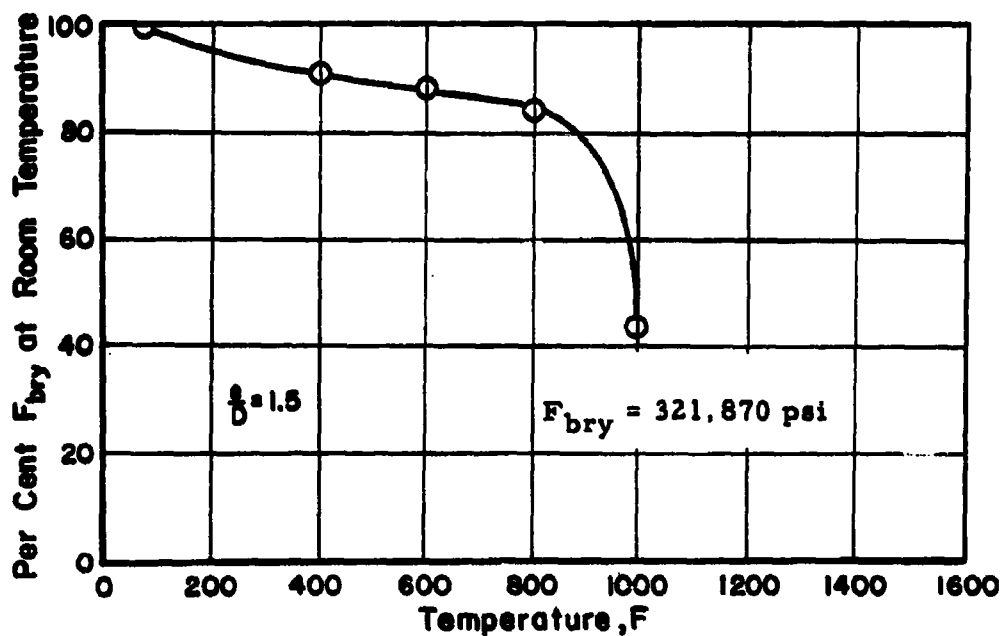


FIGURE 114. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 1000 HOURS

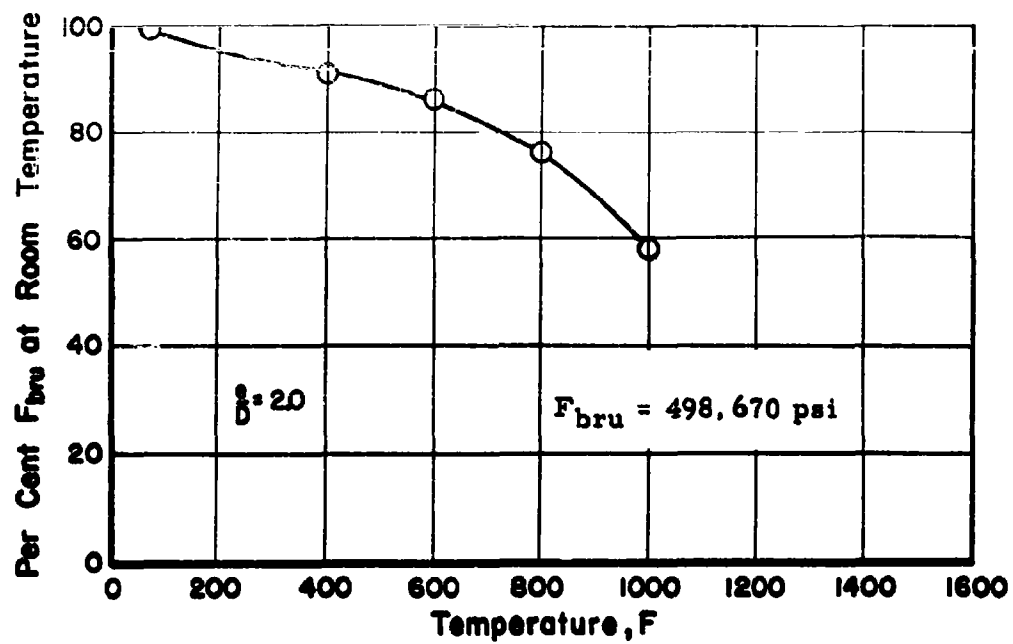


FIGURE 115. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 0.5 HOURS

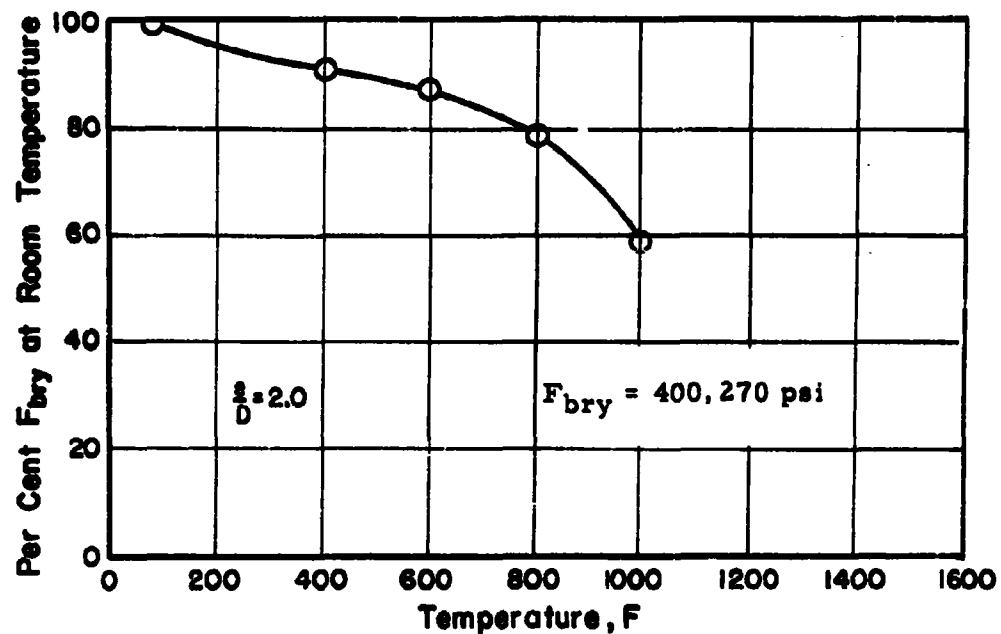


FIGURE 116. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 0.5 HOURS

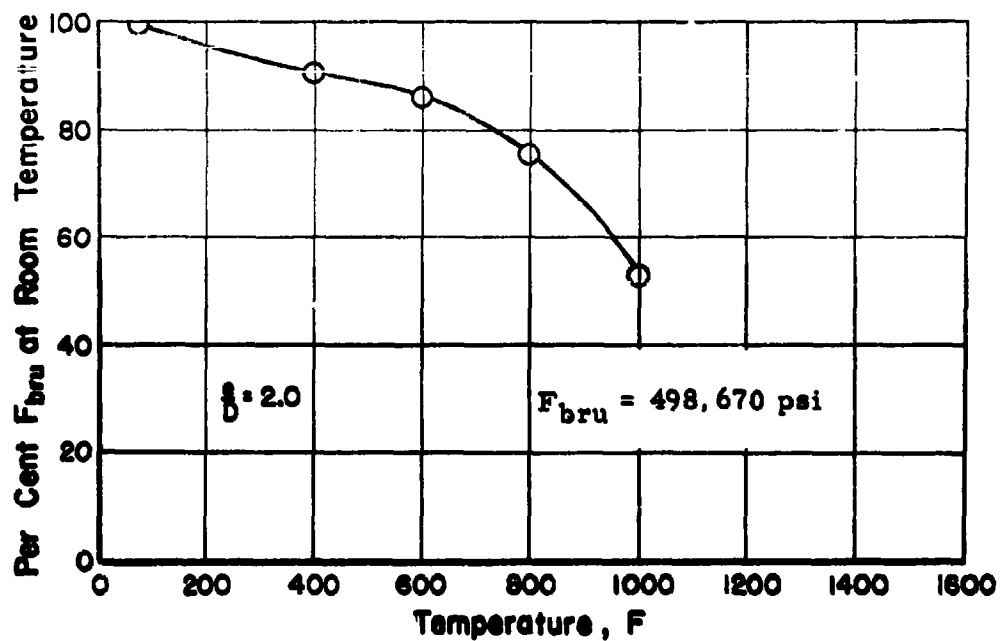


FIGURE 117. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 10 HOURS

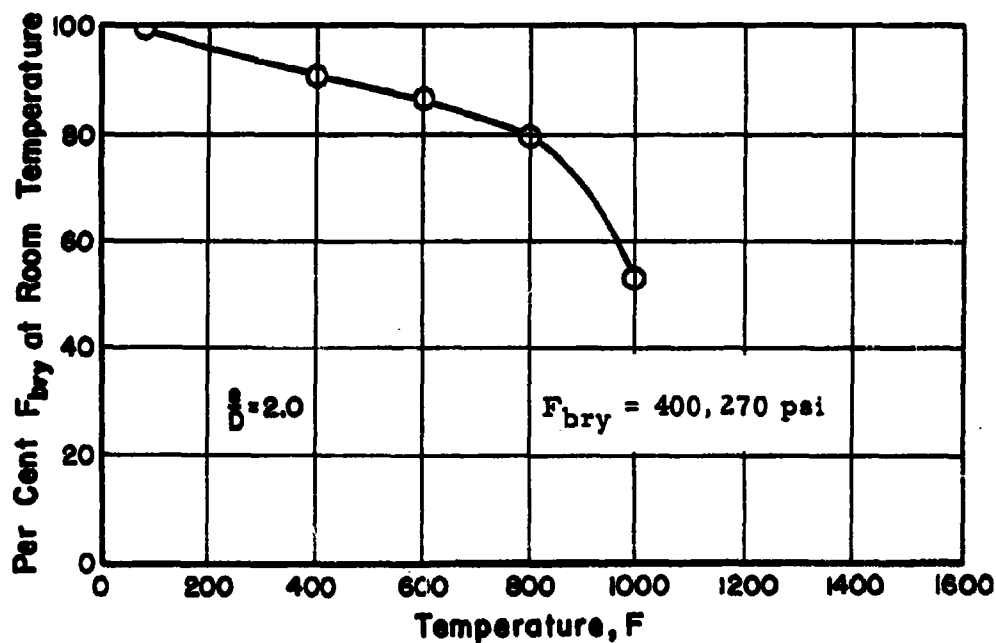


FIGURE 118. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 10 HOURS

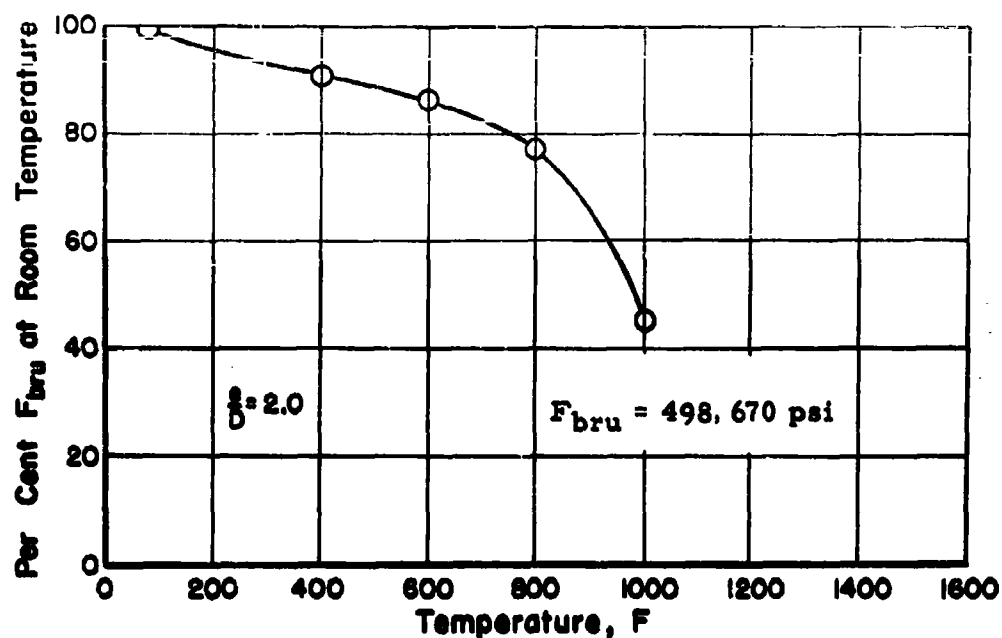


FIGURE 119. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 100 HOURS

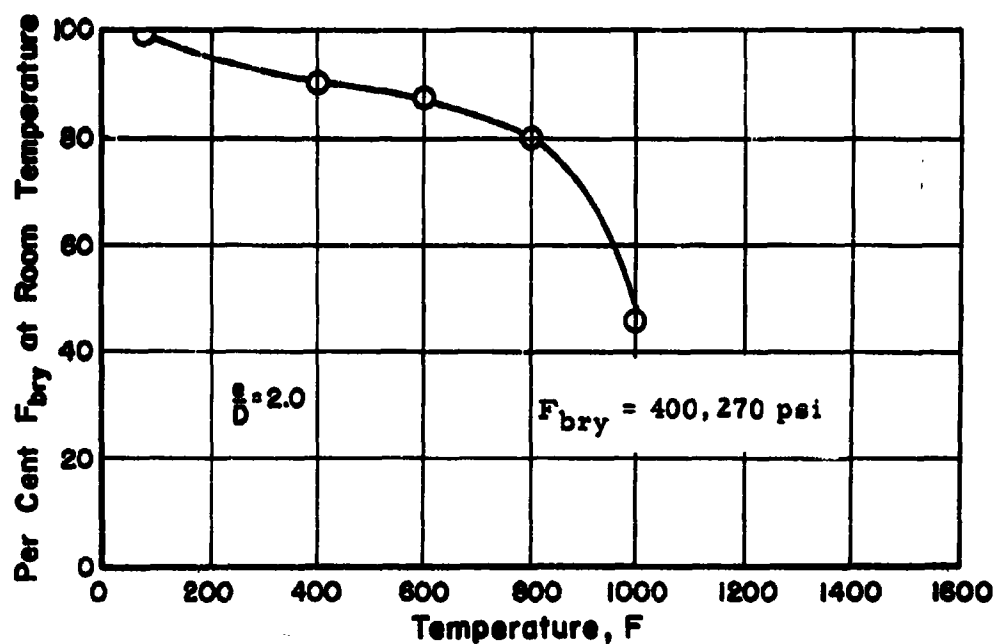


FIGURE 120. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 100 HOURS

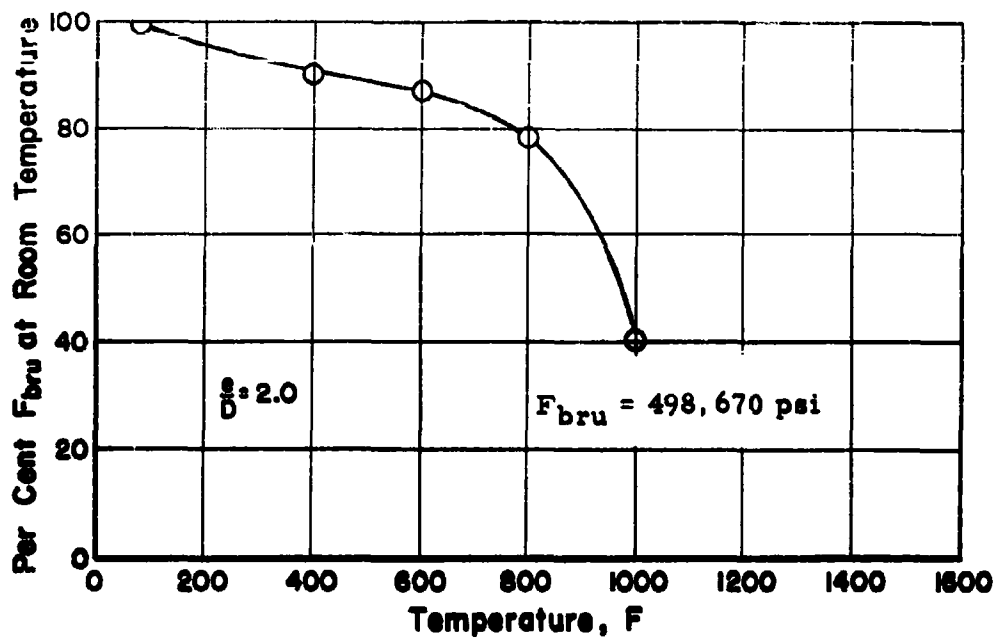


FIGURE 121. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF AM 355 EXPOSED 1000 HOURS

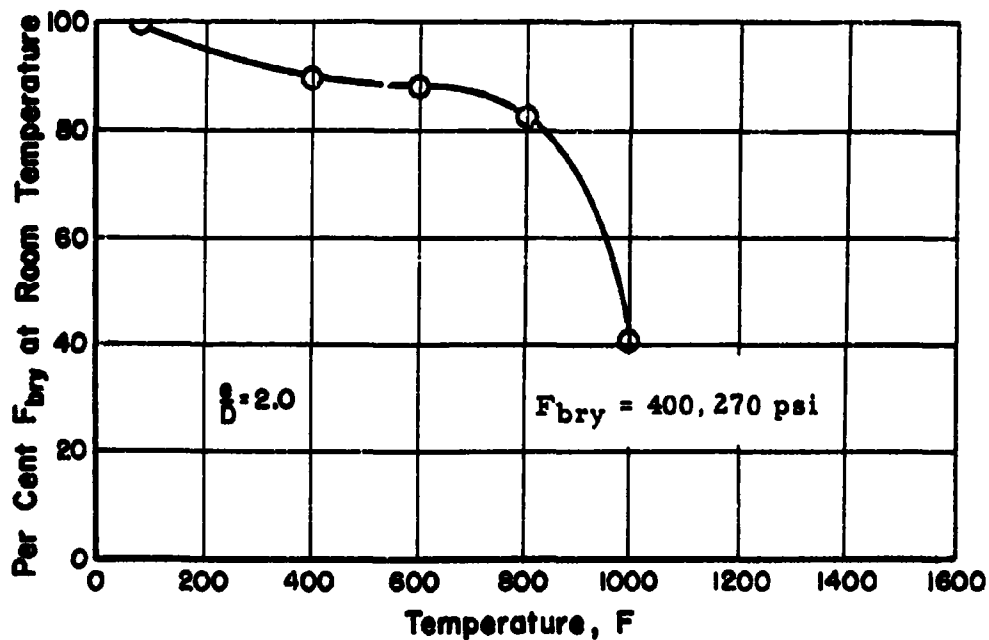


FIGURE 122. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF AM 355 EXPOSED 1000 HOURS

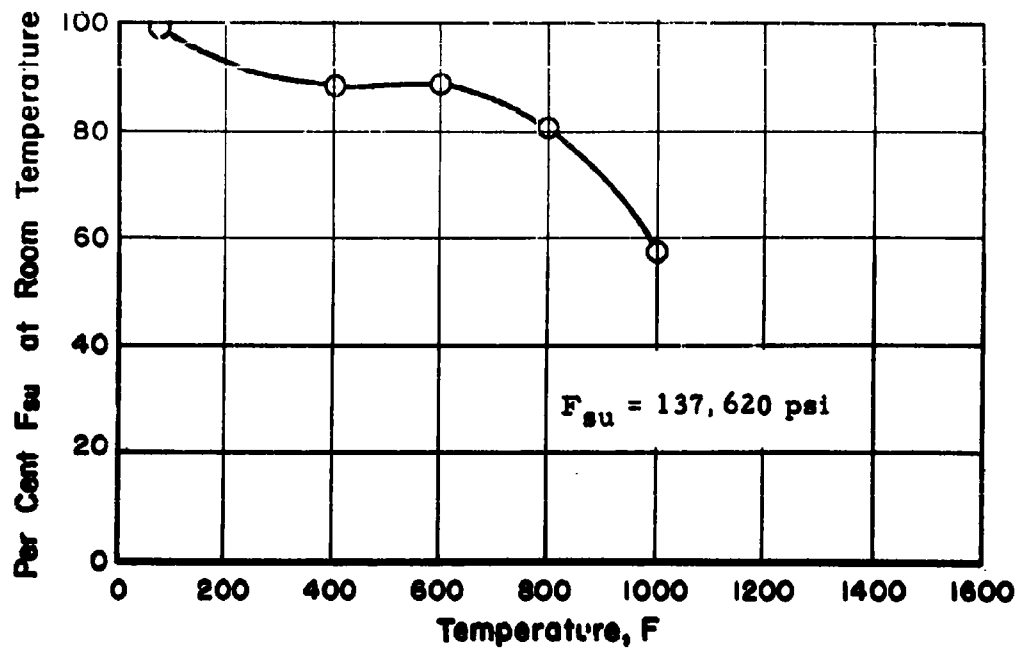


FIGURE 123. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 0.5 HOURS

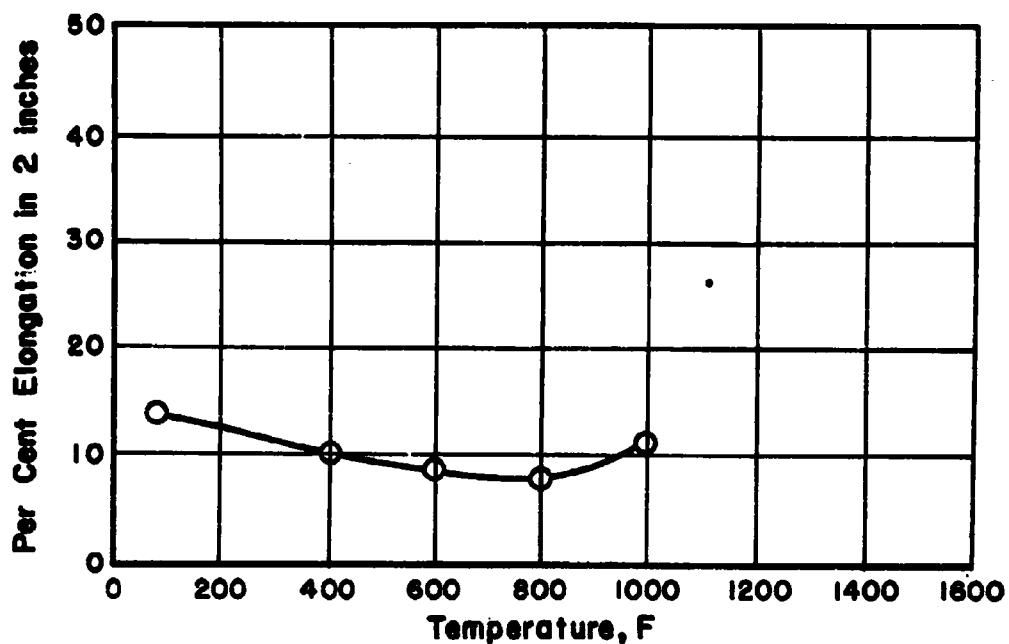


FIGURE 124. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 0.5 HOURS

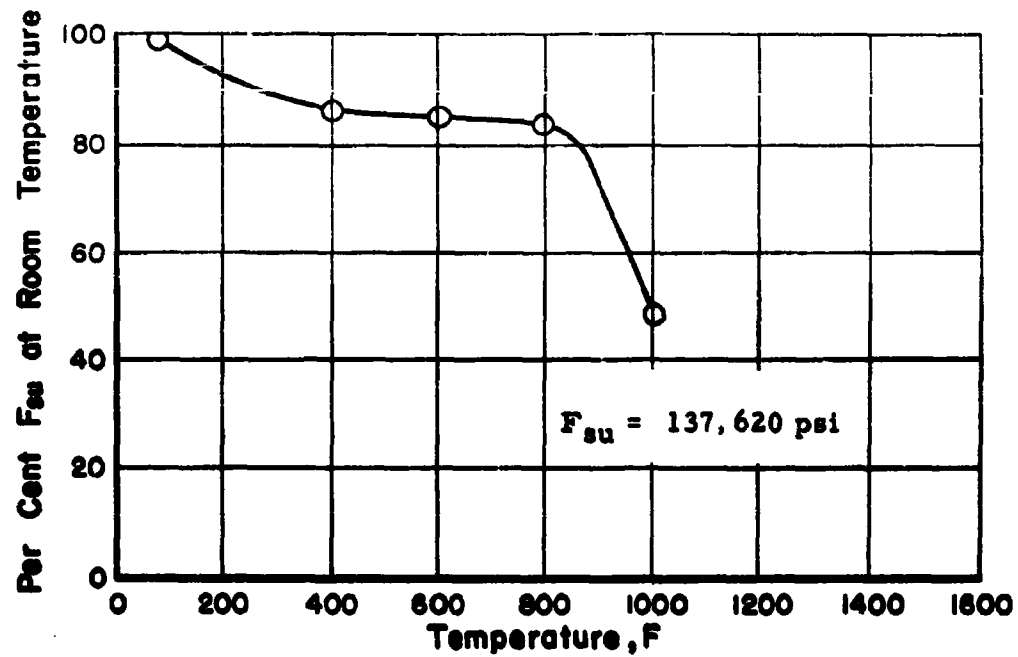


FIGURE 125. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 10 HOURS

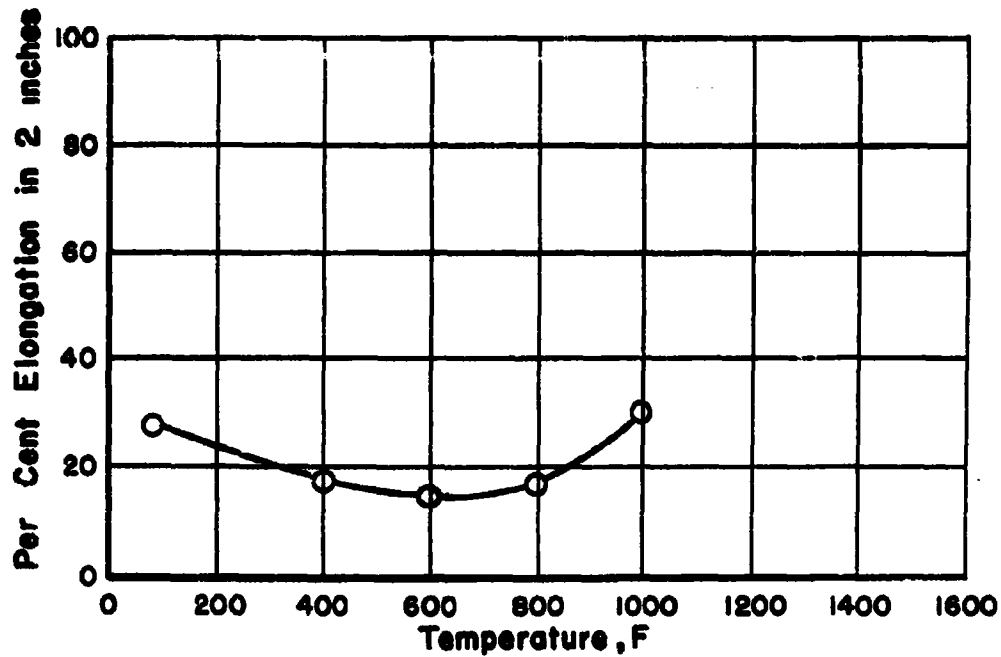


FIGURE 126. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 10 HOURS

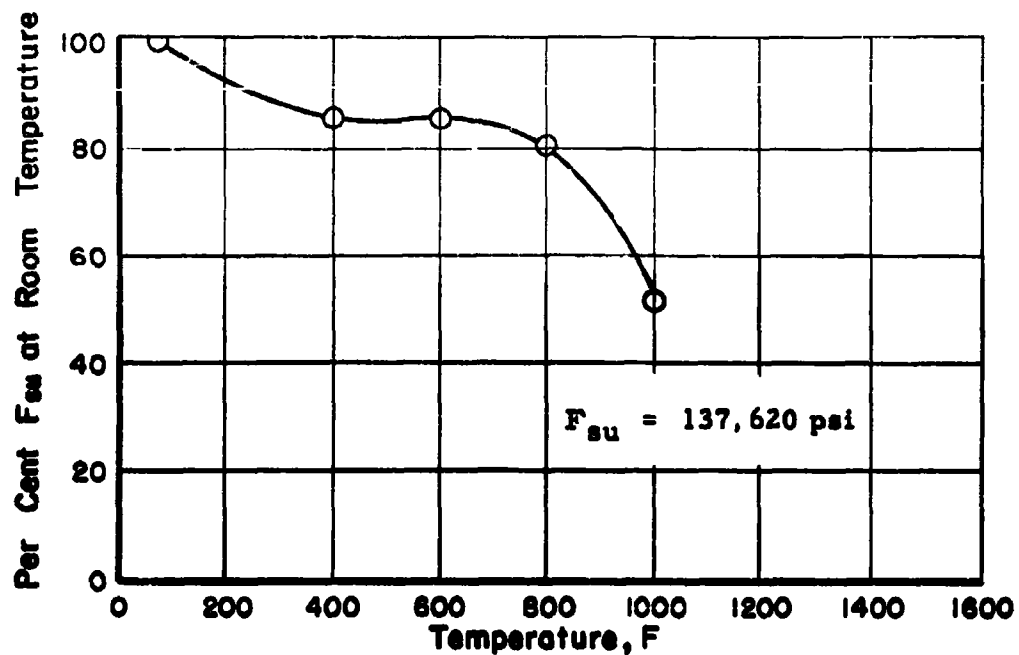


FIGURE 127. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 100 HOURS

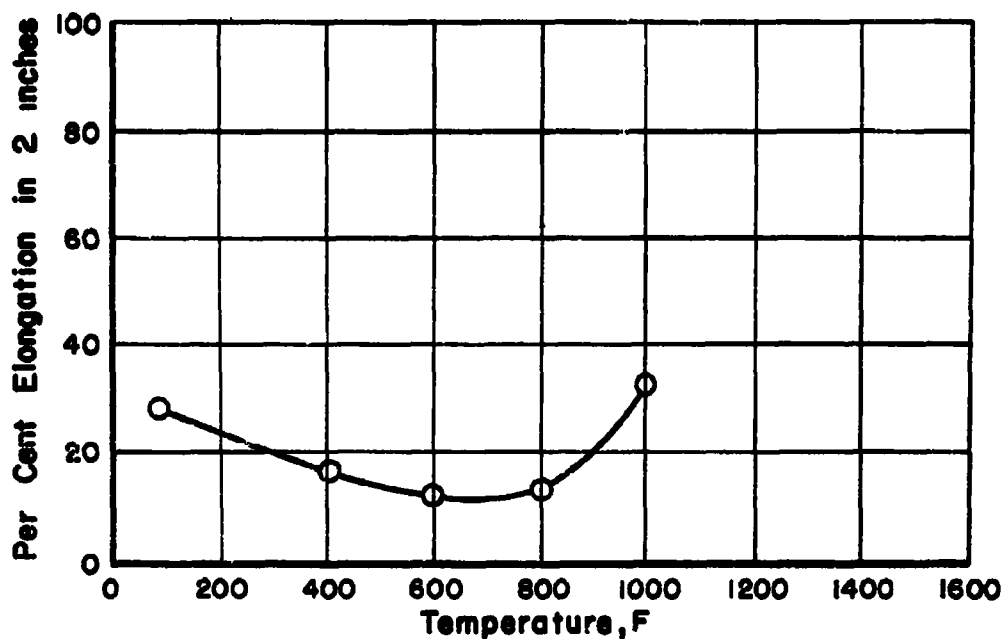


FIGURE 128. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 100 HOURS

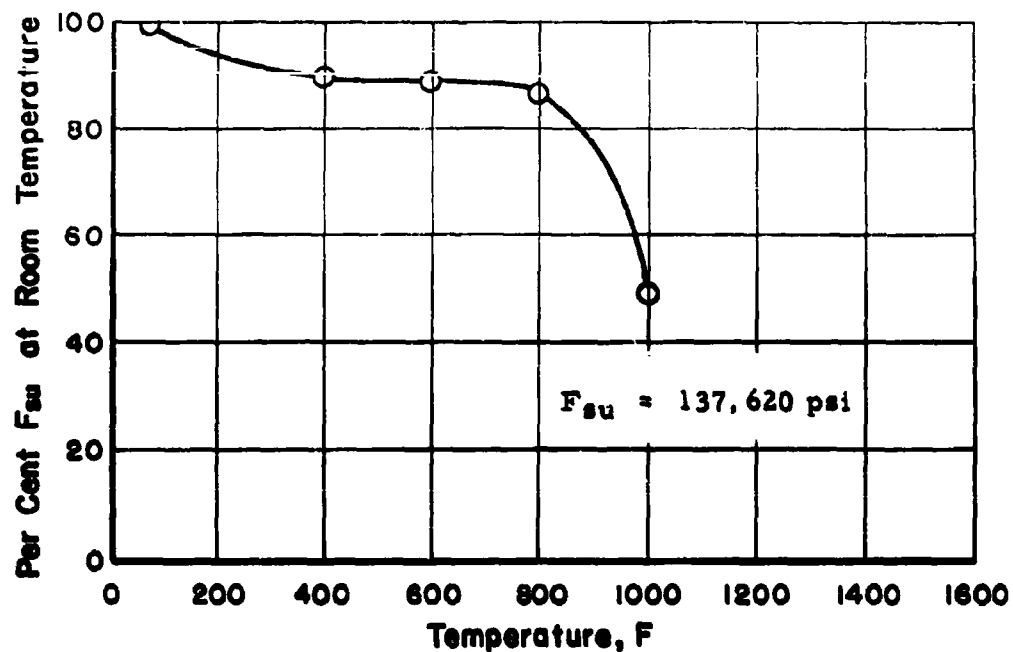


FIGURE 129. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF AM 355 EXPOSED 1000 HOURS

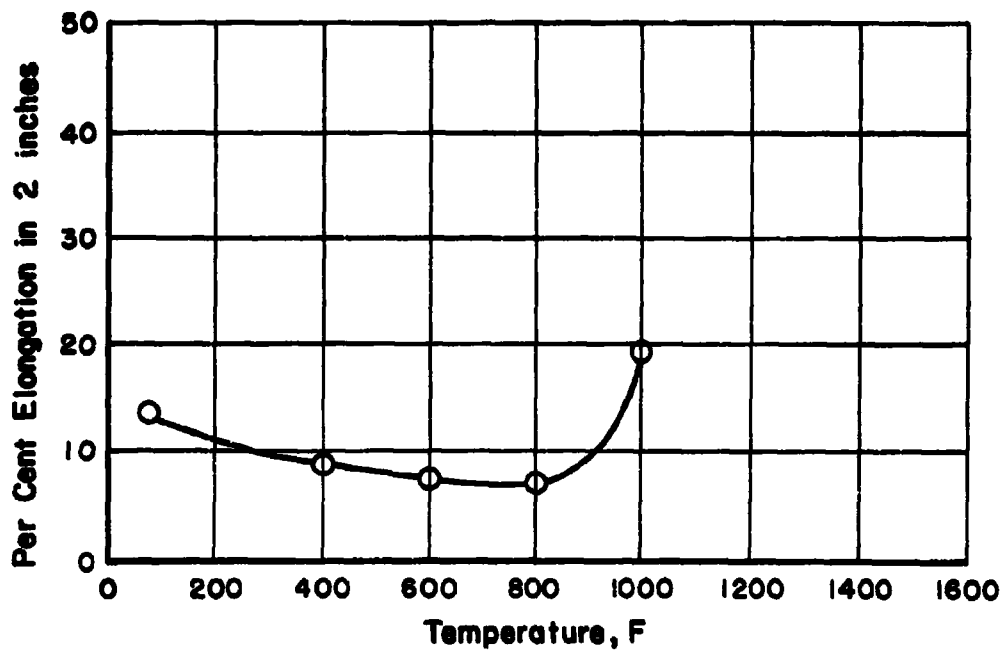


FIGURE 130. EFFECT OF TEMPERATURE ON ELONGATION OF AM 355 EXPOSED 1000 HOURS

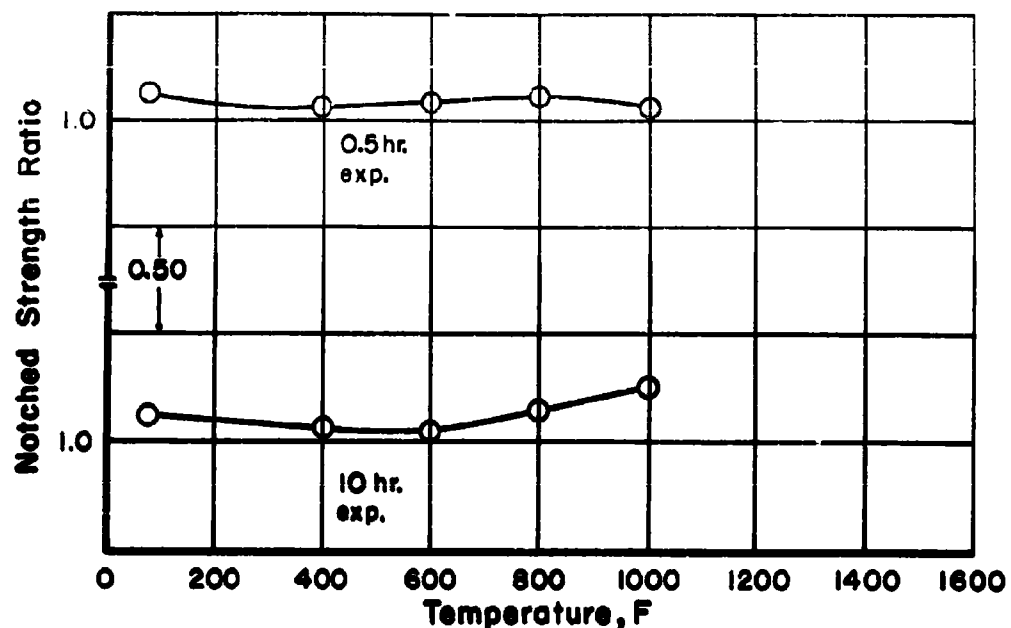


FIGURE 131. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF AM 355 EXPOSED 0.5 AND 10 HOURS

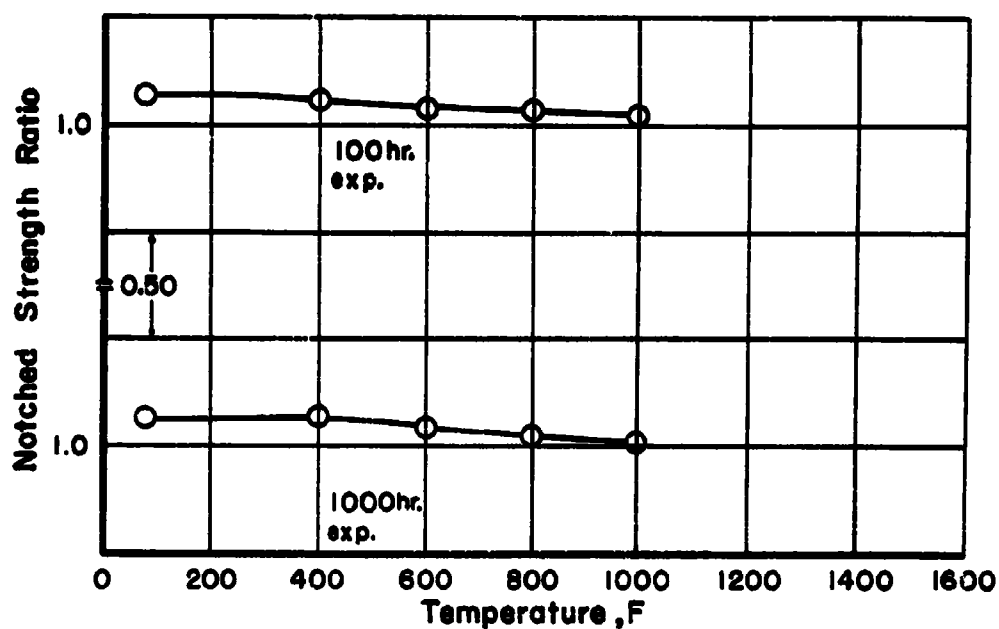


FIGURE 132. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF AM 355 EXPOSED 100 AND 1000 HOURS

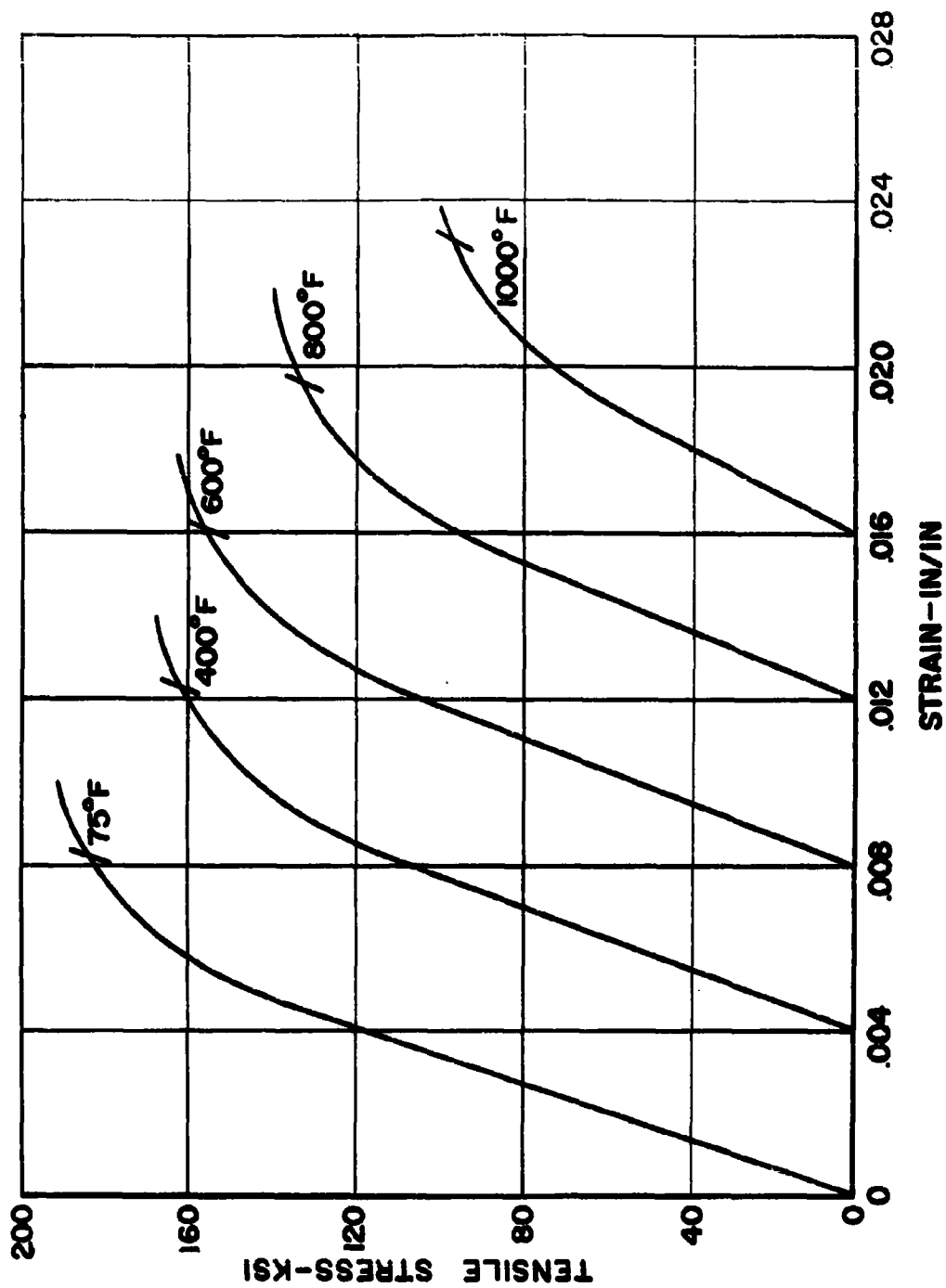


FIGURE 133. TENSILE STRESS-STRAIN CURVES OF AM 355
EXPOSED 0.5 HOURS

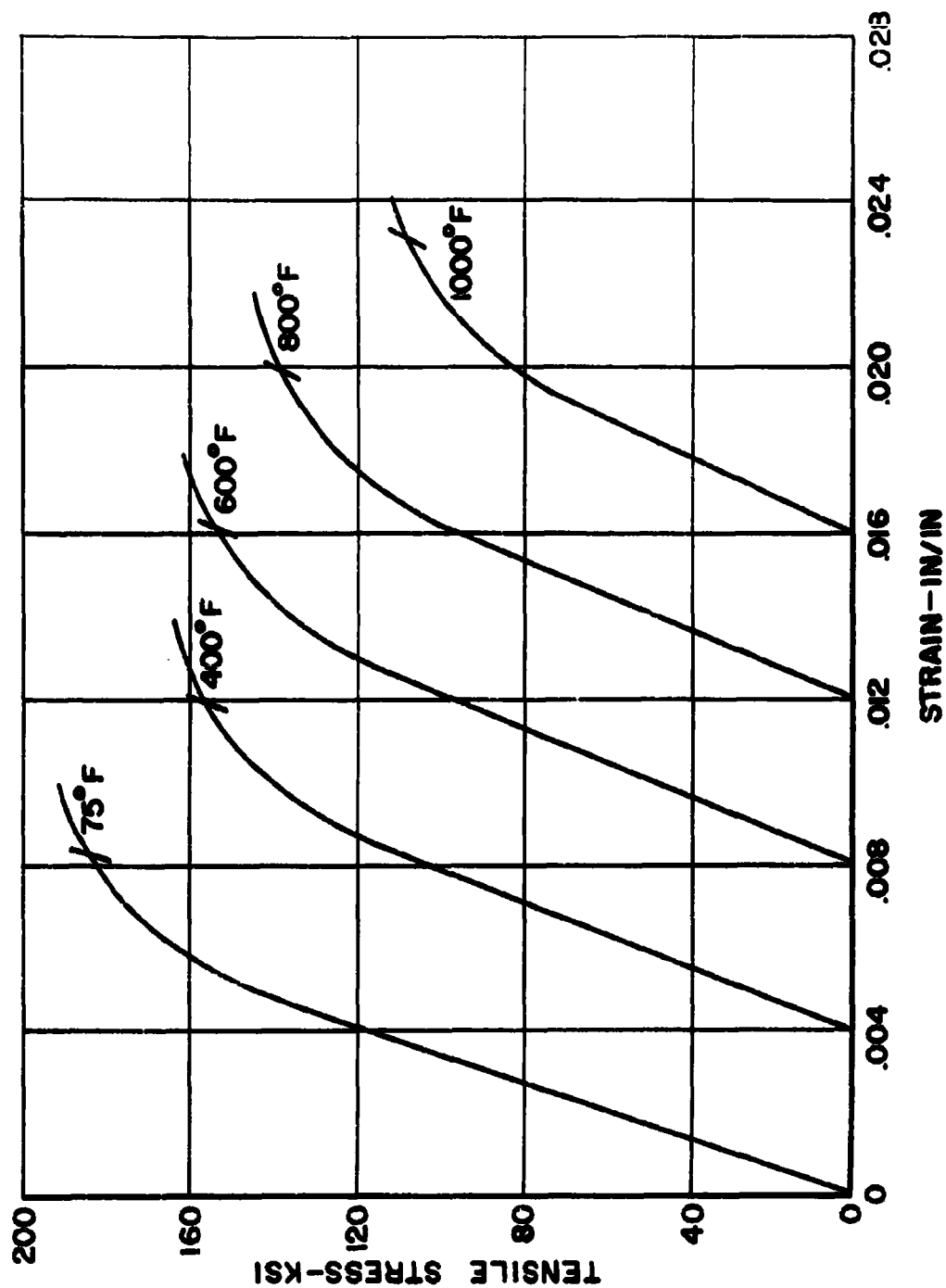


FIGURE 134. TENSILE STRESS-STRAIN CURVES OF AM 355
EXPOSED 10 HOURS

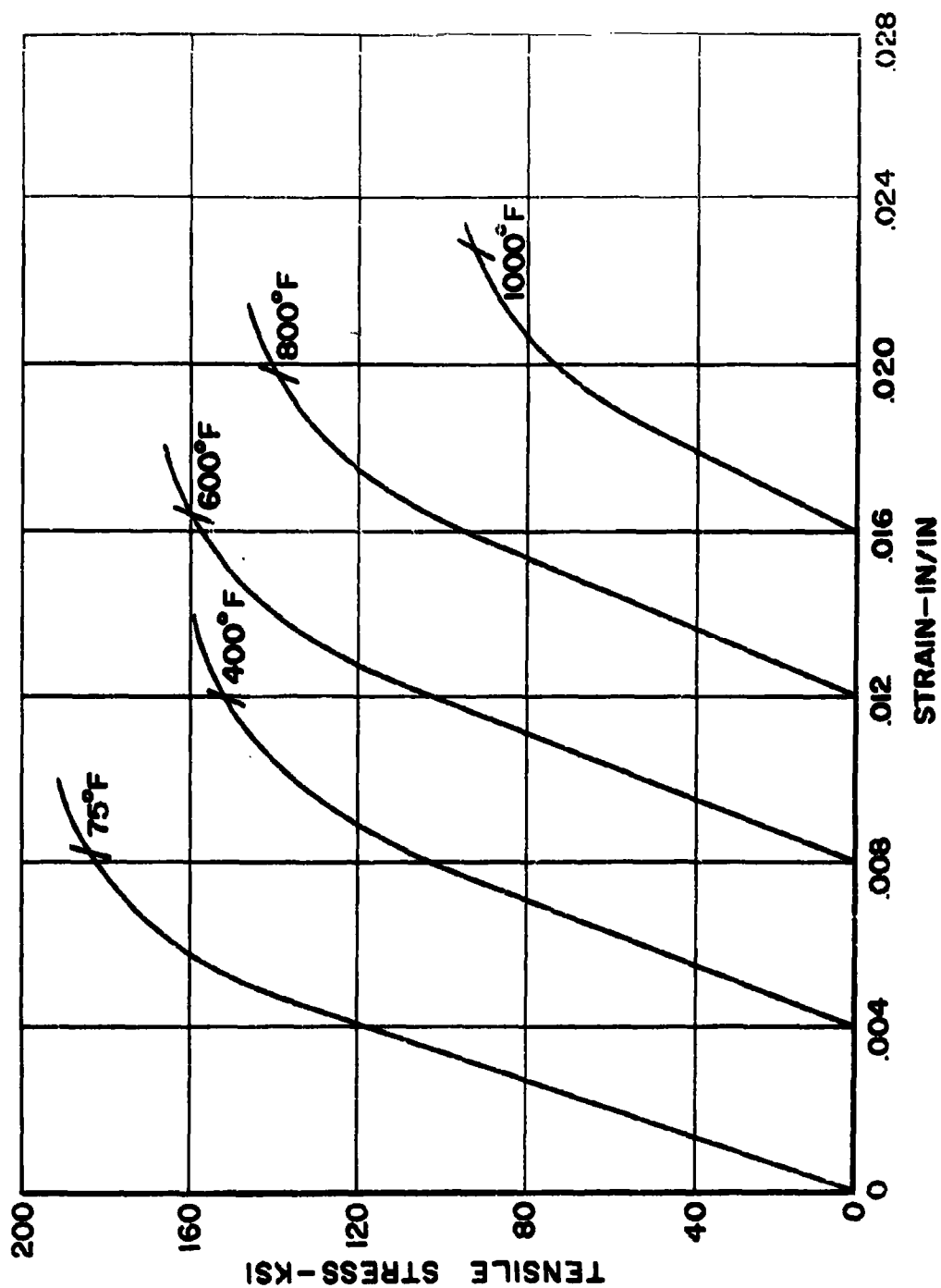


FIGURE 135. TENSILE STRESS-STRAIN CURVES OF AM 355
EXPOSED 100 HOURS

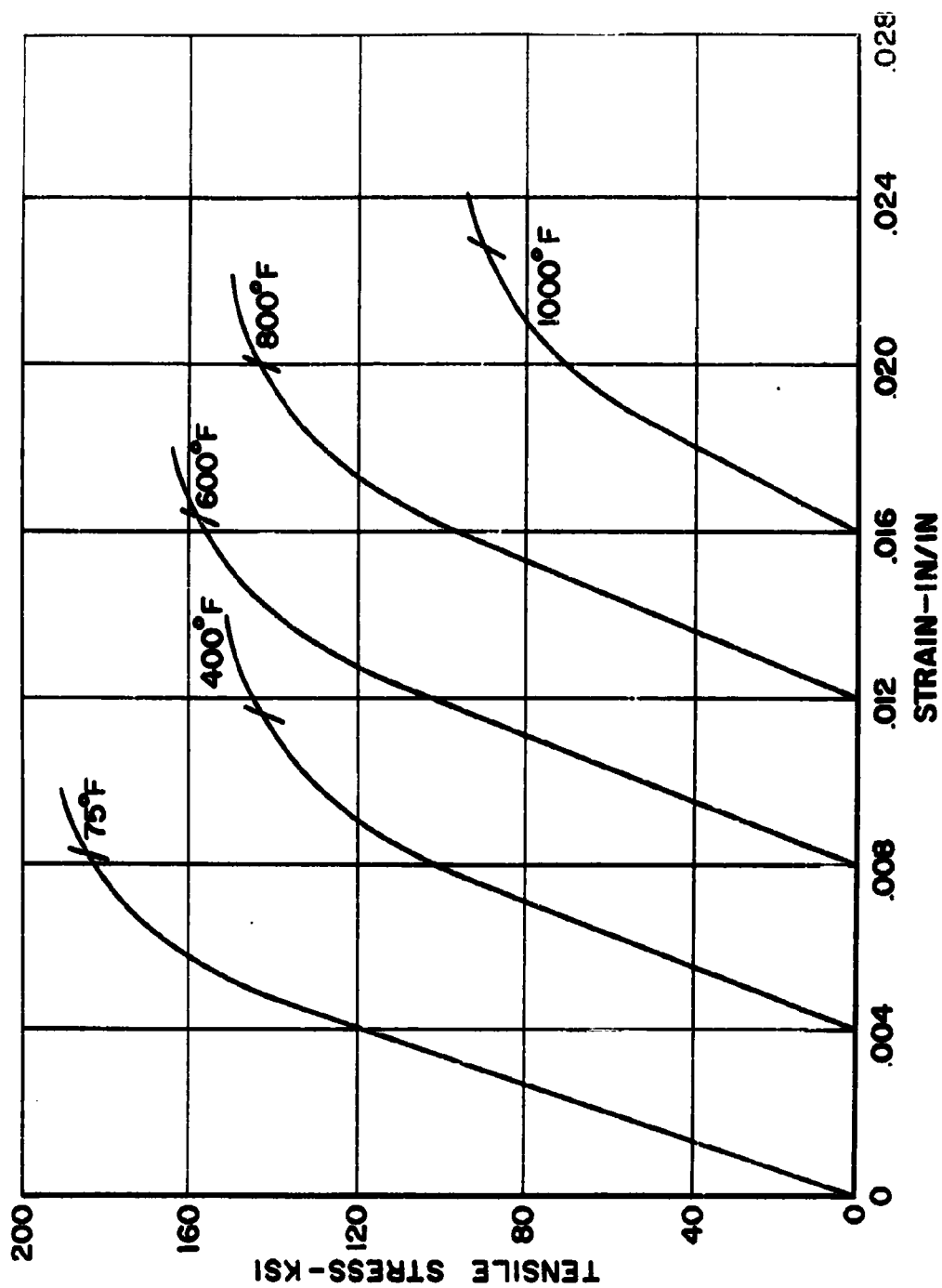


FIGURE 136. TENSILE STRESS-STRAIN CURVES OF AM 355
EXPOSED 1000 HOURS

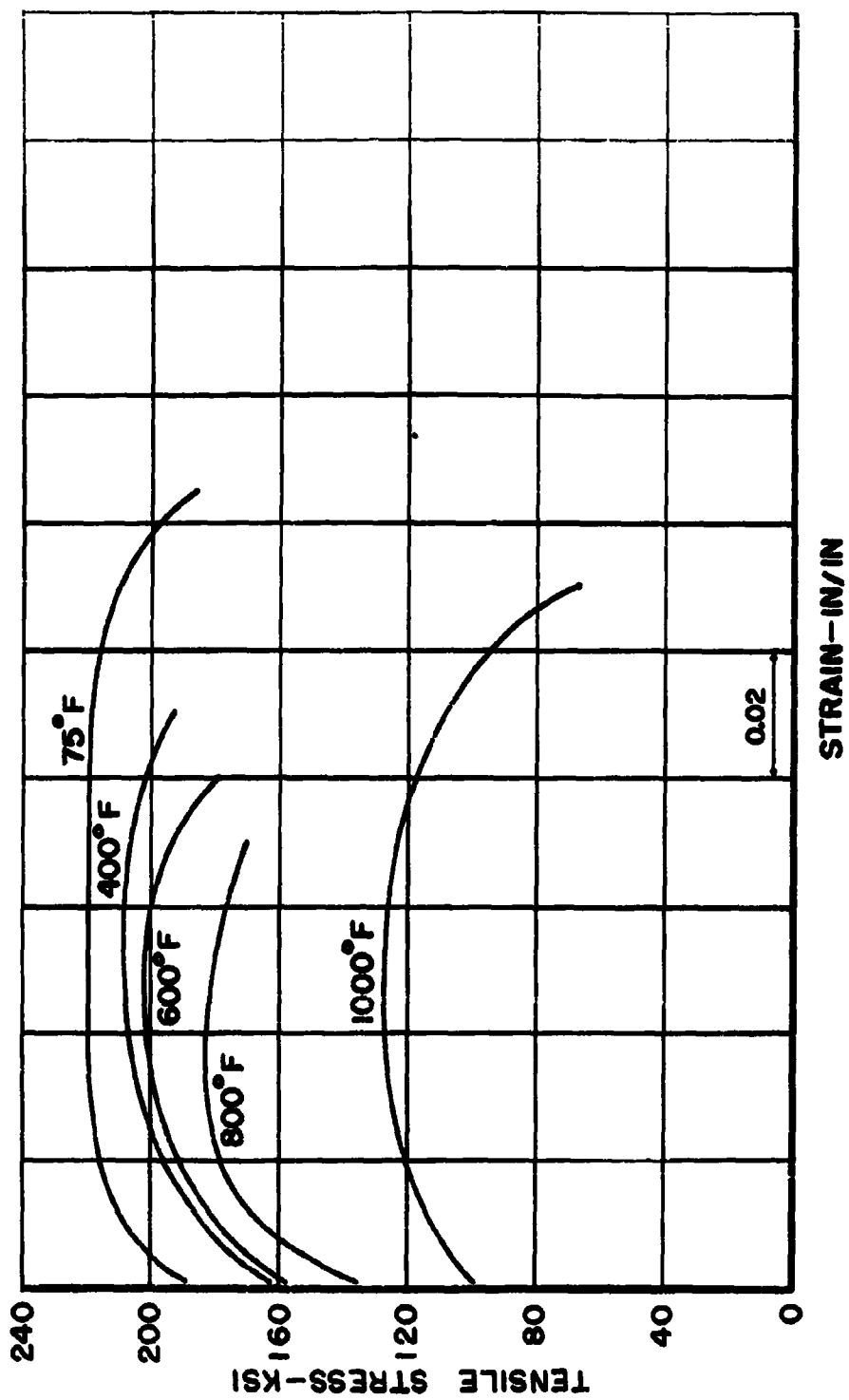


FIGURE 137. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF AM 355 EXPOSED 0.5 HOURS

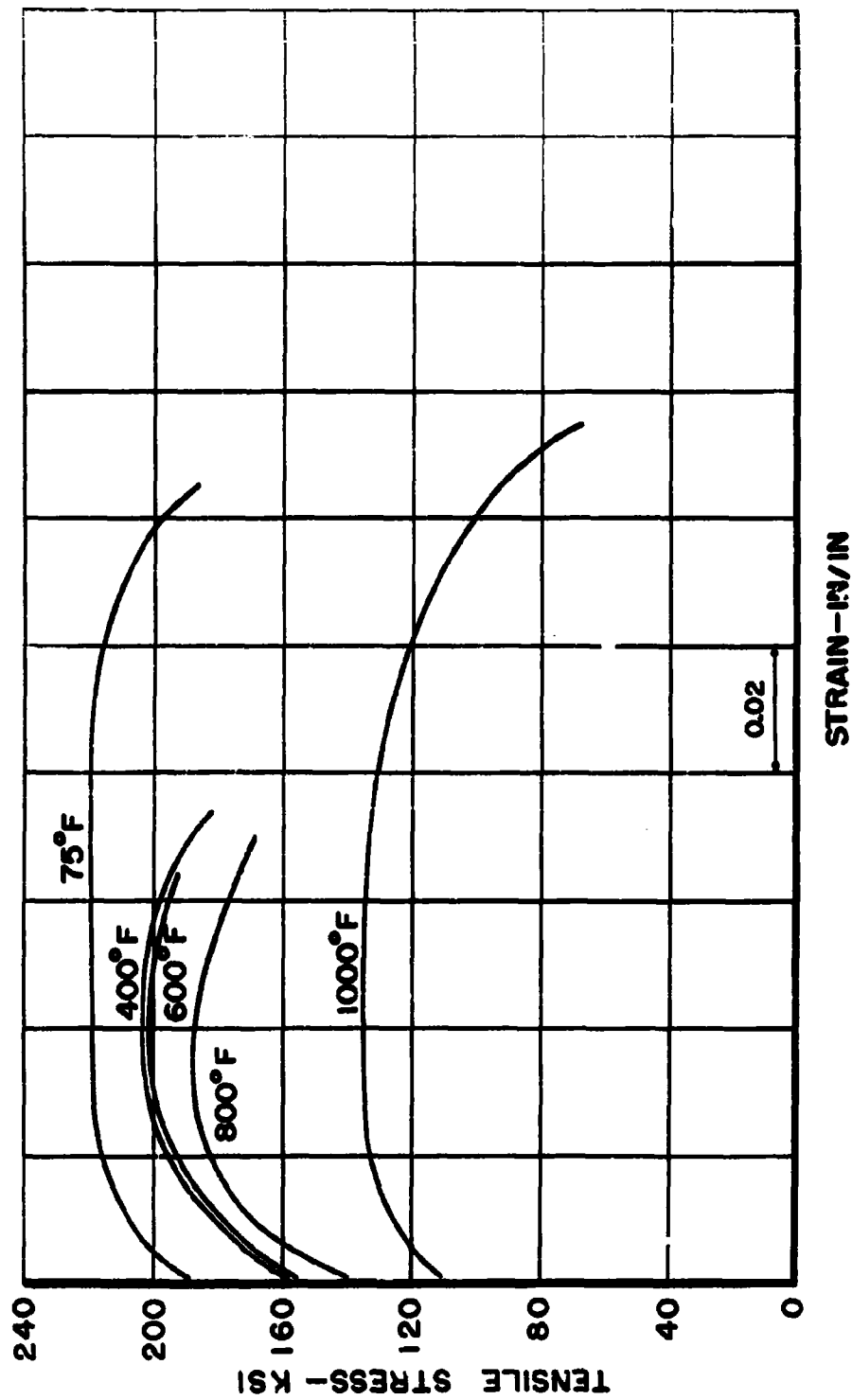


FIGURE 138. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF AM 355 EXPOSED 10 HOURS

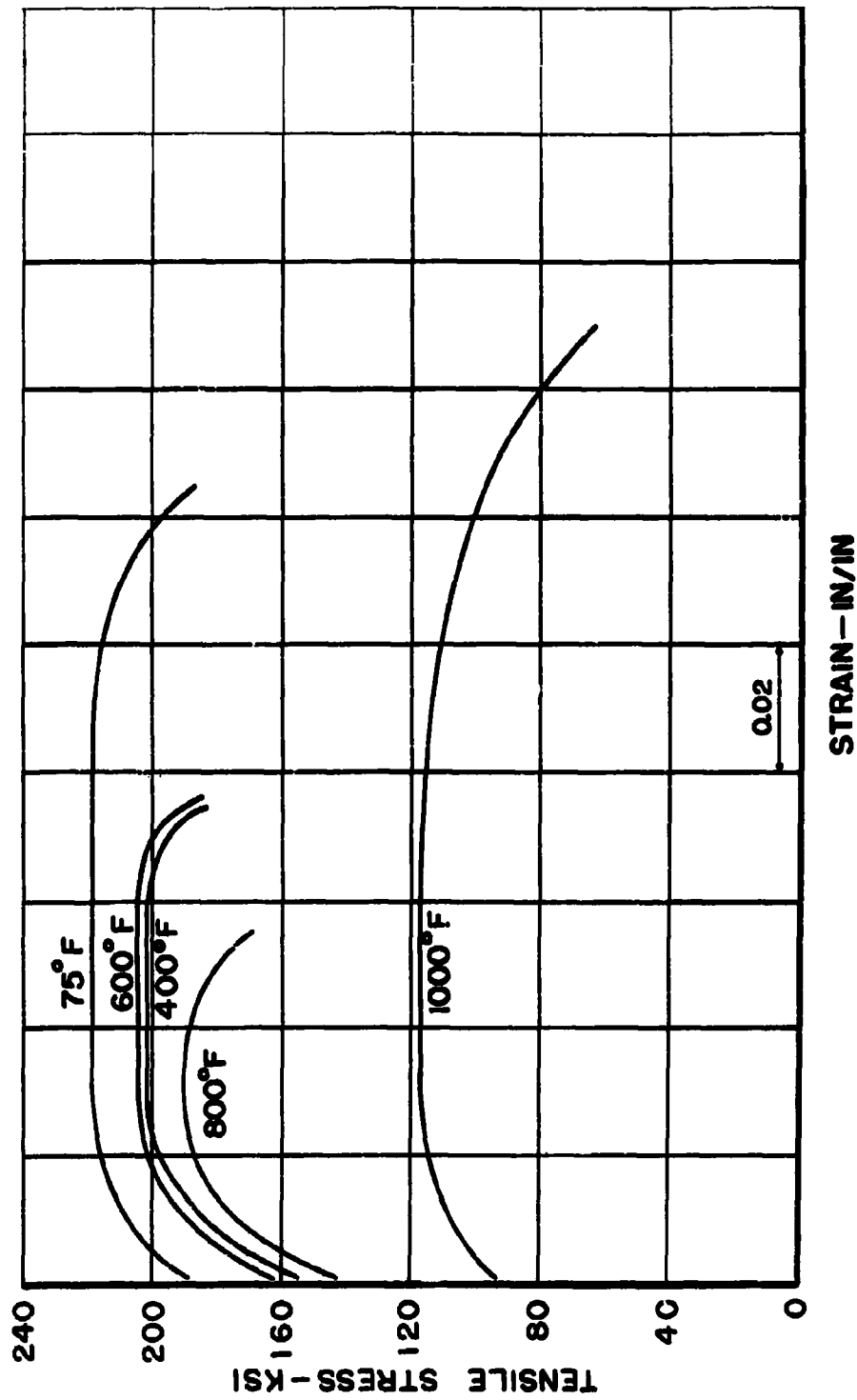


FIGURE 139. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF AM 355 EXPOSED 100 HOURS

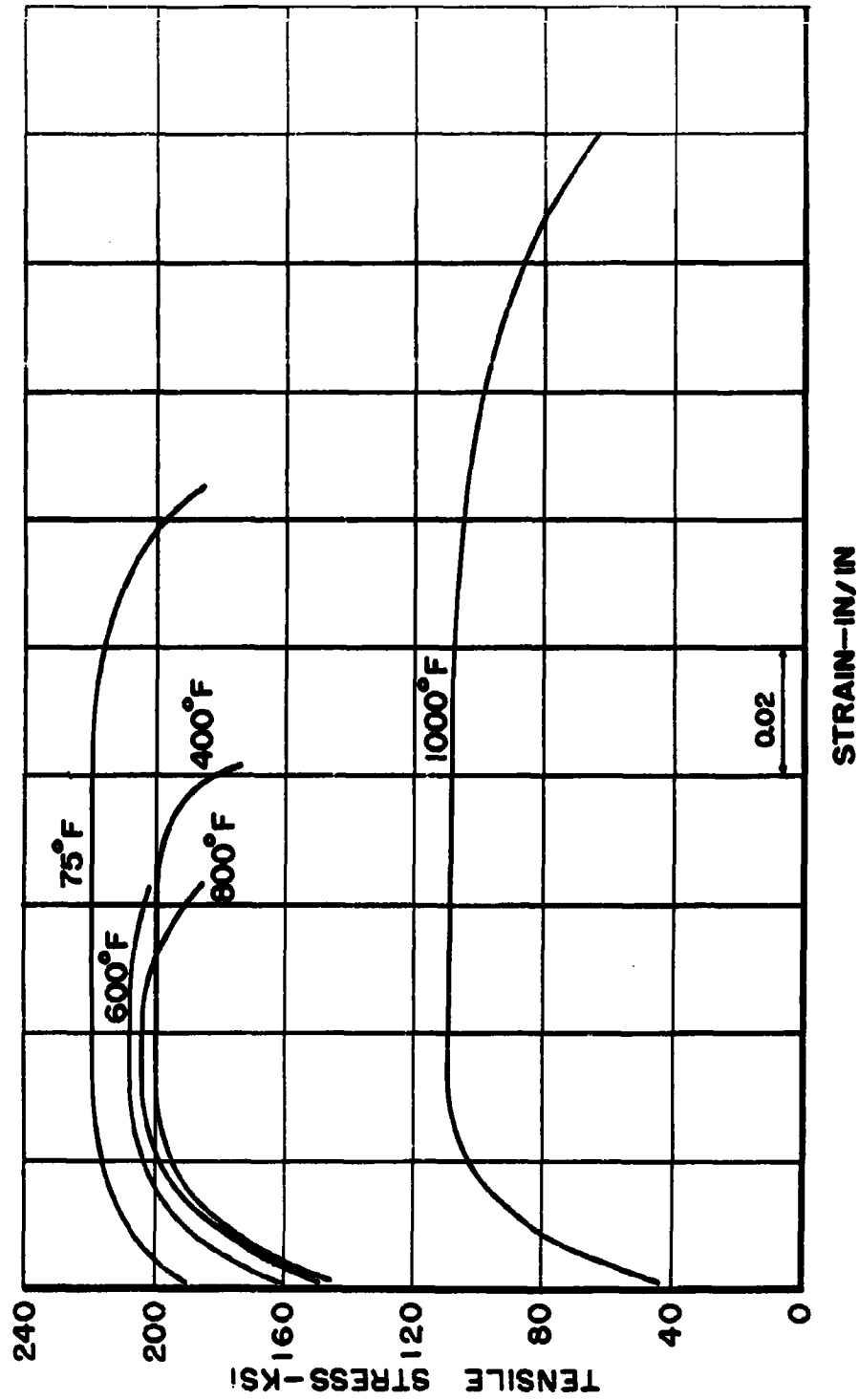


FIGURE 140. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF AM 355 EXPOSED 1000 HOURS

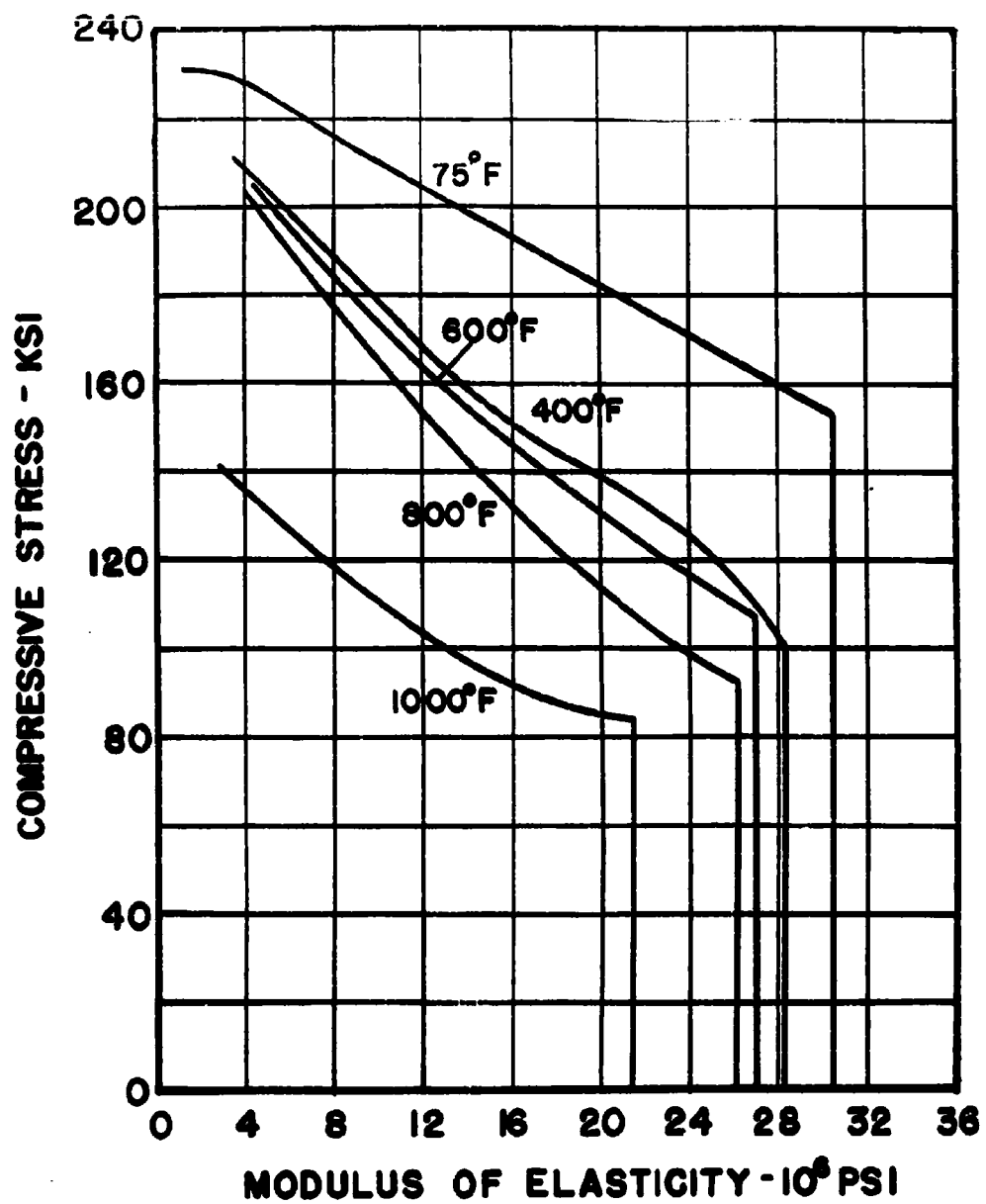


FIGURE 141. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 0.5 HOURS

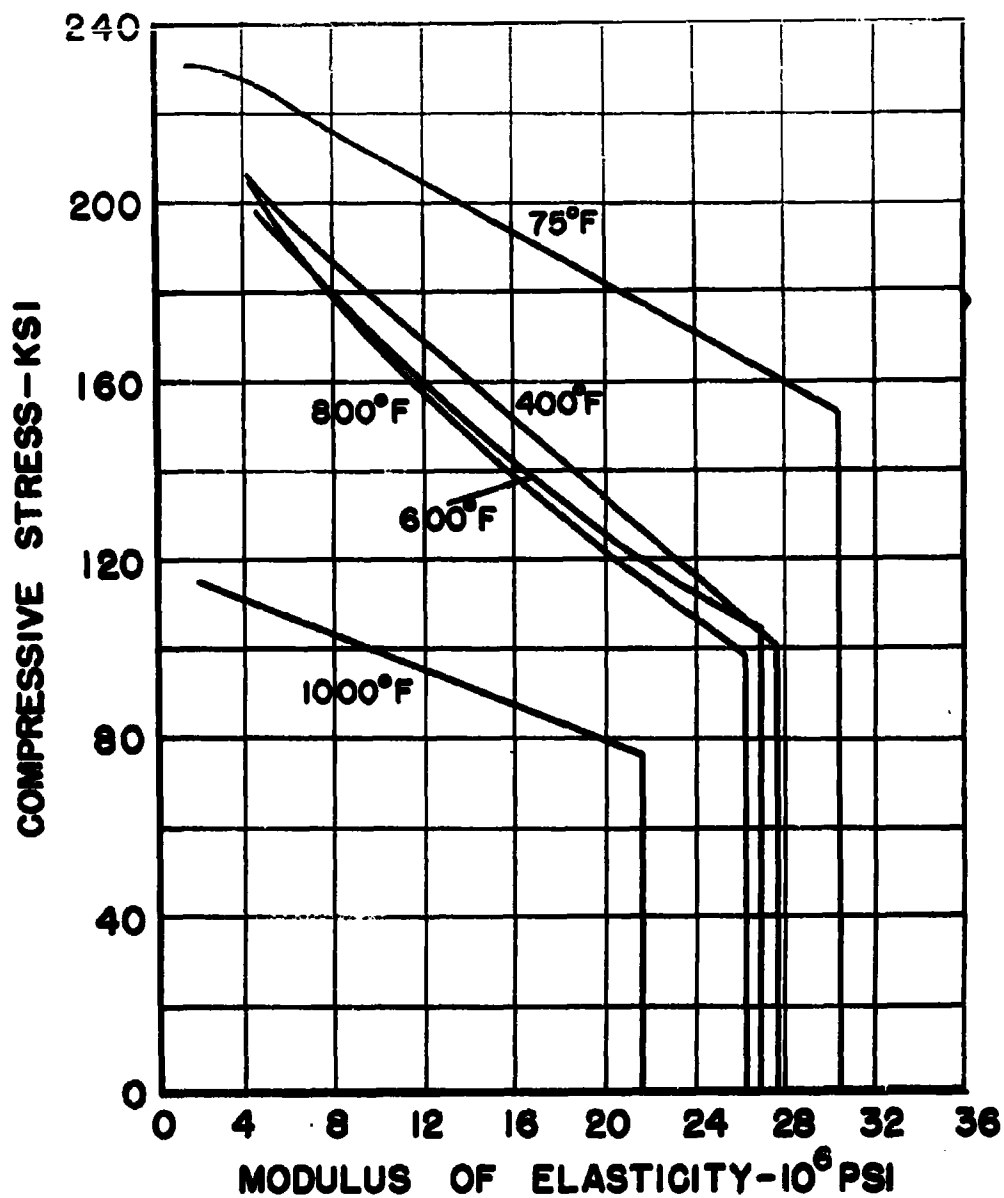


FIGURE 142. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 10 HOURS

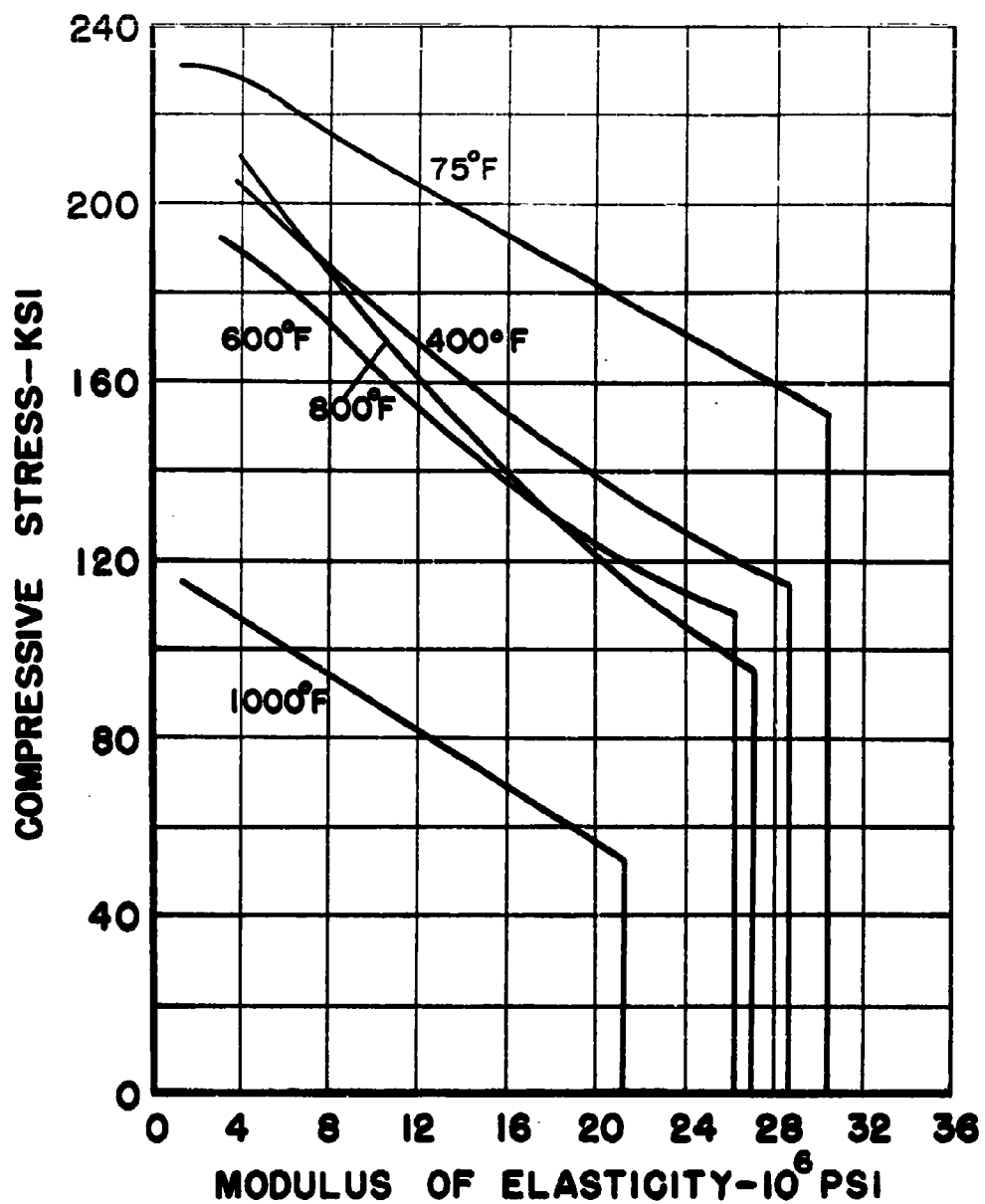


FIGURE 143. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 100 HOURS

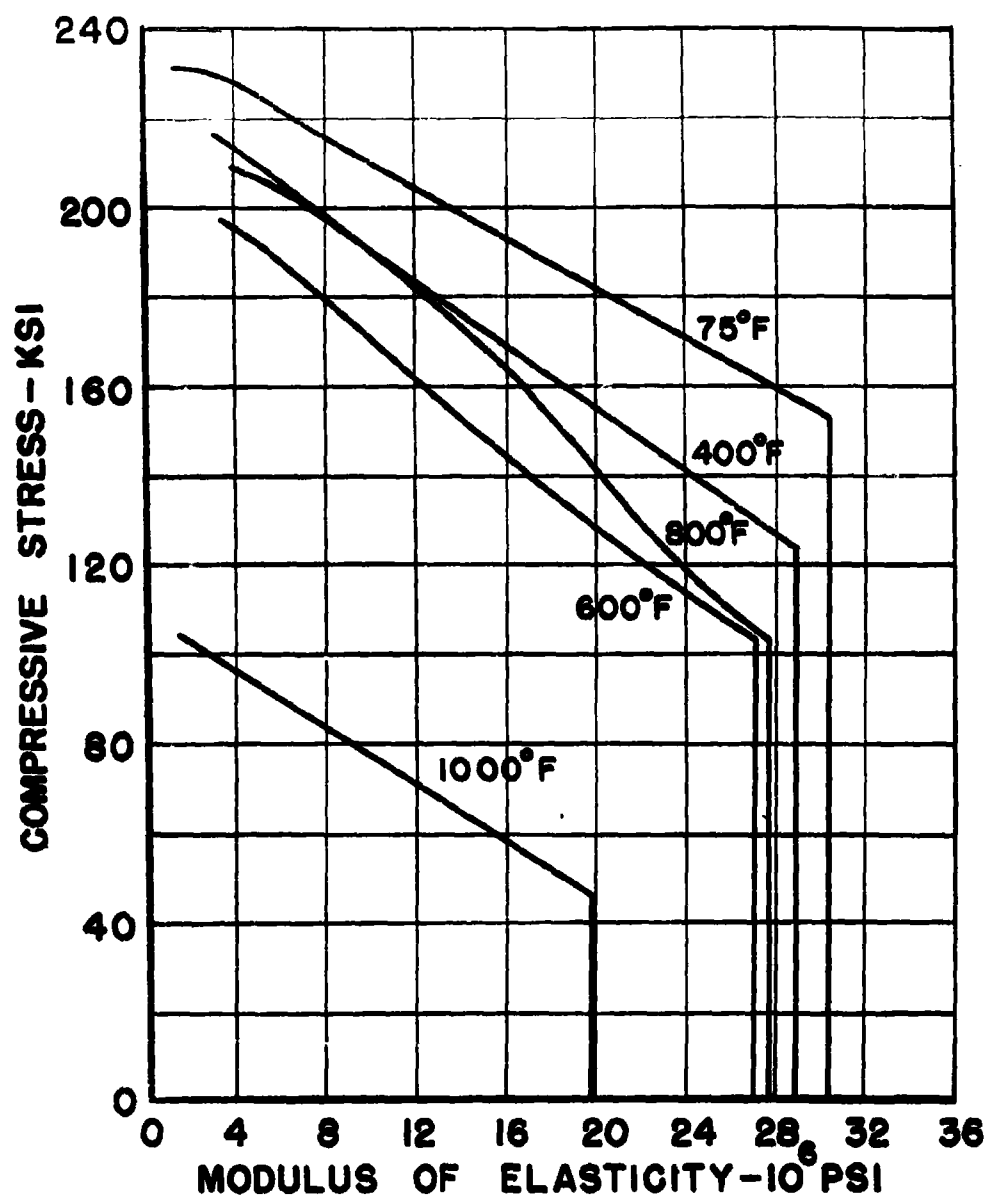


FIGURE 144. COMPRESSIVE TANGENT MODULUS CURVES OF AM 355 EXPOSED 1000 HOURS

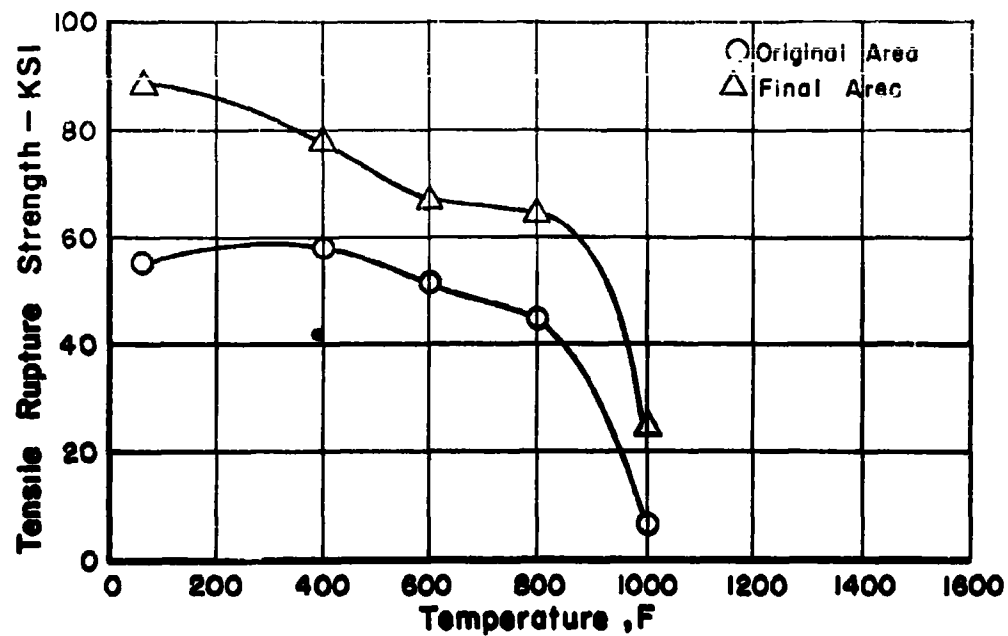


FIGURE 145. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

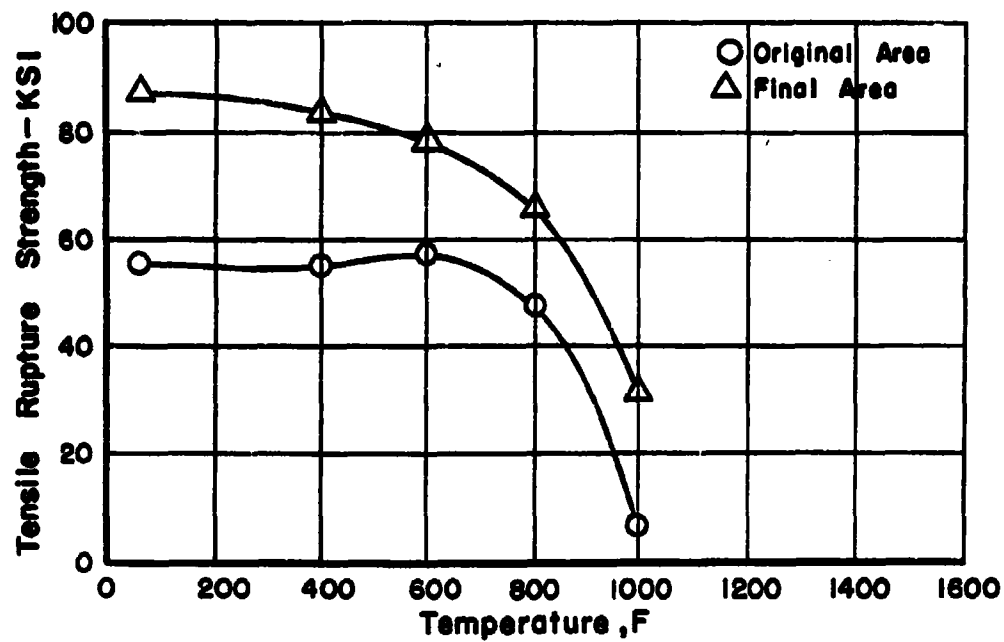


FIGURE 146. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

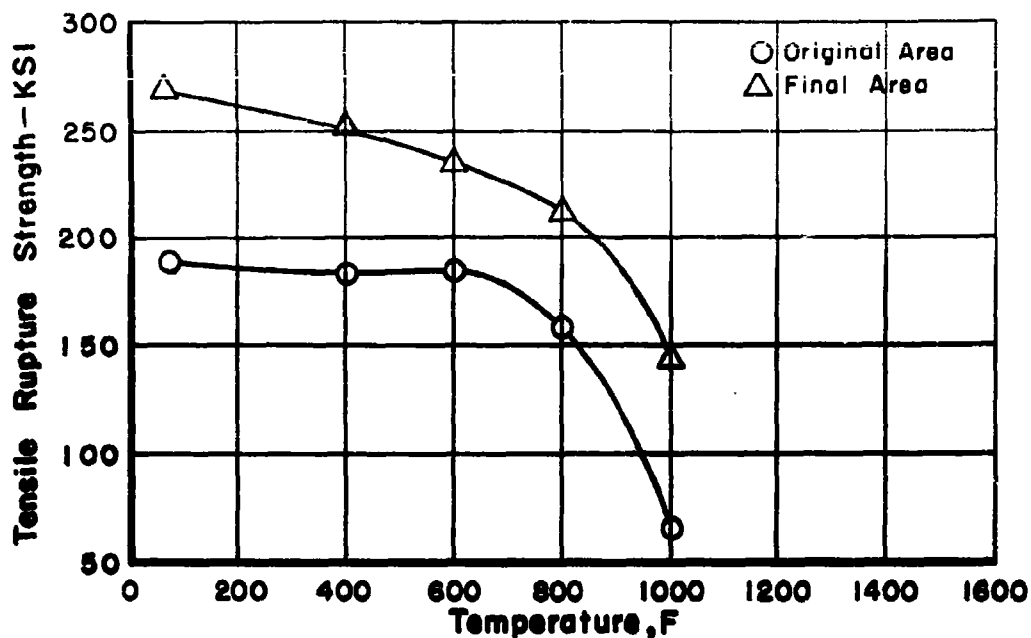


FIGURE 147. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

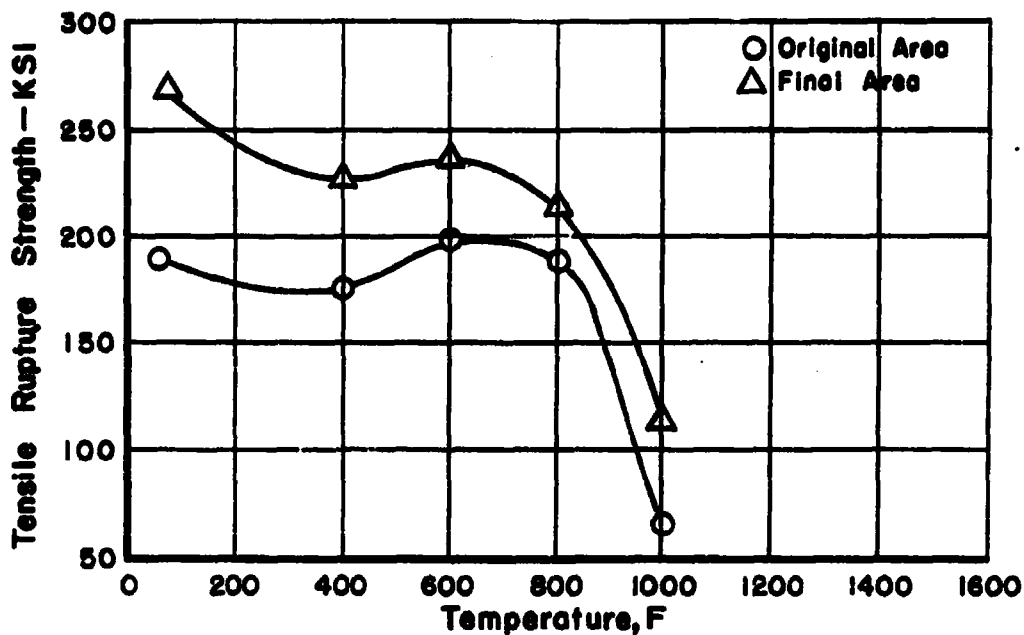


FIGURE 148. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF AM 355 EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX III

SUMMARY OF ROOM TEMPERATURE PROPERTIES OF RENÉ 41

Form: 0.051 Inch Sheet

Condition: C

Properties:

Ultimate Tensile Strength	-	F_{tu}	=	184,850 psi
Tensile Yield Strength	-	F_{ty}	=	141,790 psi
Modulus of Elasticity	-	E	=	29.97×10^6 psi
Percent Elongation in 2 inches			=	10.4
Notched Tensile Strength	-	F_{tu}	=	190,290 psi
Compressive Yield Strength	-	F_{cy}	=	147,070 psi
Compressive Modulus of Elasticity	-	E_c	=	31.63×10^6 psi
Ultimate Bearing Strength				
(e/D = 1.5)	-	F_{bru}	=	297,660 psi
(e/D = 2.0)	-	F_{bru}	=	369,760 psi
Bearing Yield Strength				
(e/D = 1.5)	-	F_{bry}	=	236,200 psi
(e/D = 2.0)	-	F_{bry}	=	290,360 psi
Ultimate Shear Strength	-	F_{su}	=	115,180 psi

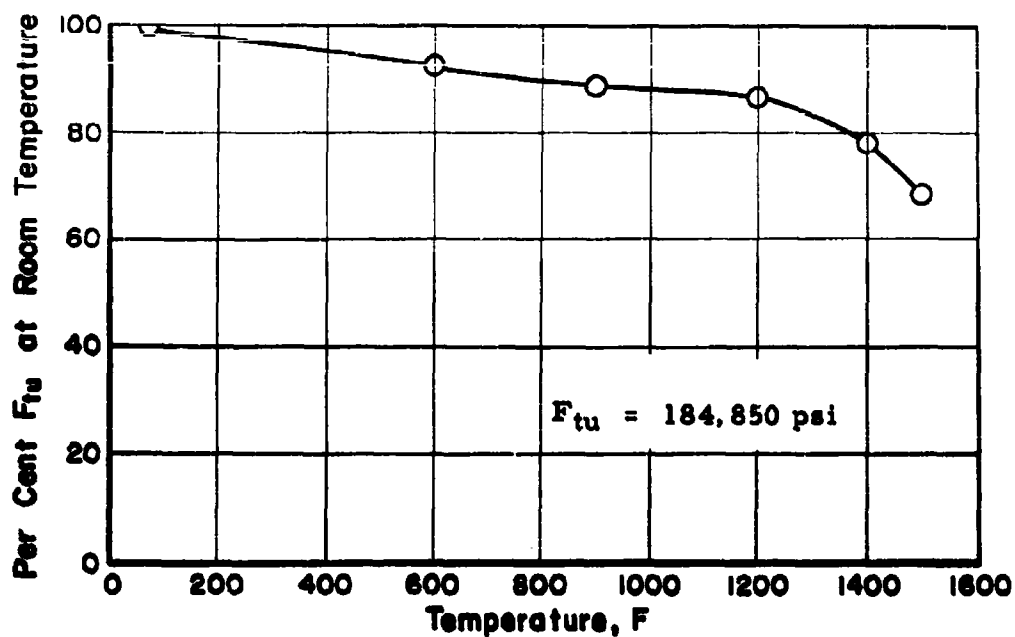


FIGURE 149. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

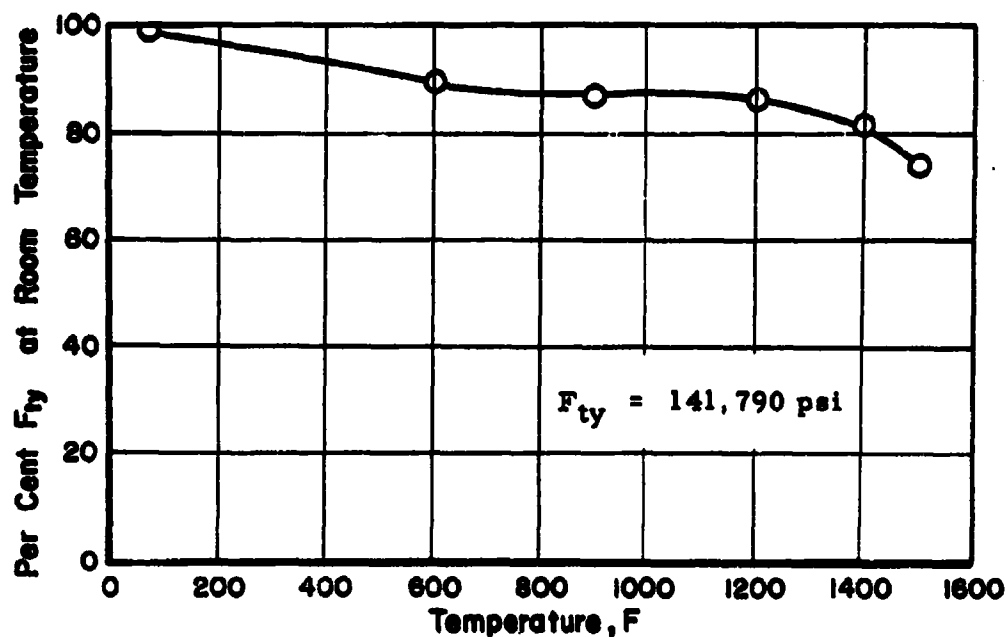


FIGURE 150. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

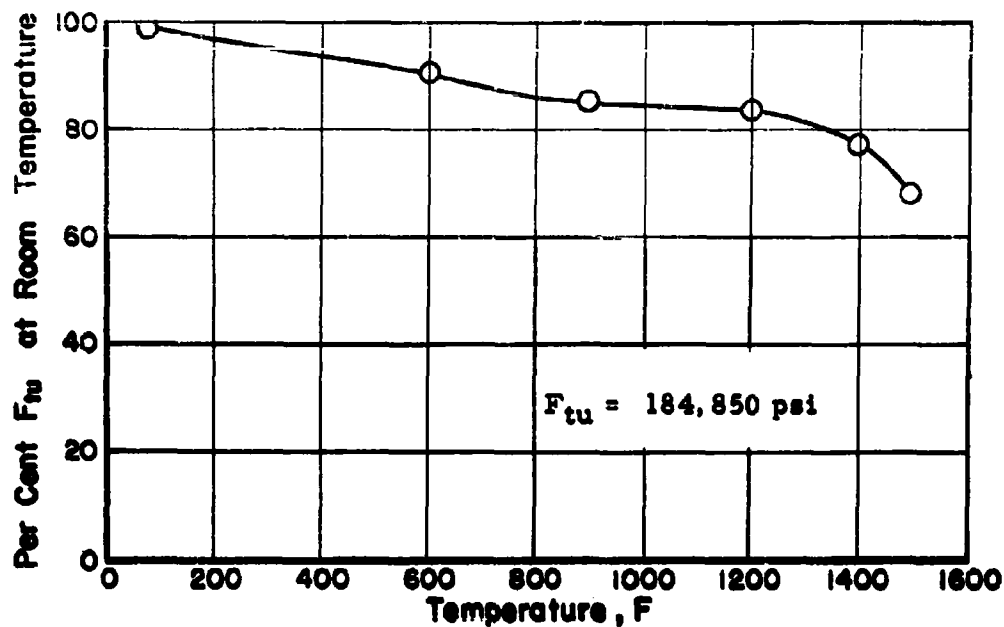


FIGURE 151. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

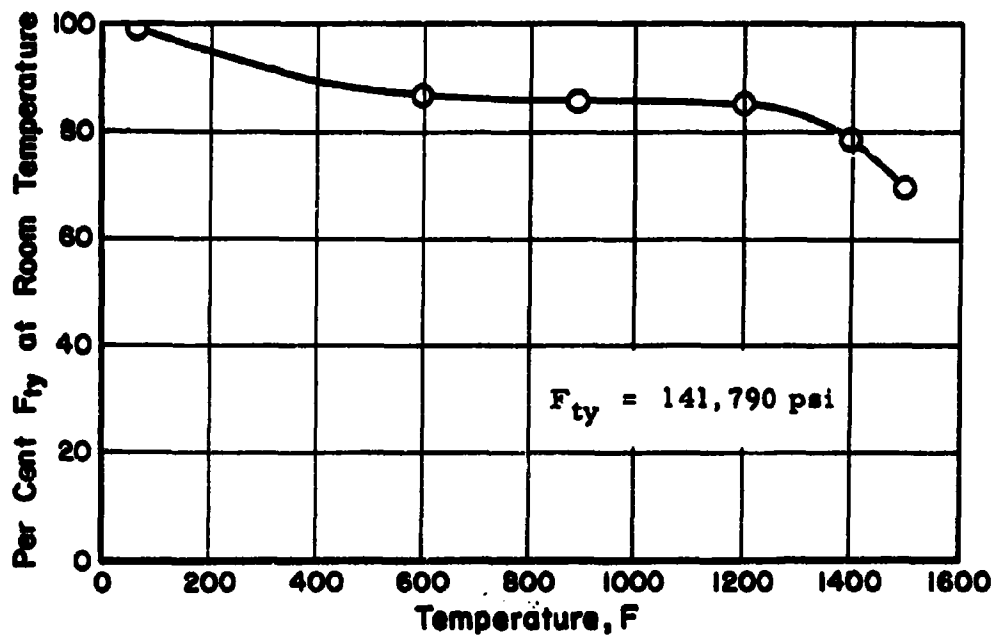


FIGURE 152. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

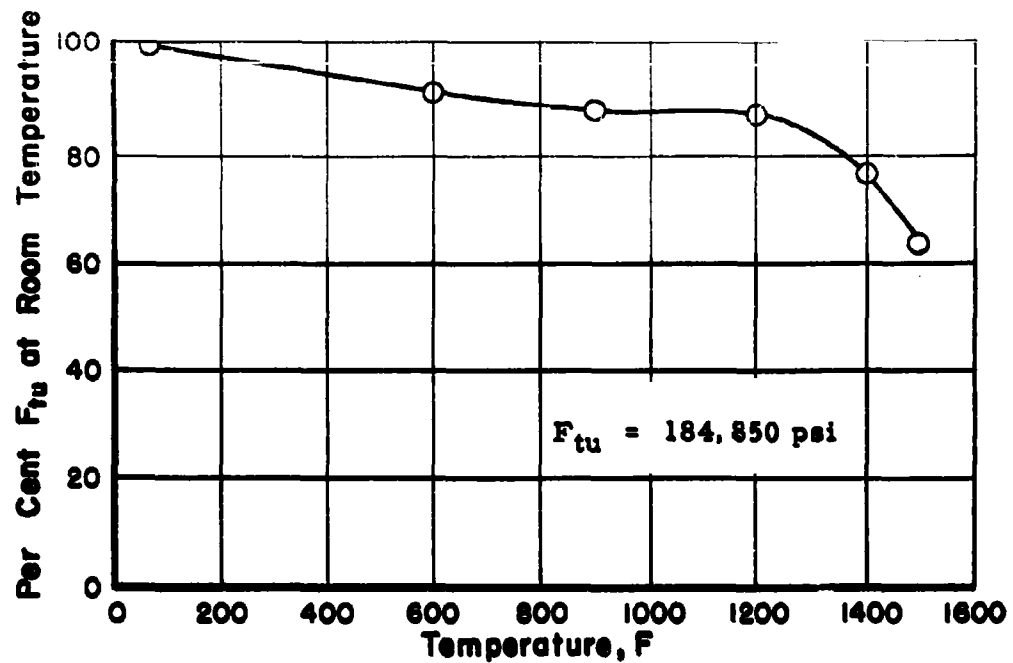


FIGURE 153. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

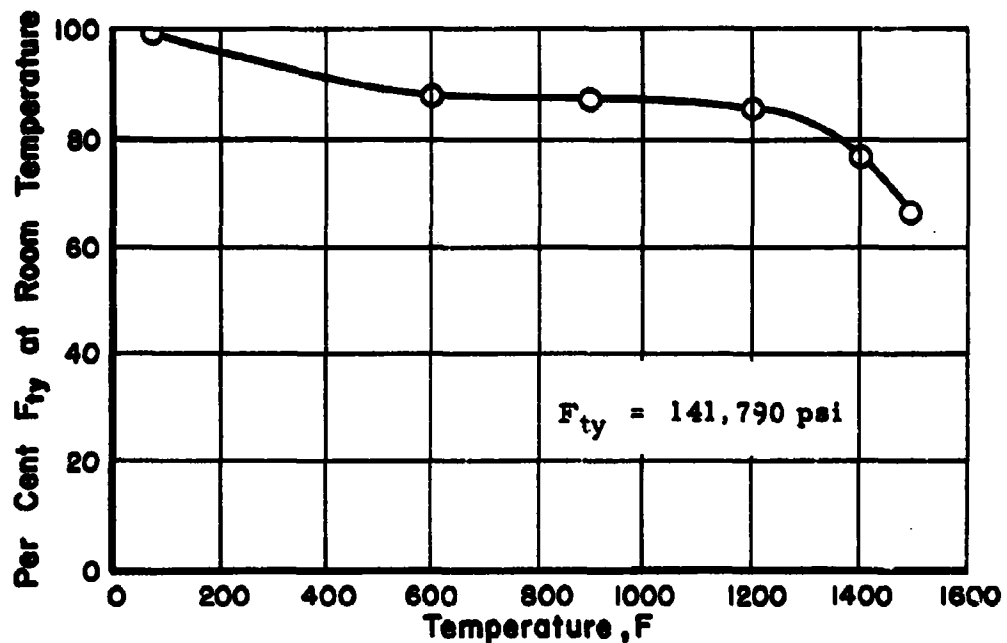


FIGURE 154. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

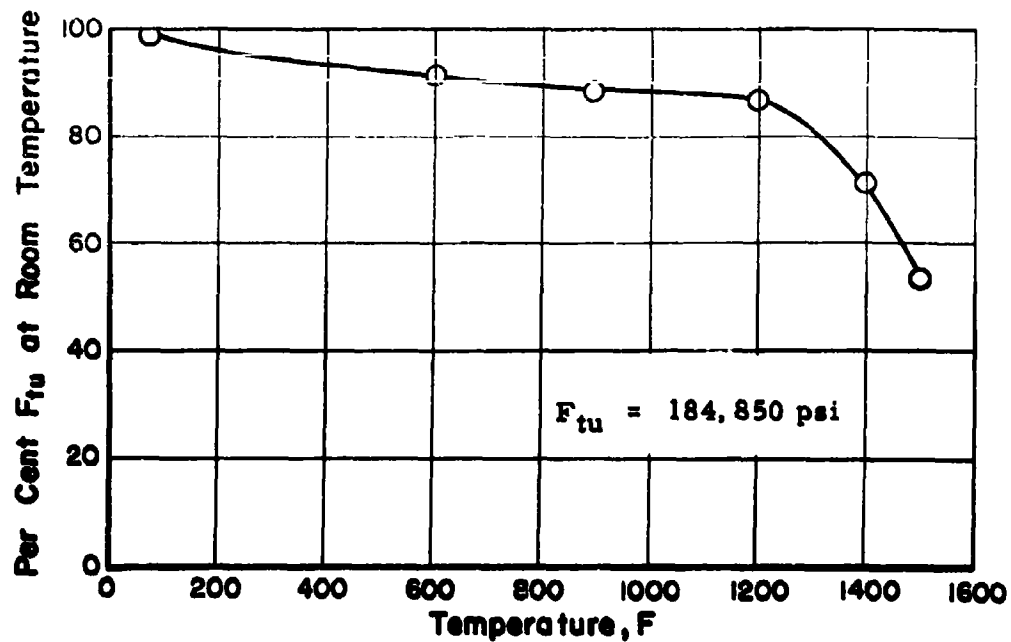


FIGURE 155. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

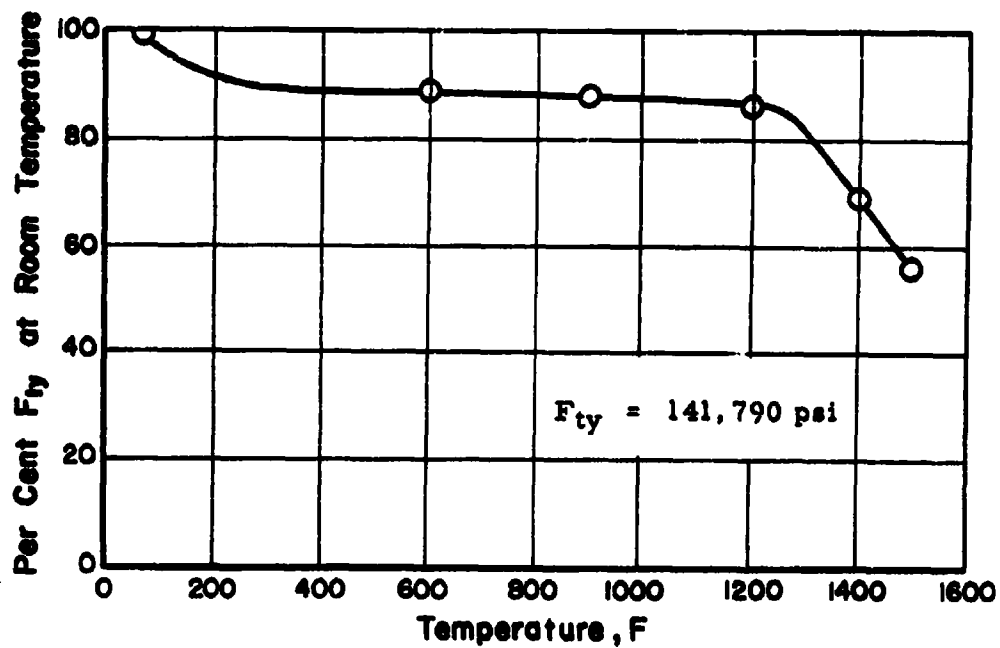


FIGURE 156. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

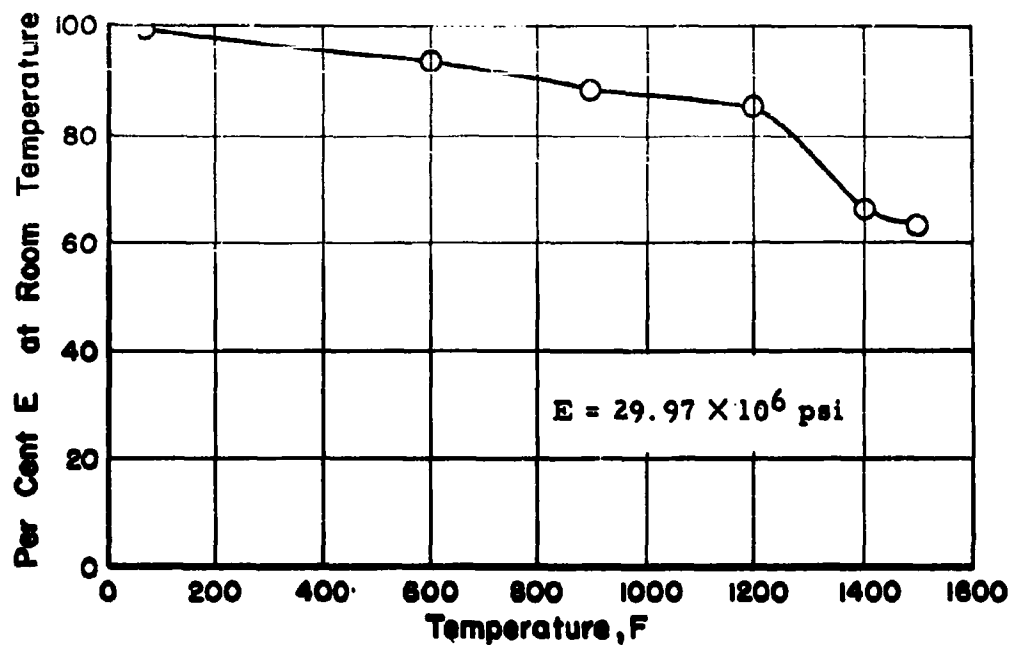


FIGURE 157. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF RENÉ 41
EXPOSED 0.5 HOURS

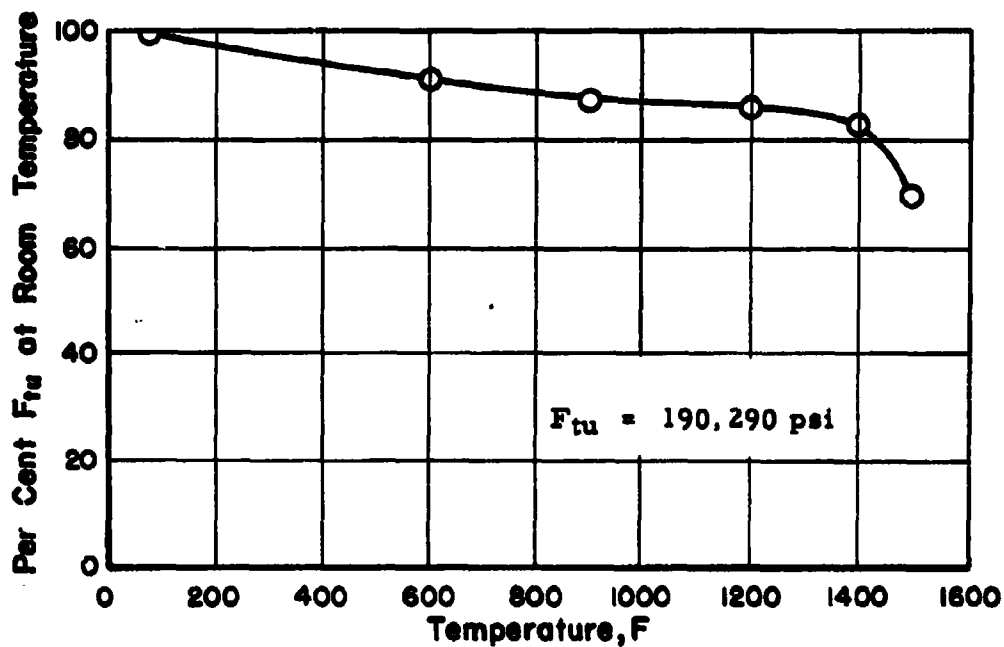


FIGURE 158. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF RENÉ 41 EXPOSED 0.5 HOURS

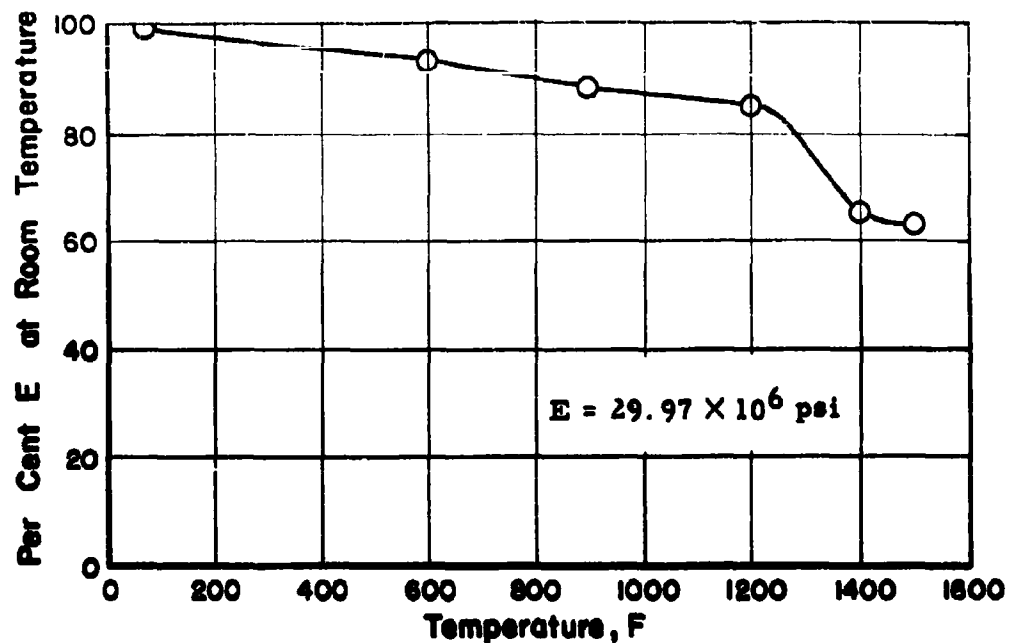


FIGURE 159. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF RENÉ 41
EXPOSED 10 HOURS

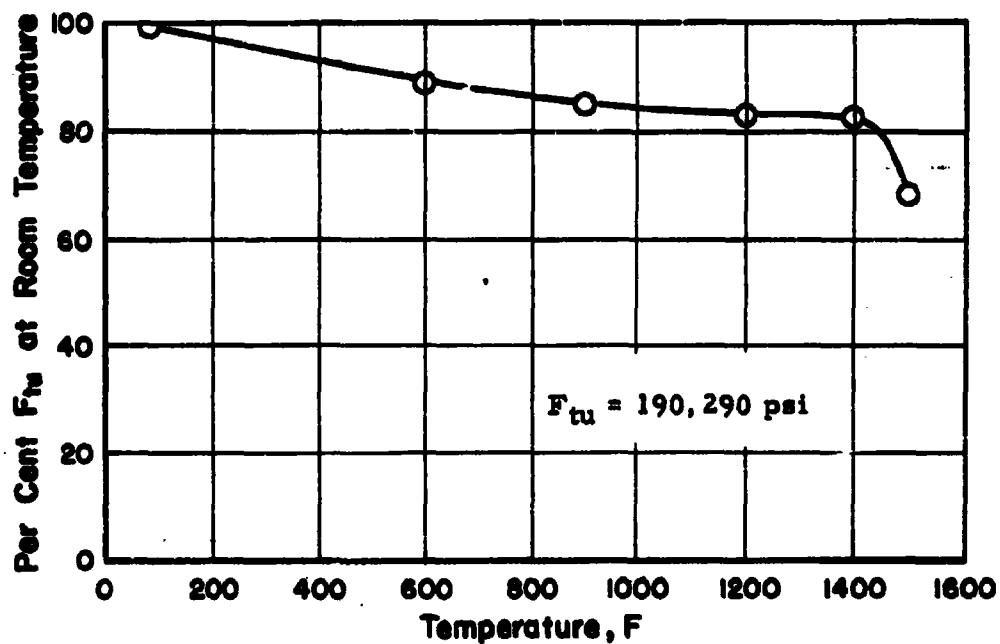


FIGURE 160. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF RENÉ 41 EXPOSED 10 HOURS

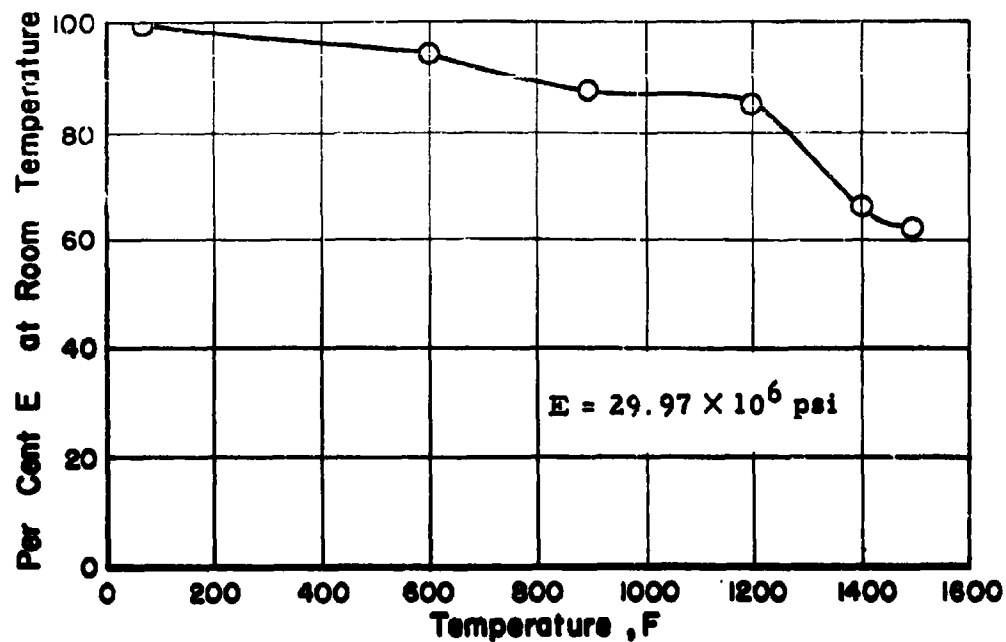


FIGURE 161. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF RENÉ 41
EXPOSED 100 HOURS

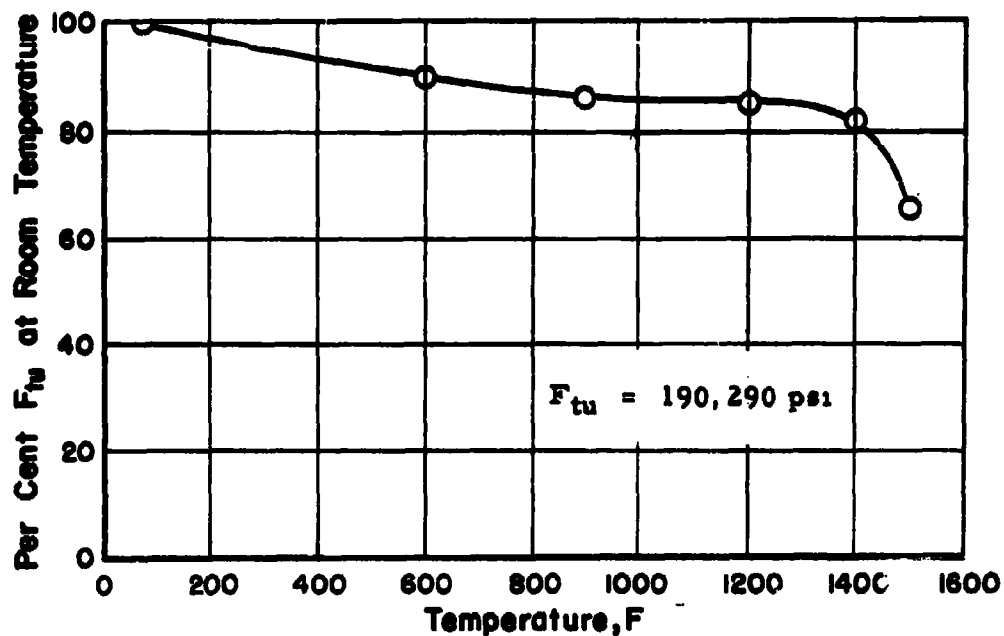


FIGURE 162. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF RENÉ 41 EXPOSED 100 HOURS

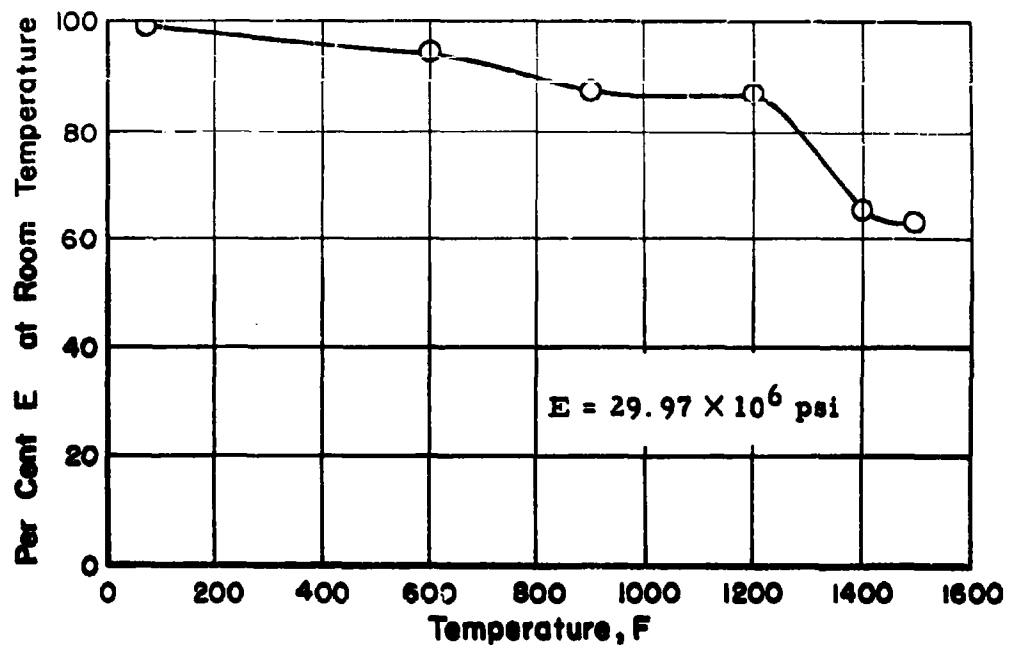


FIGURE 163. EFFECT OF TEMPERATURE ON
MODULUS OF ELASTICITY OF RENÉ 41
EXPOSED 1000 HOURS

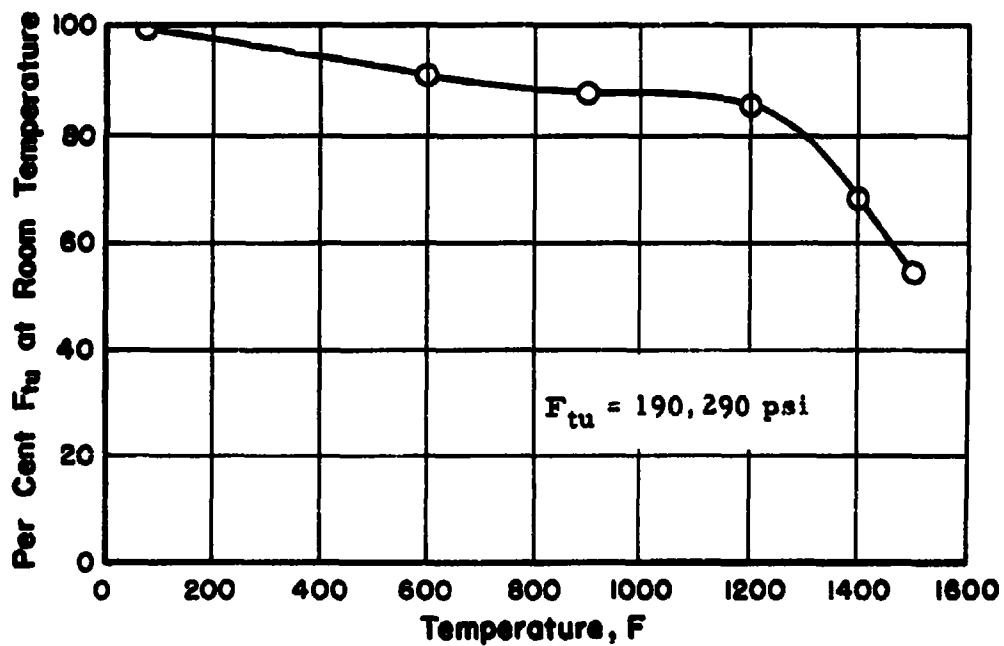


FIGURE 164. EFFECT OF TEMPERATURE ON
NOTCHED ULTIMATE TENSILE STRENGTH
OF RENÉ 41 EXPOSED 1000 HOURS

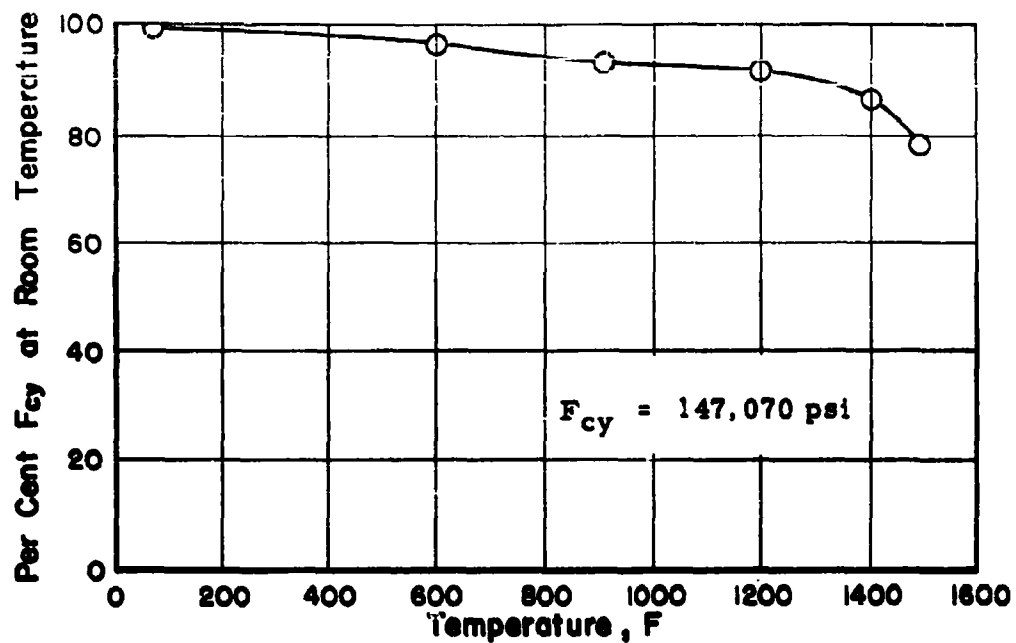


FIGURE 165. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

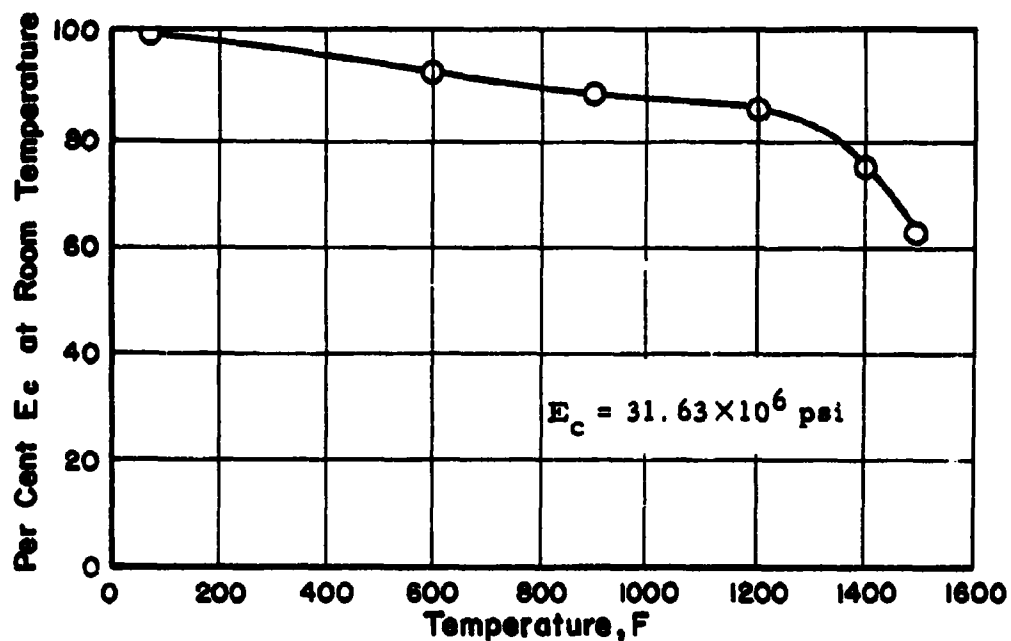


FIGURE 166. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 0.5 HOURS

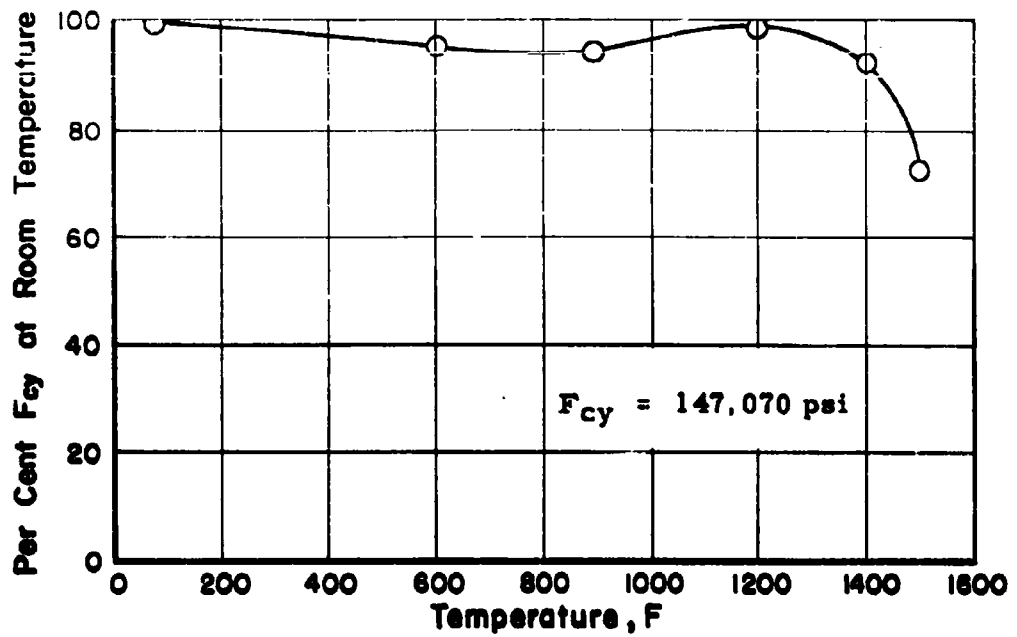


FIGURE 167. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

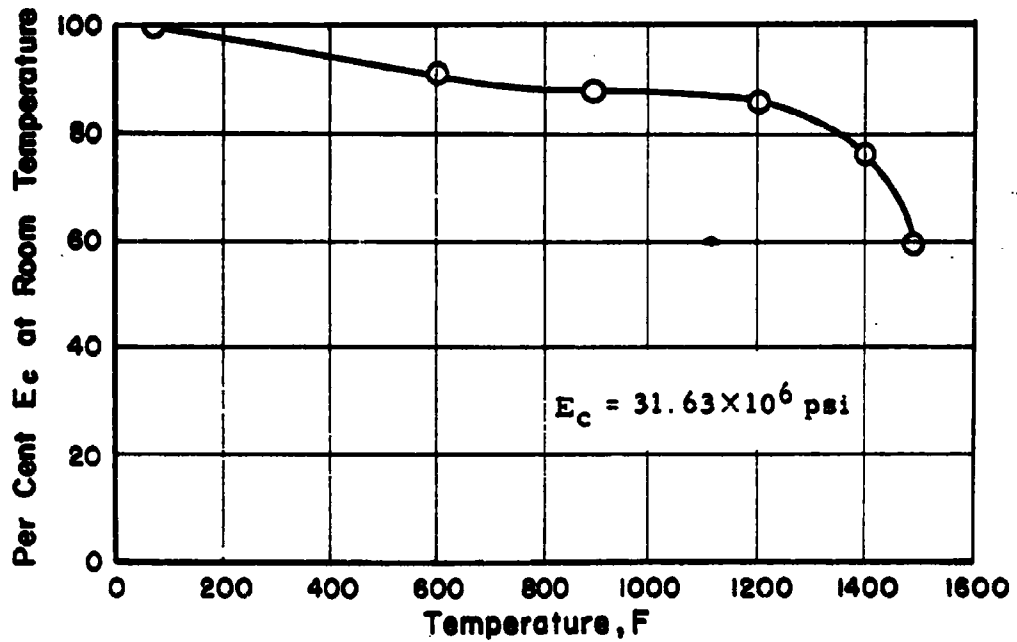


FIGURE 168. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 10 HOURS

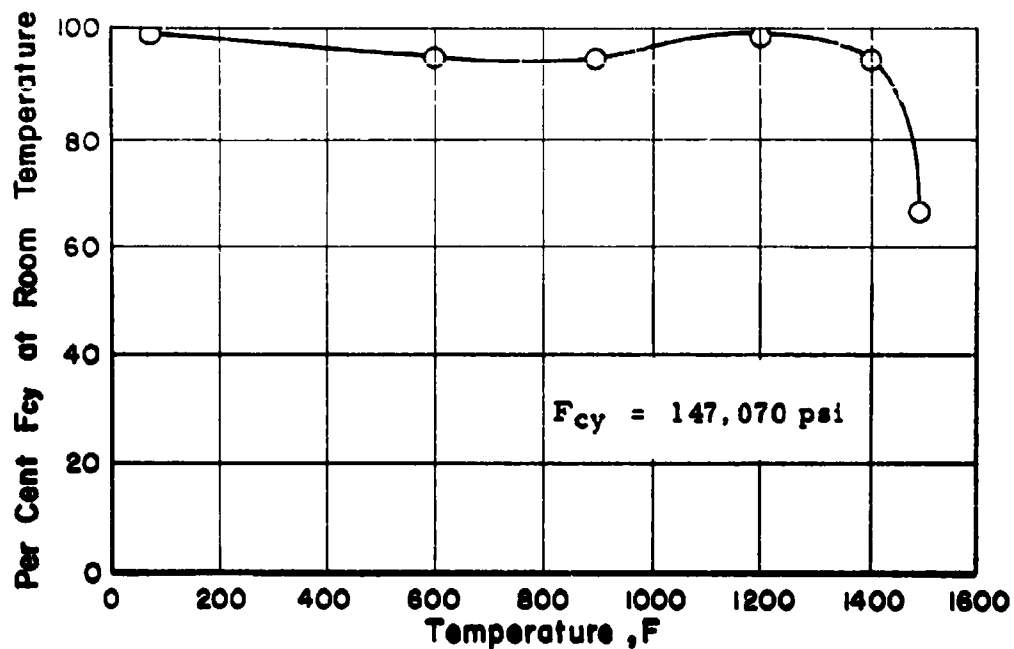


FIGURE 169. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

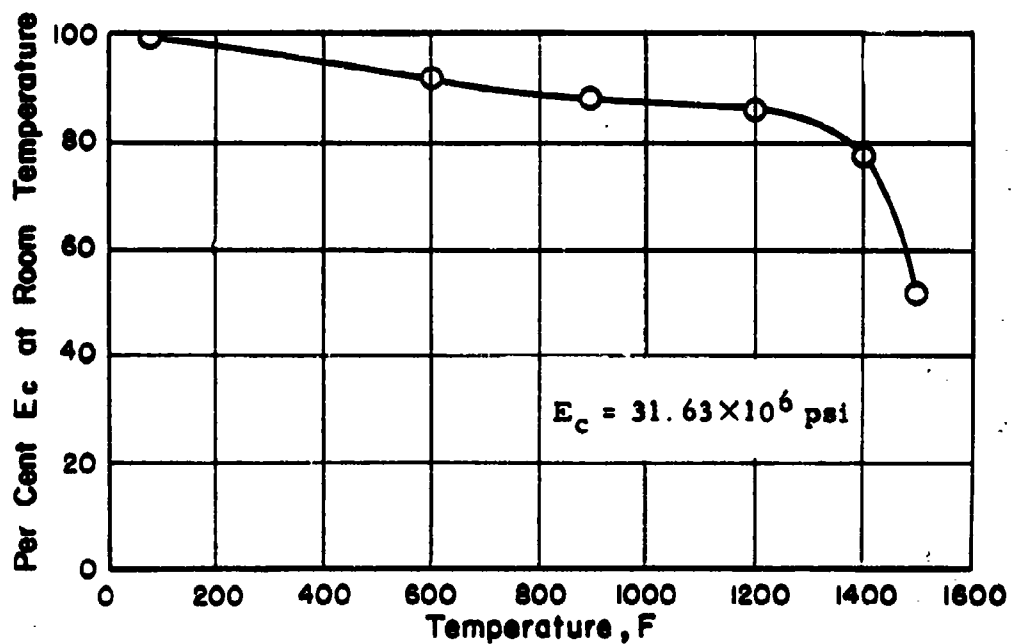


FIGURE 170. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 100 HOURS

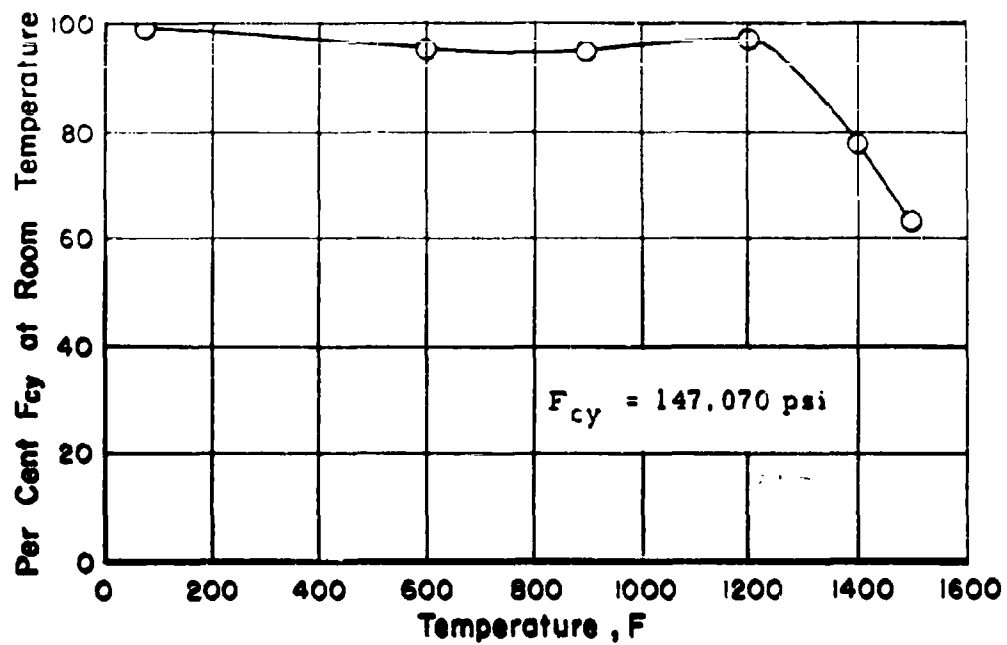


FIGURE 171. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

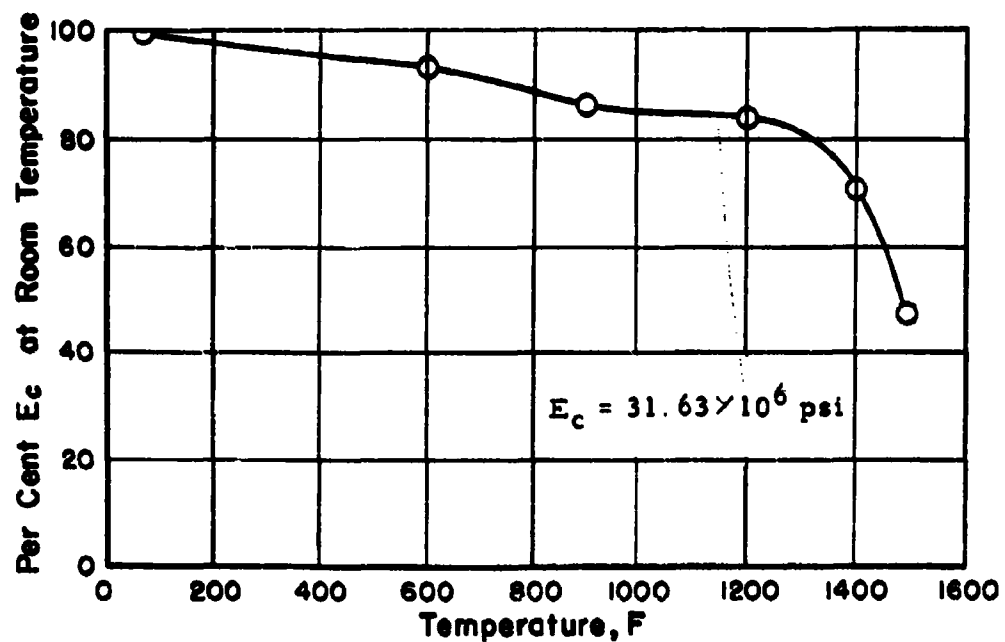


FIGURE 172. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF RENÉ 41 EXPOSED 1000 HOURS

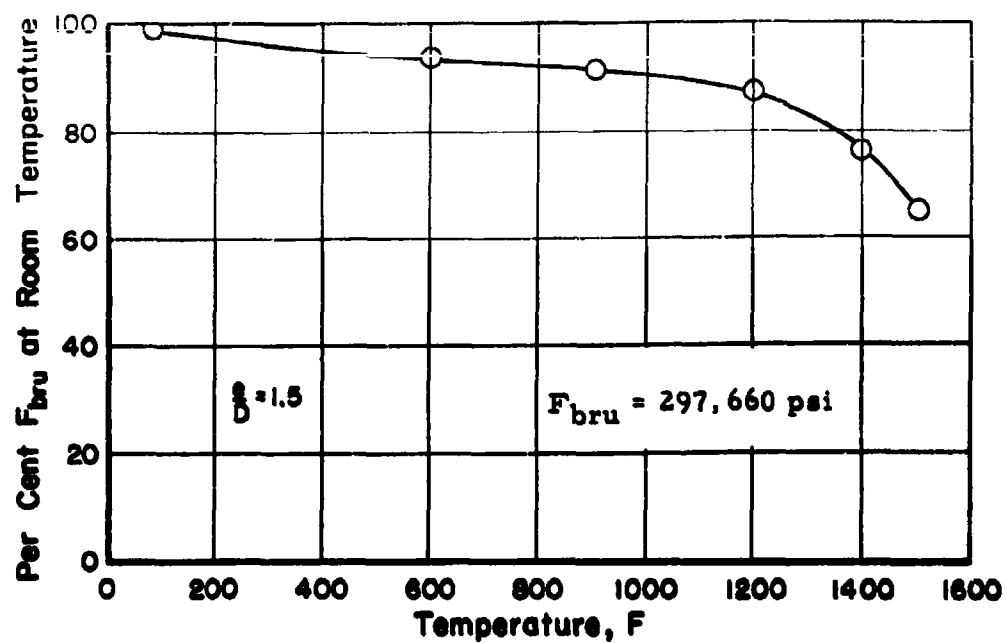


FIGURE 173. EFFECT OF TEMPERATURE ON
ULTIMATE BEARING STRENGTH OF
RENÉ 41 EXPOSED 0.5 HOURS

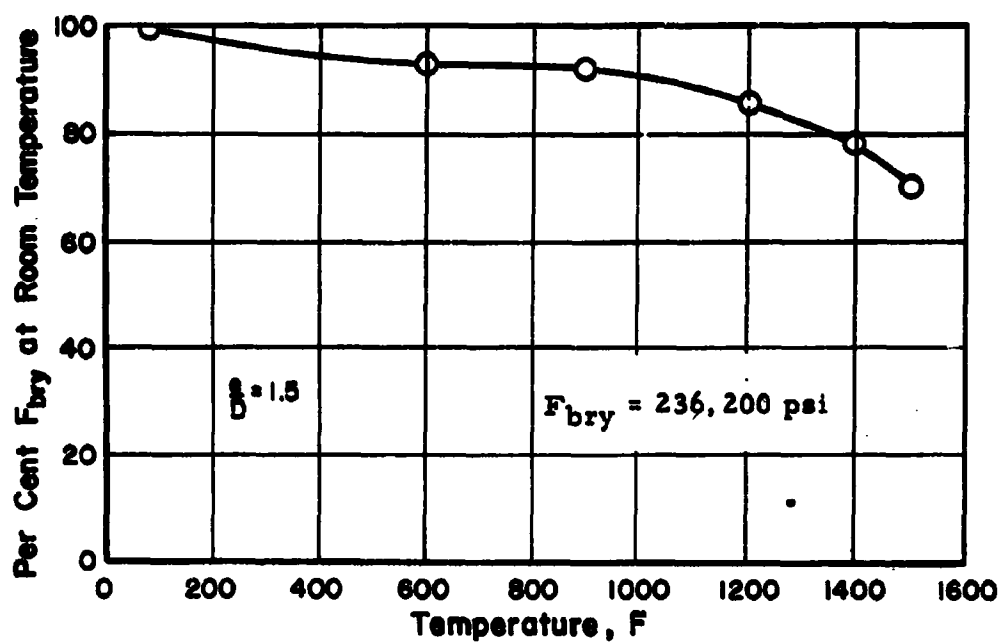


FIGURE 174. EFFECT OF TEMPERATURE ON
BEARING YIELD STRENGTH OF RENÉ 41
EXPOSED 0.5 HOURS

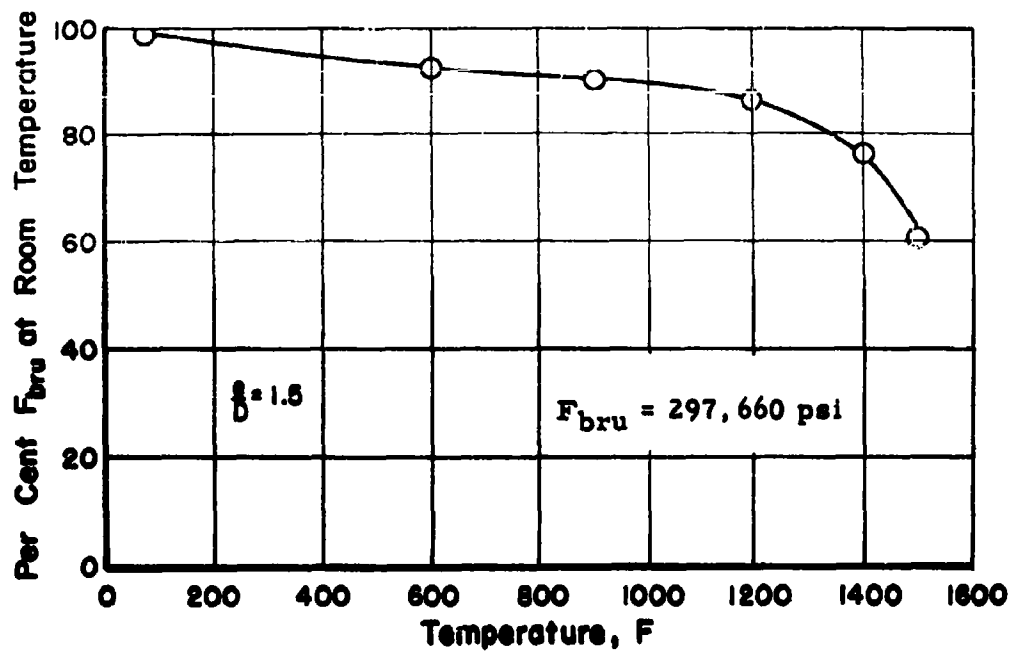


FIGURE 175. EFFECT OF TEMPERATURE ON
 ULTIMATE BEARING STRENGTH OF
 RENÉ 41 EXPOSED 10 HOURS

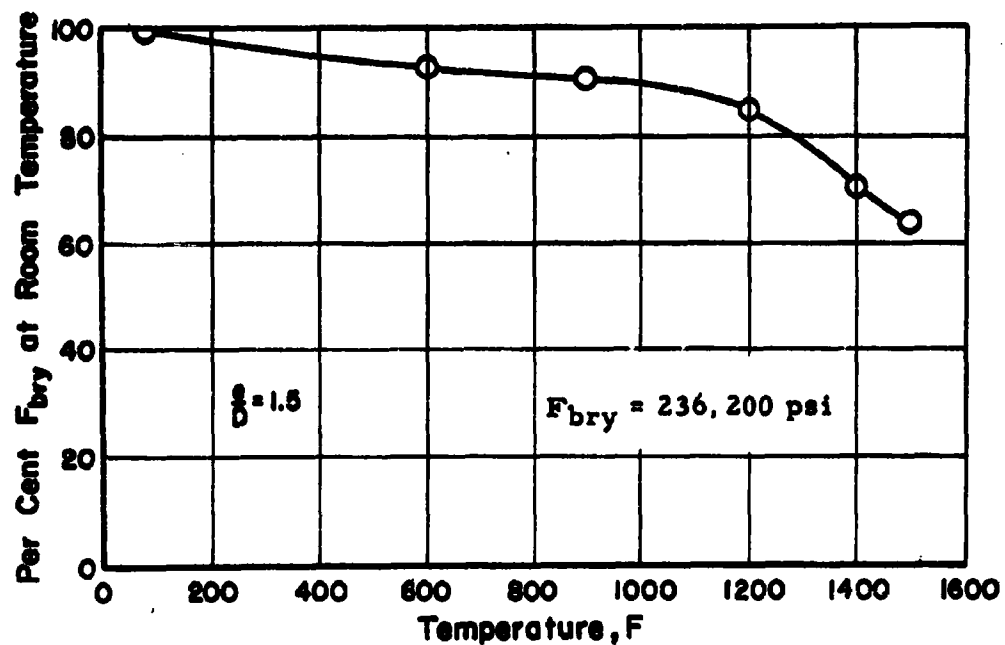


FIGURE 176. EFFECT OF TEMPERATURE ON
 BEARING YIELD STRENGTH OF RENÉ 41
 EXPOSED 10 HOURS

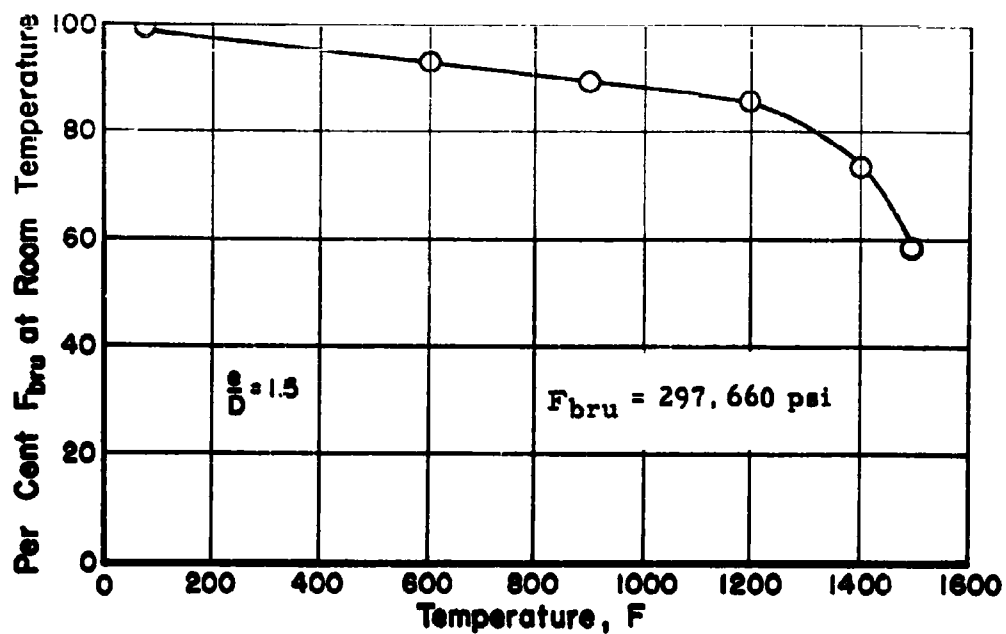


FIGURE 177. EFFECT OF TEMPERATURE ON
ULTIMATE BEARING STRENGTH OF
RENÉ 41 EXPOSED 100 HOURS

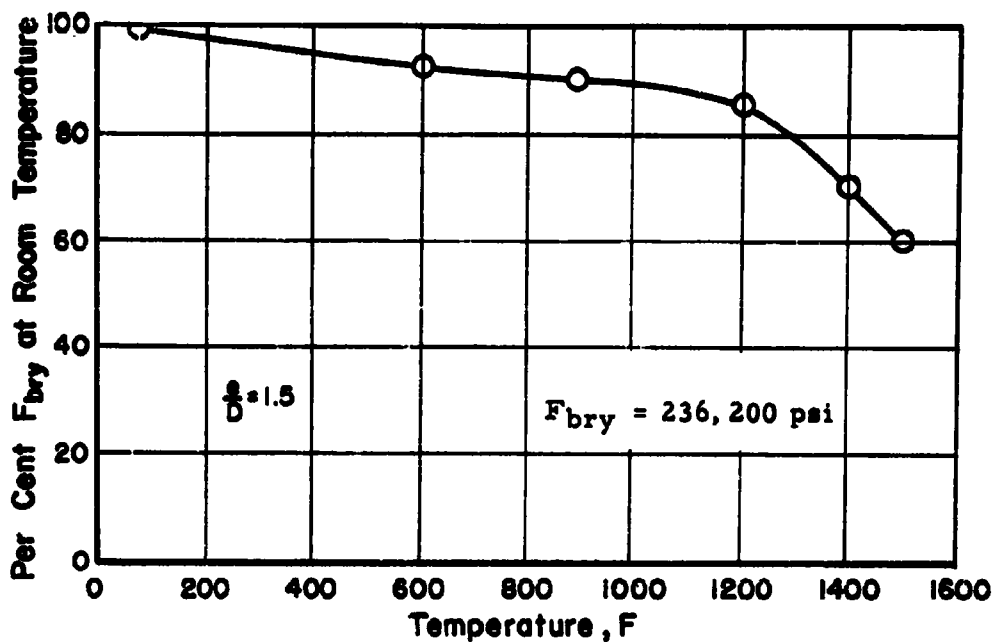


FIGURE 178. EFFECT OF TEMPERATURE ON
BEARING YIELD STRENGTH OF RENÉ 41
EXPOSED 100 HOURS

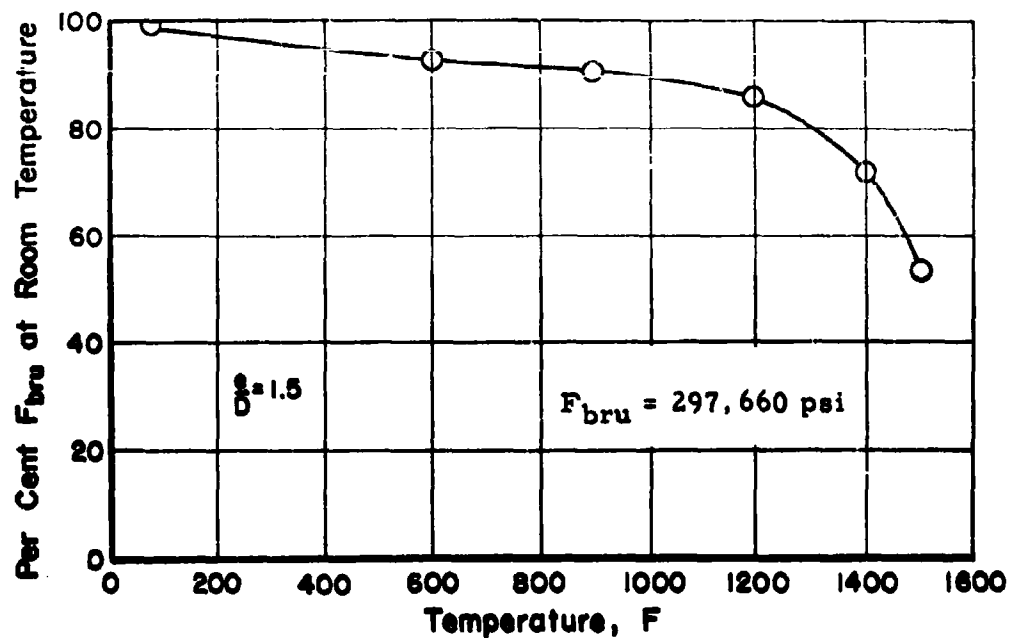


FIGURE 179. EFFECT OF TEMPERATURE ON
ULTIMATE BEARING STRENGTH OF
RENÉ 41 EXPOSED 1000 HOURS

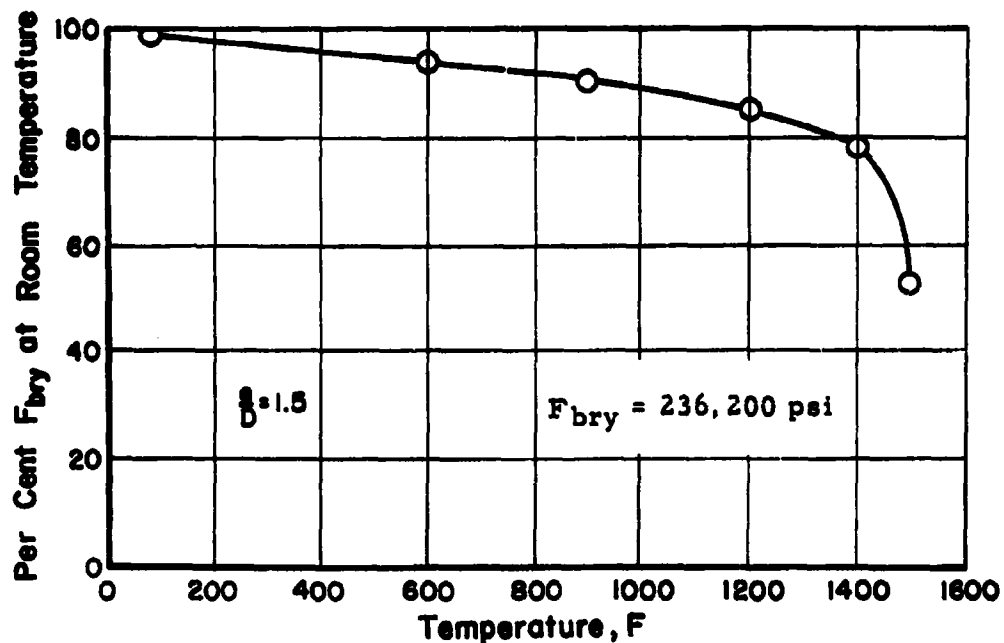


FIGURE 180. EFFECT OF TEMPERATURE ON
BEARING YIELD STRENGTH OF RENÉ 41
EXPOSED 1000 HOURS

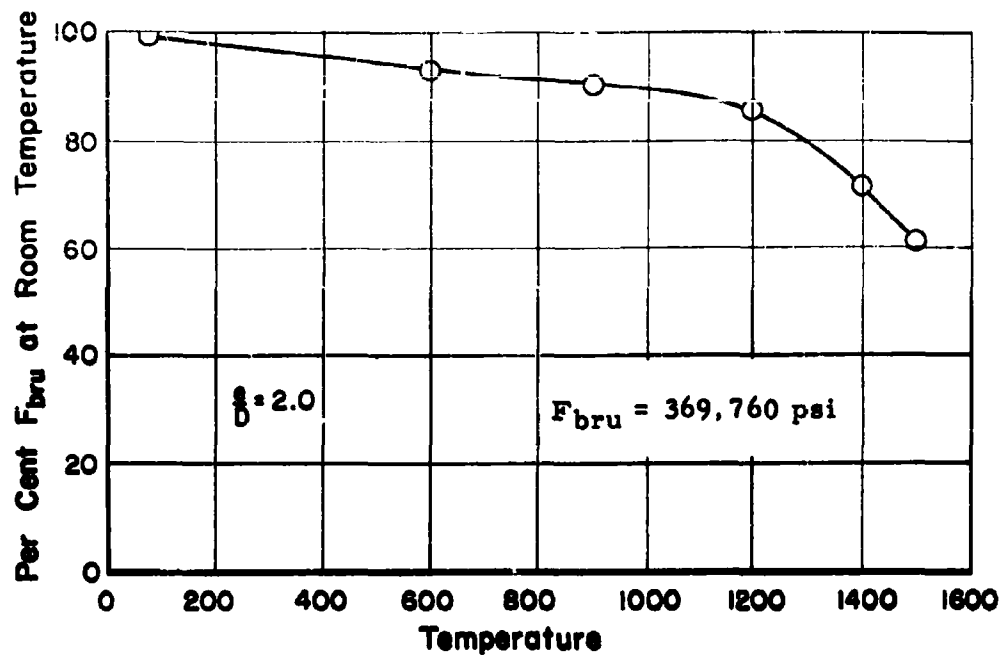


FIGURE 181. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

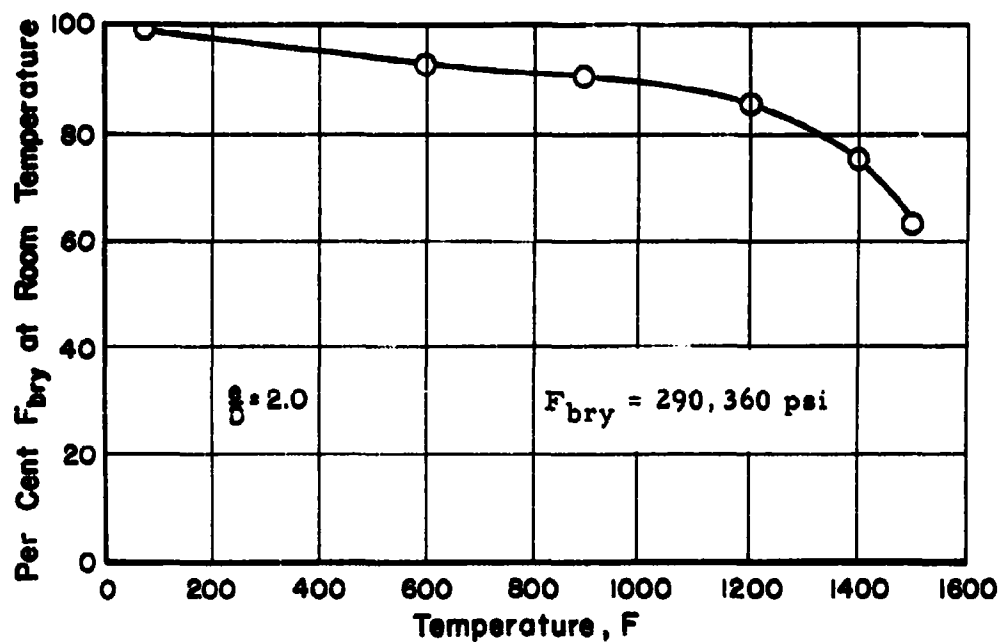


FIGURE 182. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

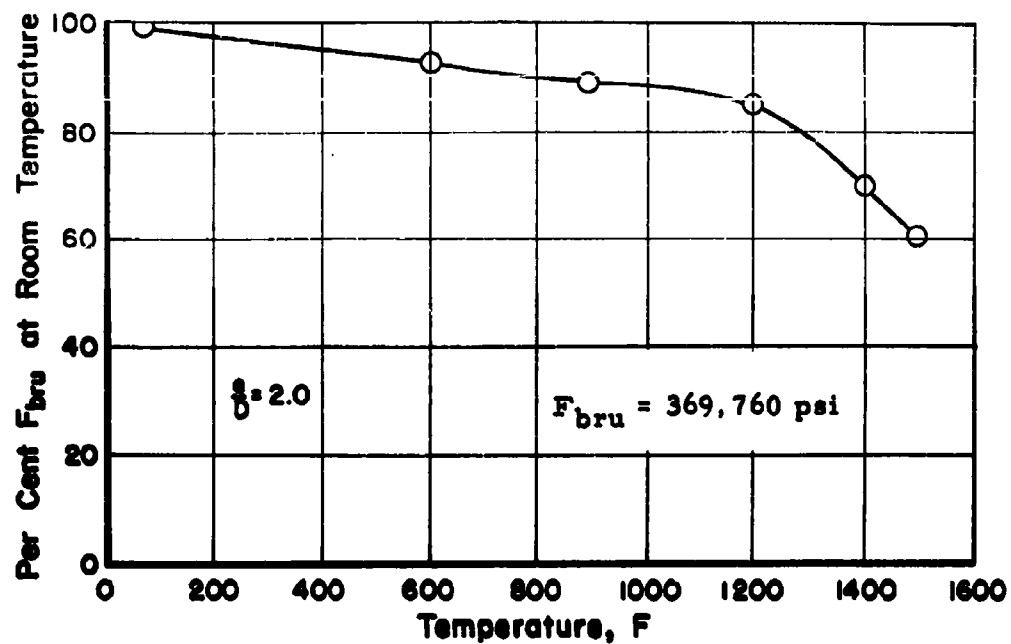


FIGURE 183. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

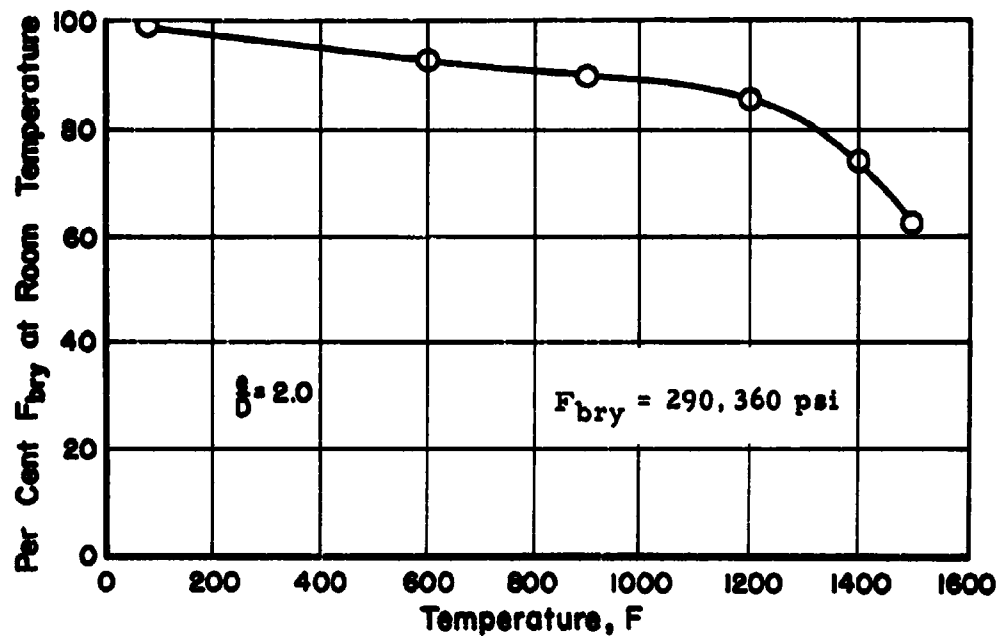


FIGURE 184. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

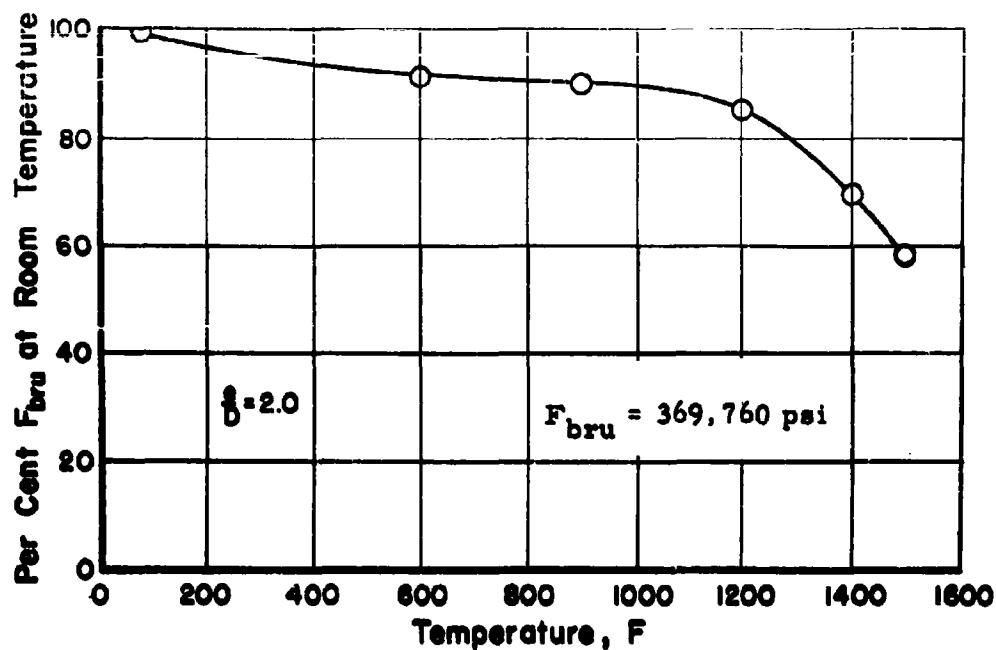


FIGURE 185. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

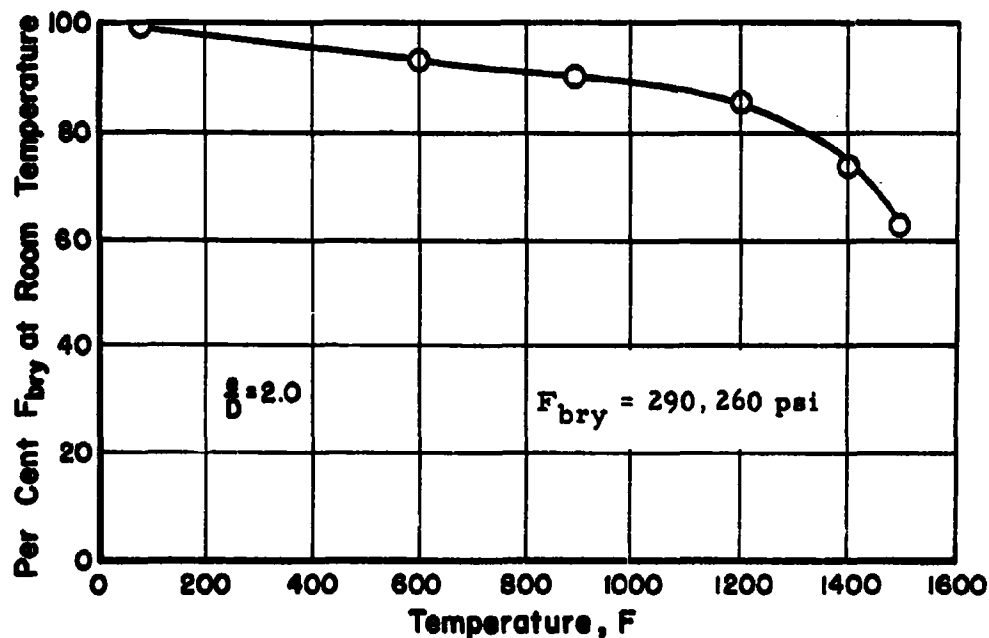


FIGURE 186. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

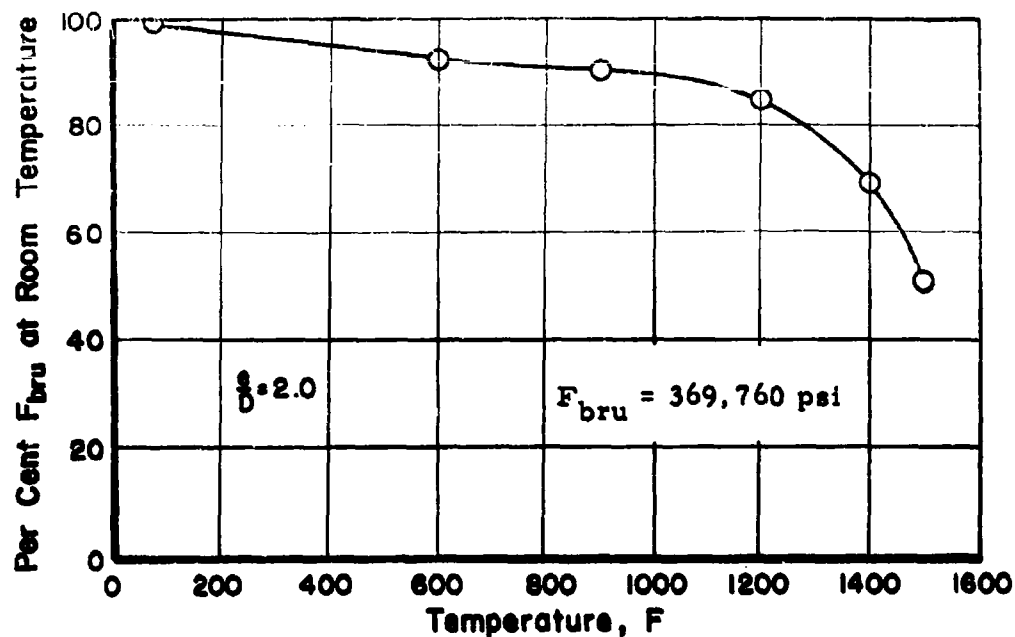


FIGURE 187. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

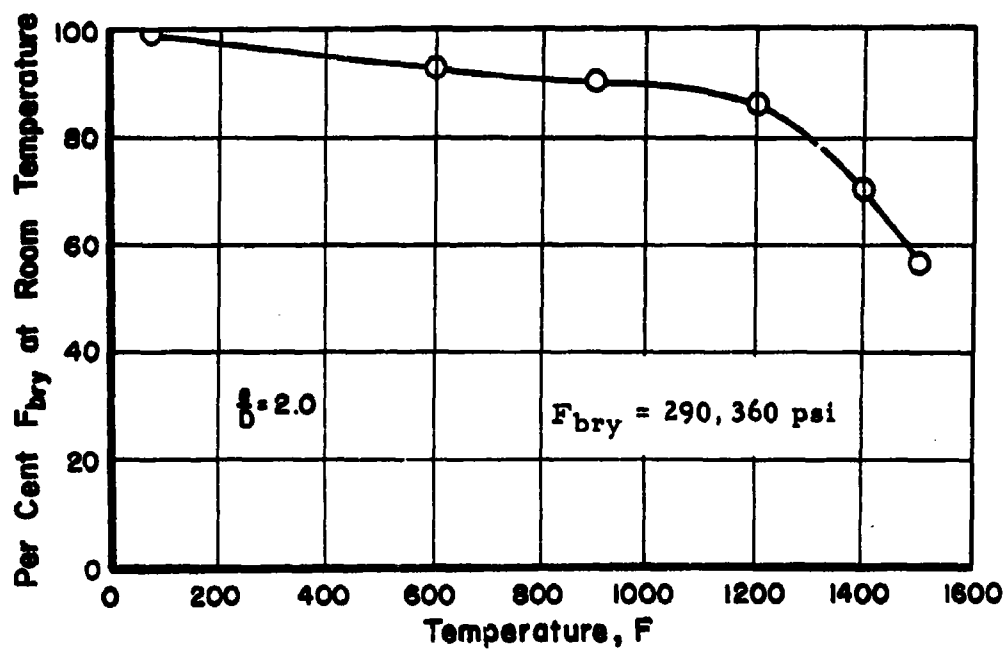


FIGURE 188. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

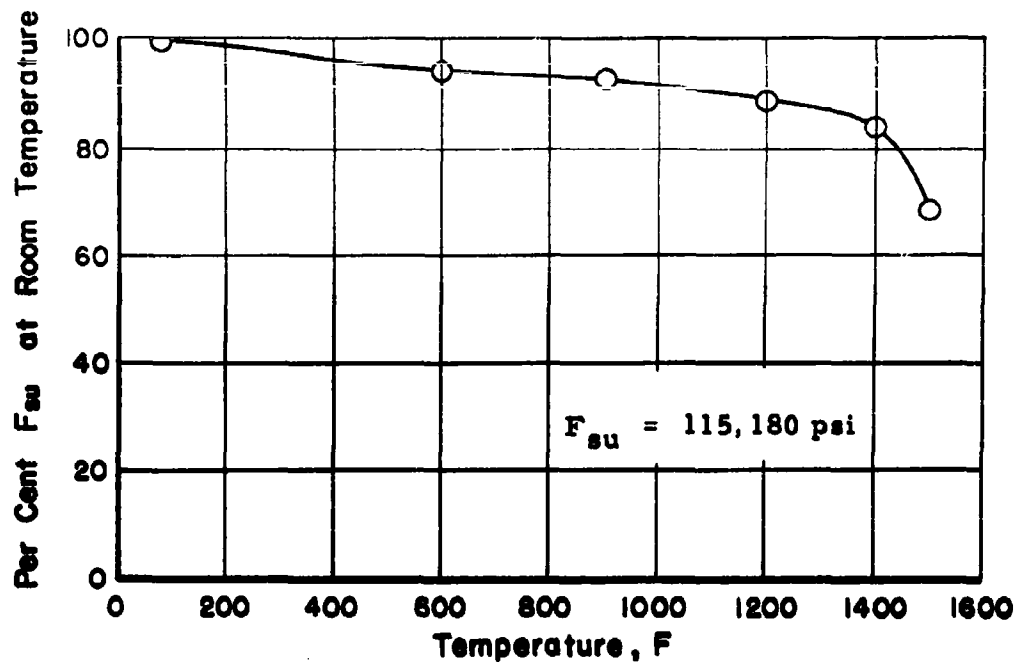


FIGURE 189. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 0.5 HOURS

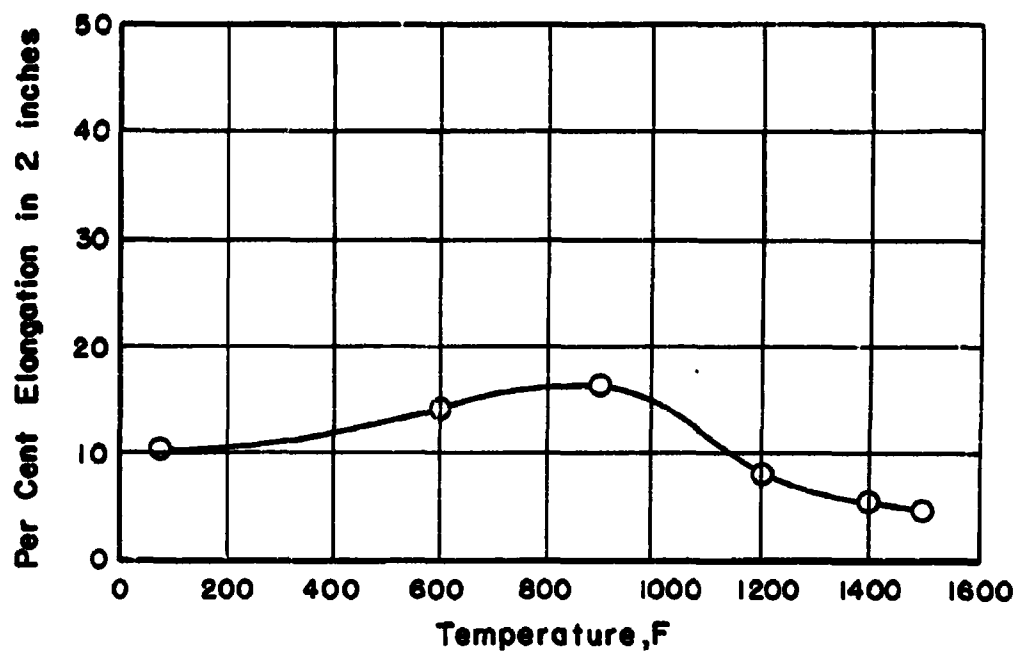


FIGURE 190. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 0.5 HOURS

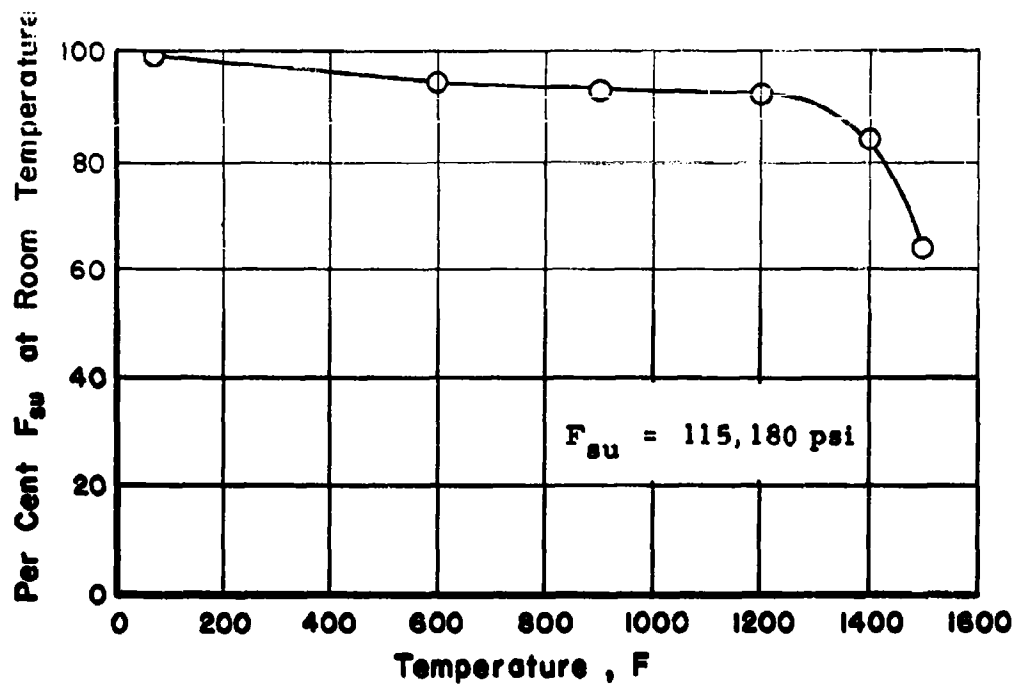


FIGURE 191. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 10 HOURS

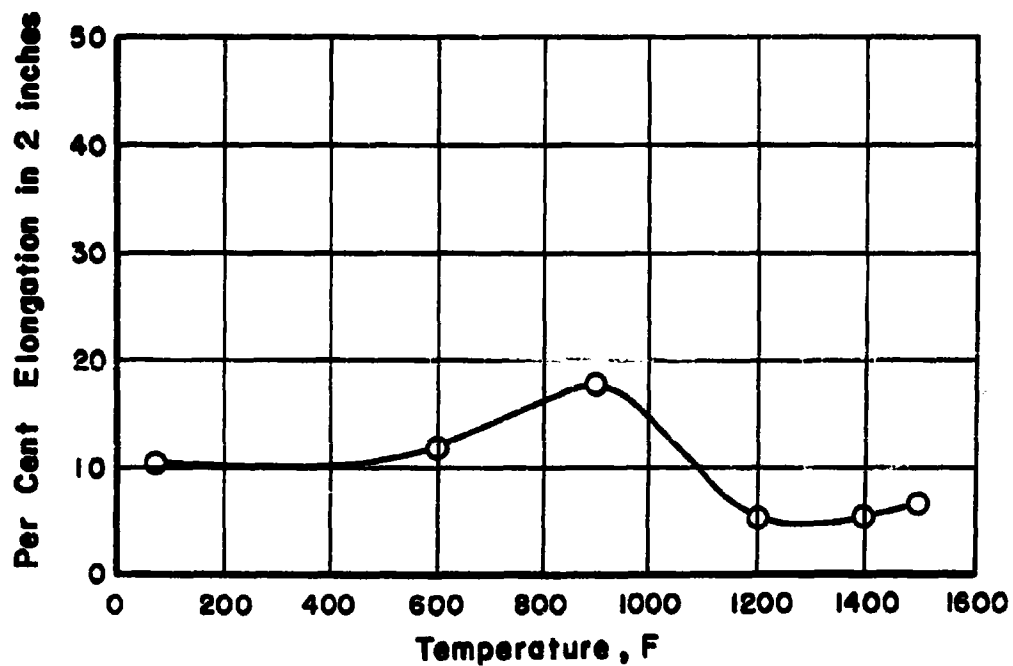


FIGURE 192. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 10 HOURS

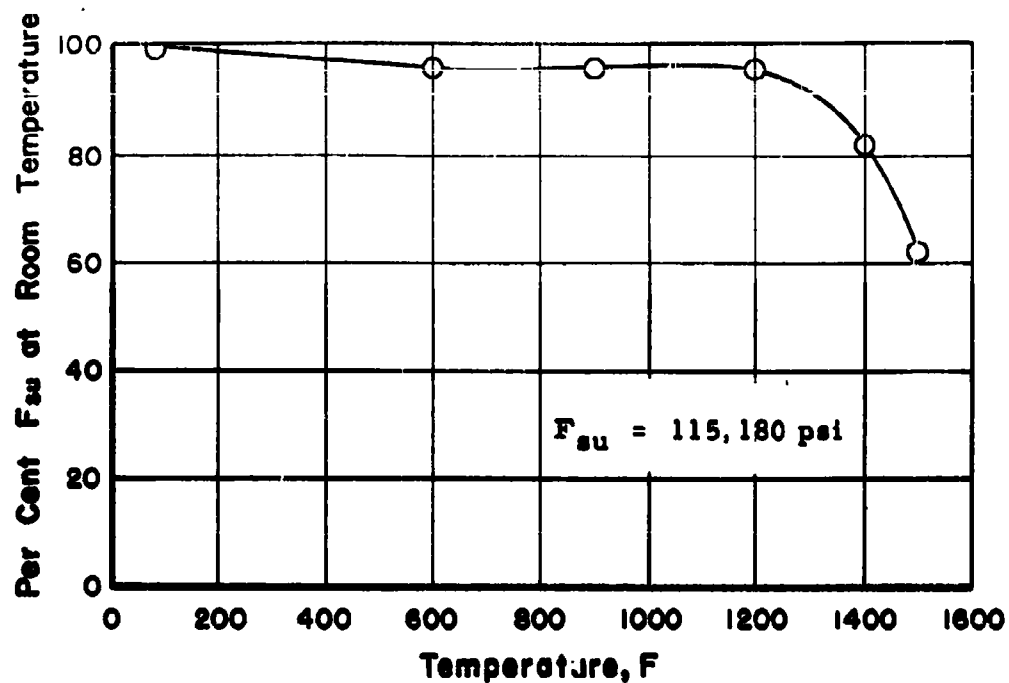


FIGURE 193. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 100 HOURS

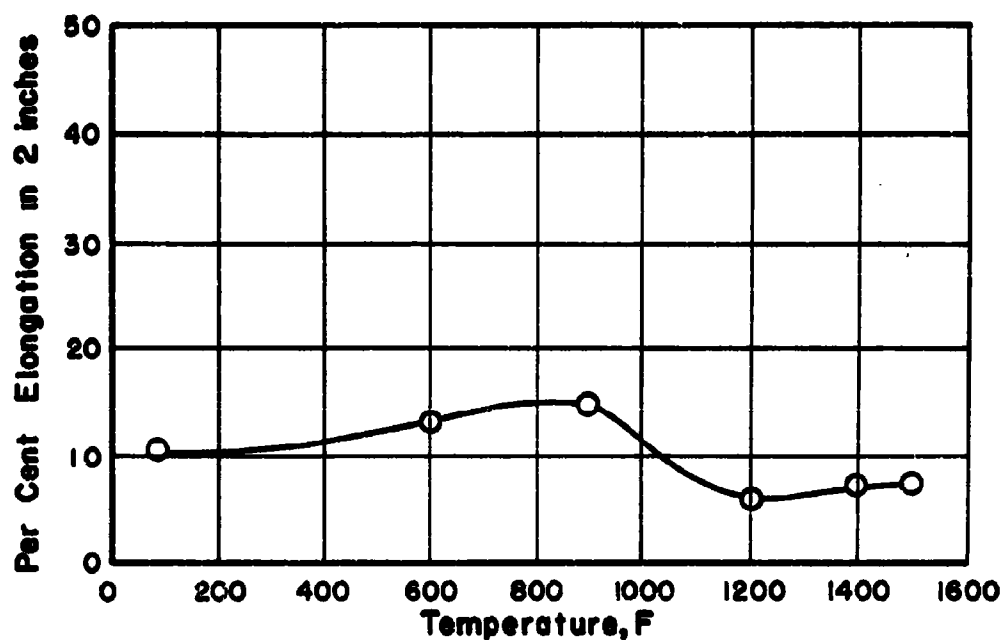


FIGURE 194. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 100 HOURS

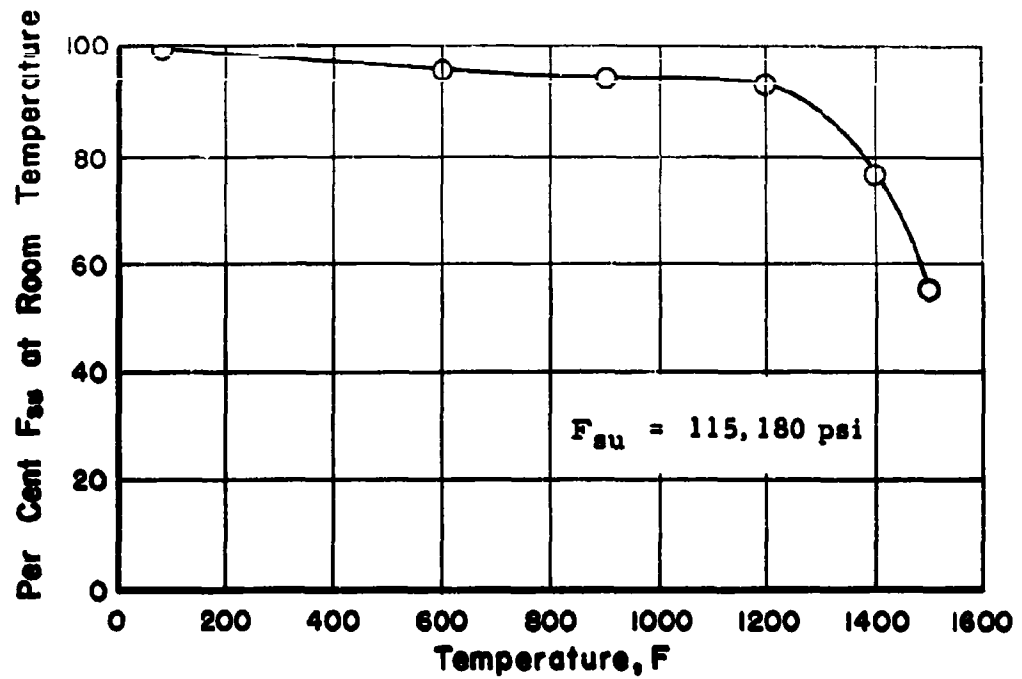


FIGURE 195. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS

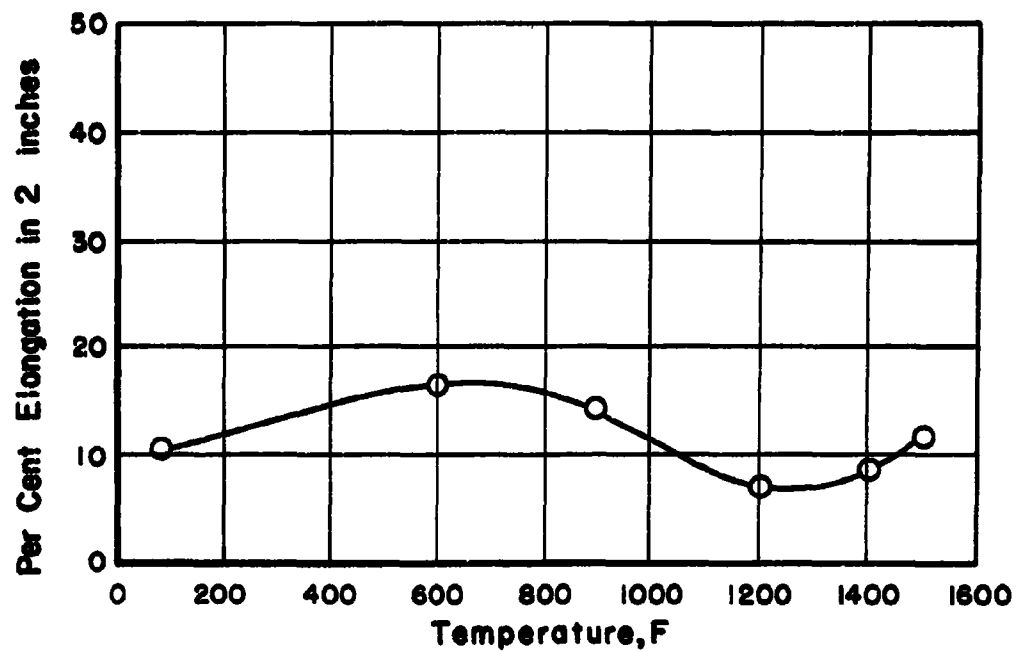


FIGURE 196. EFFECT OF TEMPERATURE ON ELONGATION OF RENÉ 41 EXPOSED 1000 HOURS

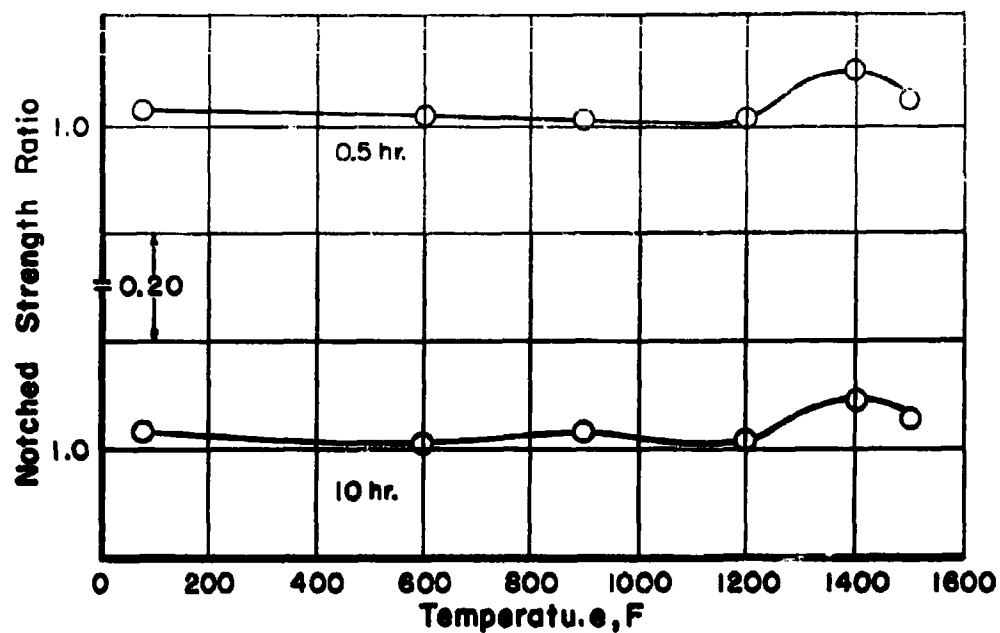


FIGURE 197. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF RENÉ 41 EXPOSED 0.5 AND 10 HOURS

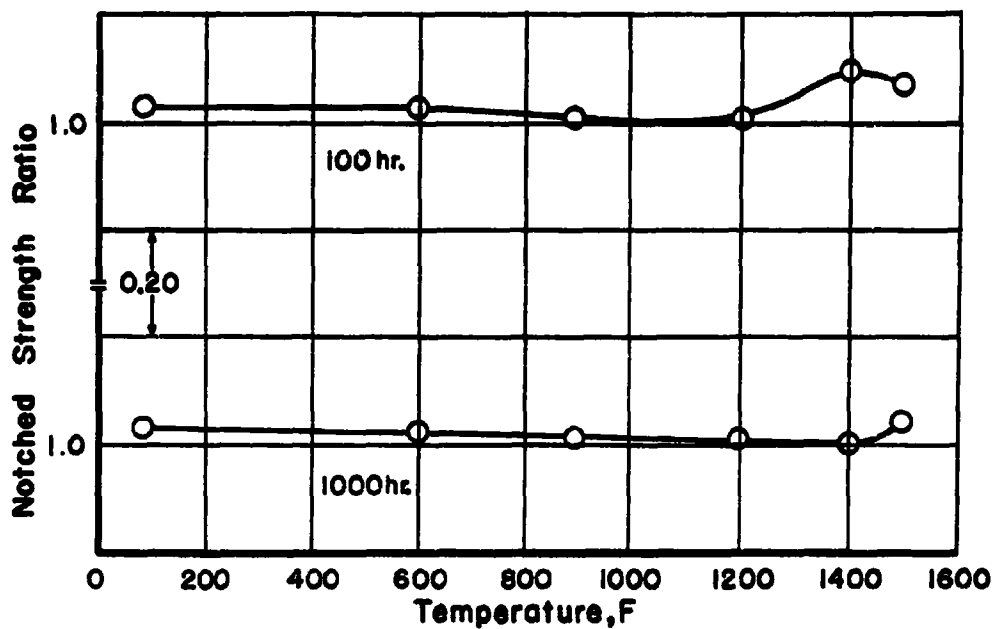


FIGURE 198. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF RENÉ 41 EXPOSED 100 AND 1000 HOURS

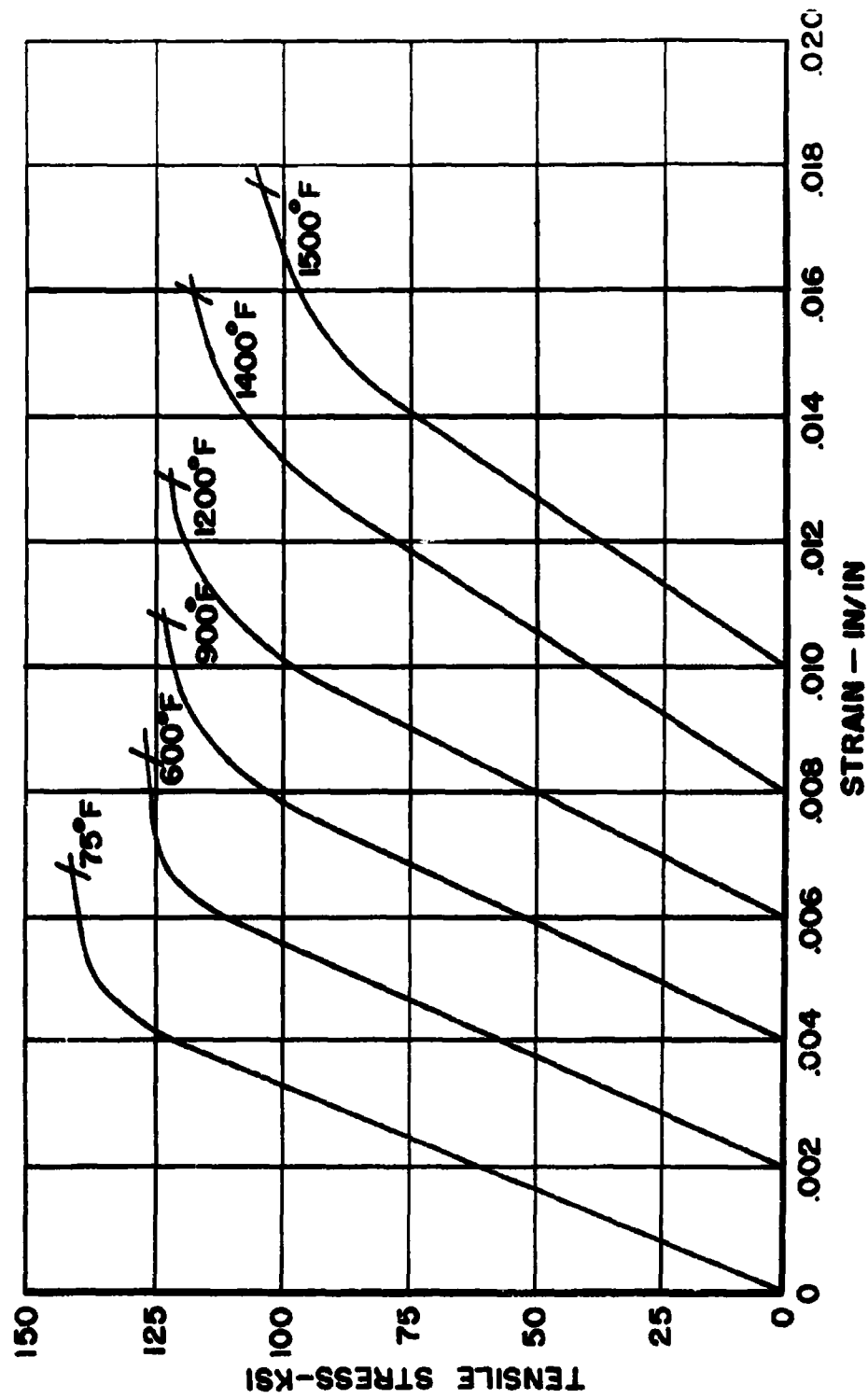


FIGURE 199. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 0.5 HOURS

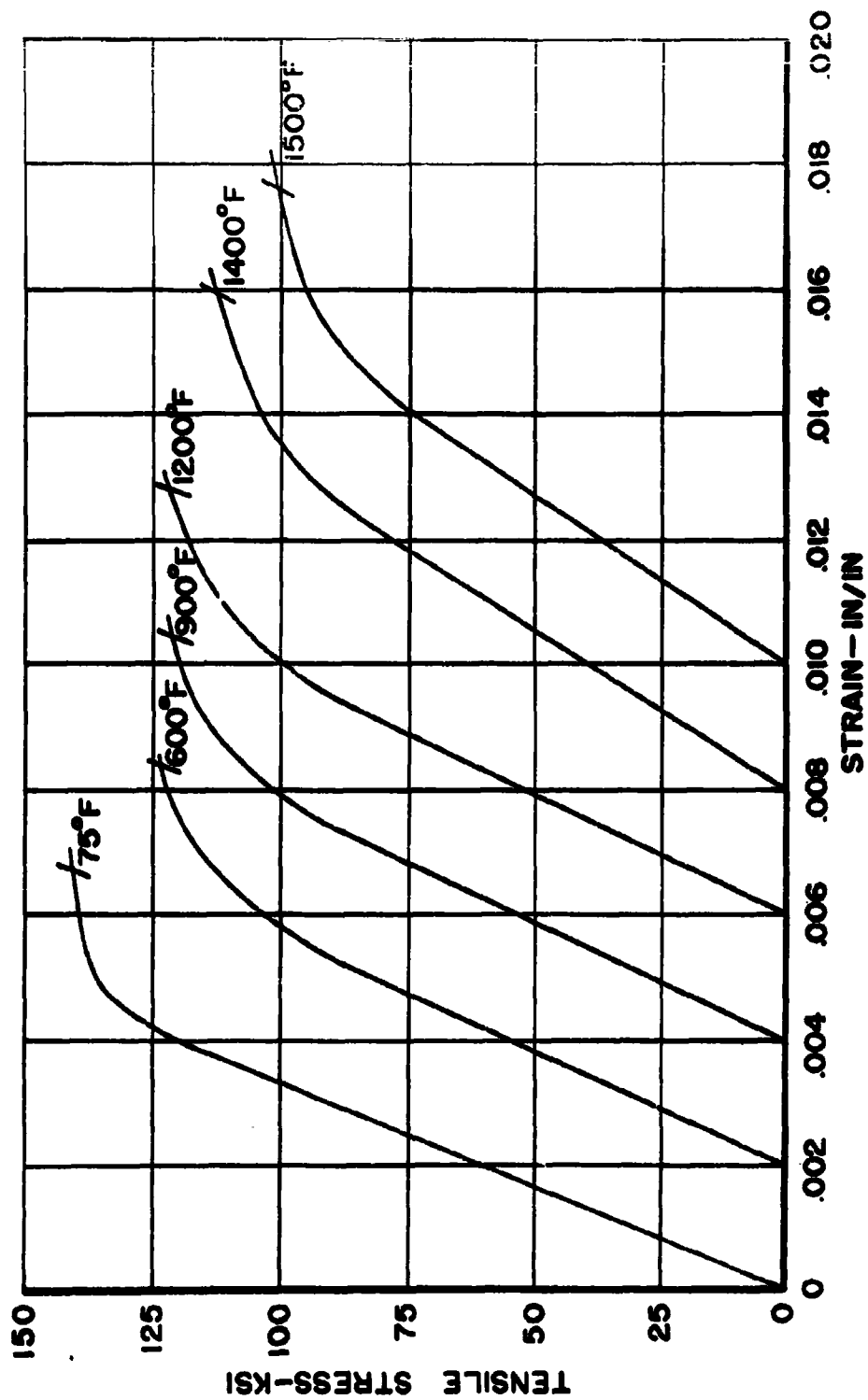


FIGURE 200. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 10 HOURS

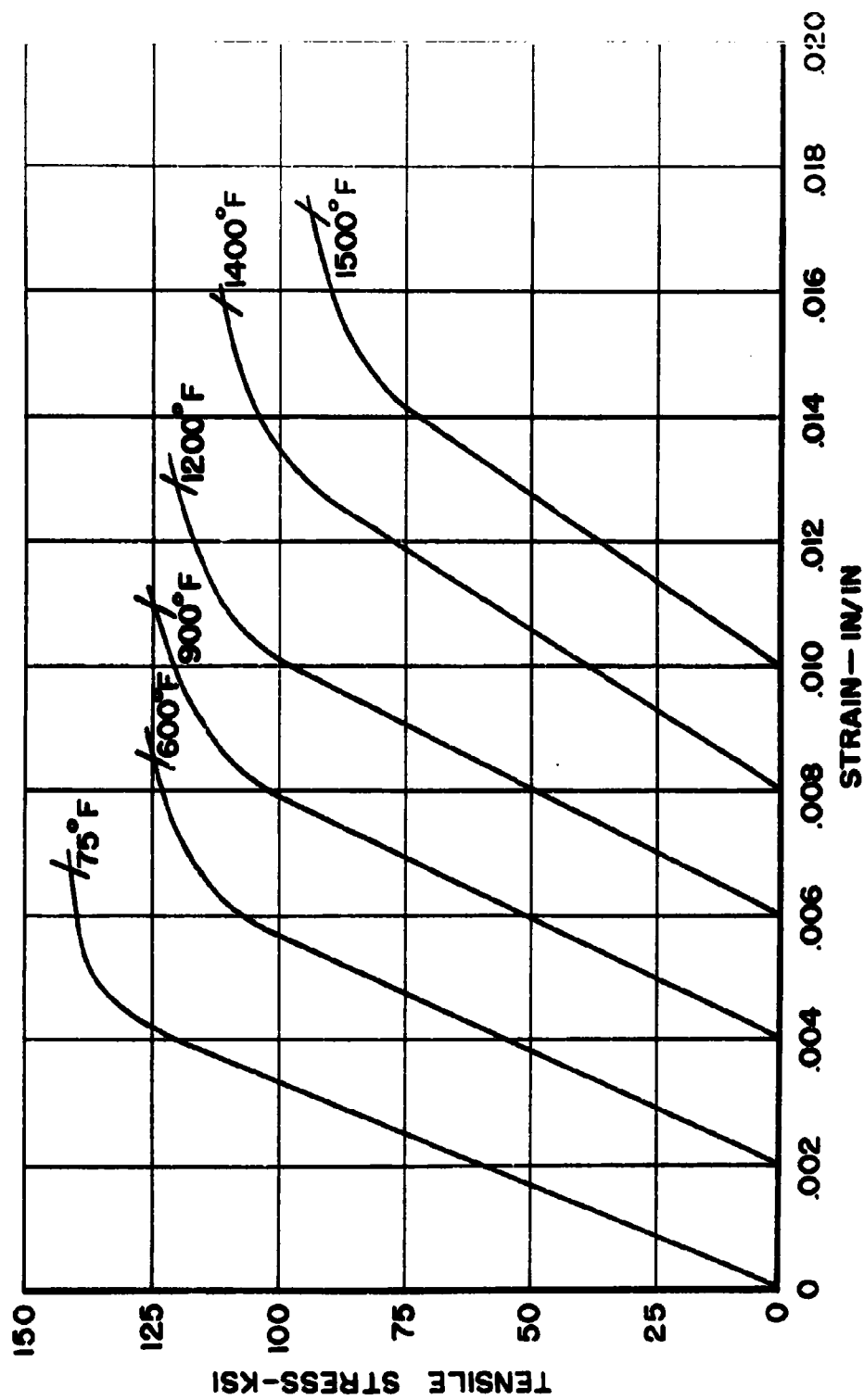


FIGURE 201. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 100 HOURS

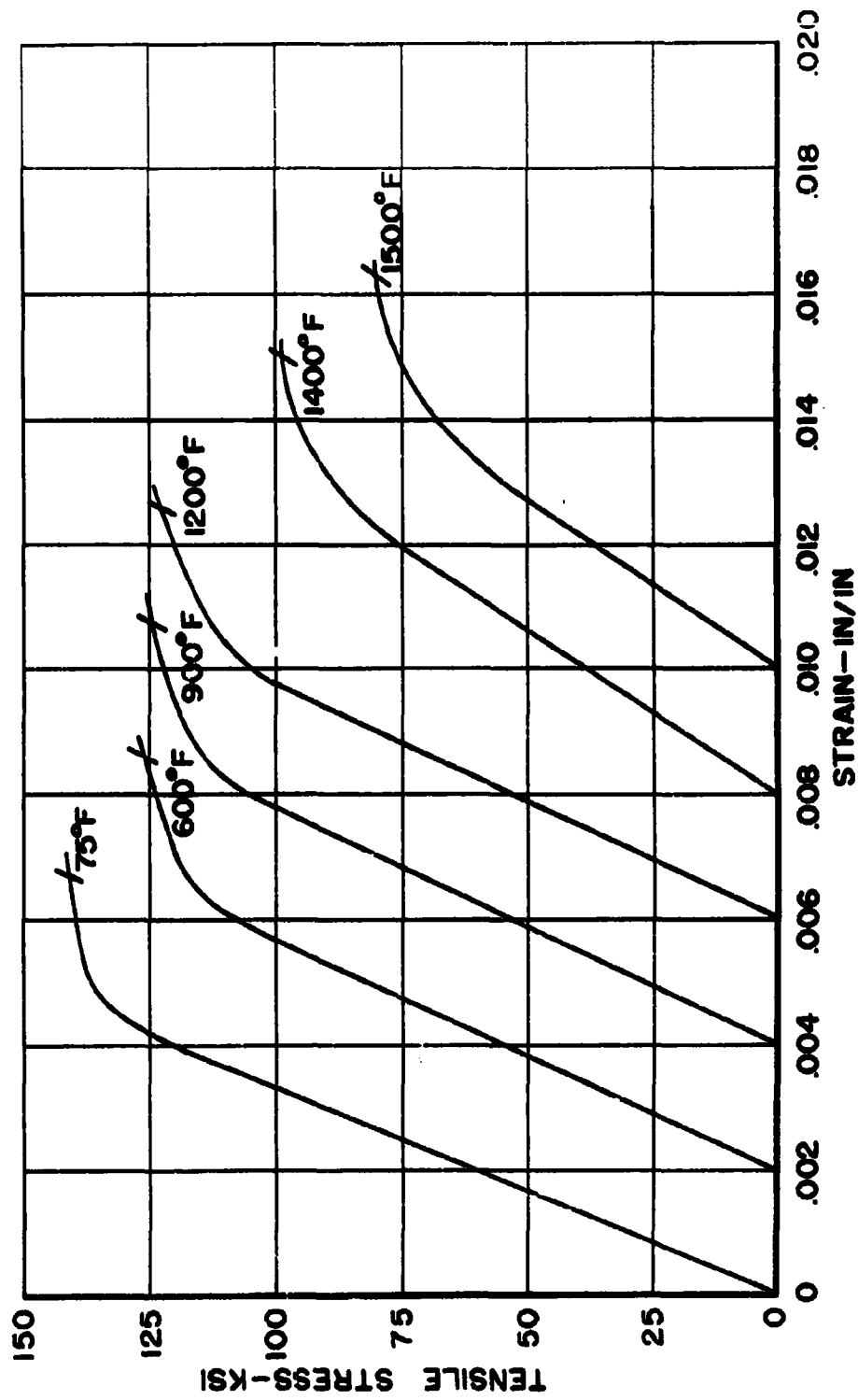


FIGURE 202. TENSILE STRESS-STRAIN CURVES OF RENÉ 41 EXPOSED 1000 HOURS

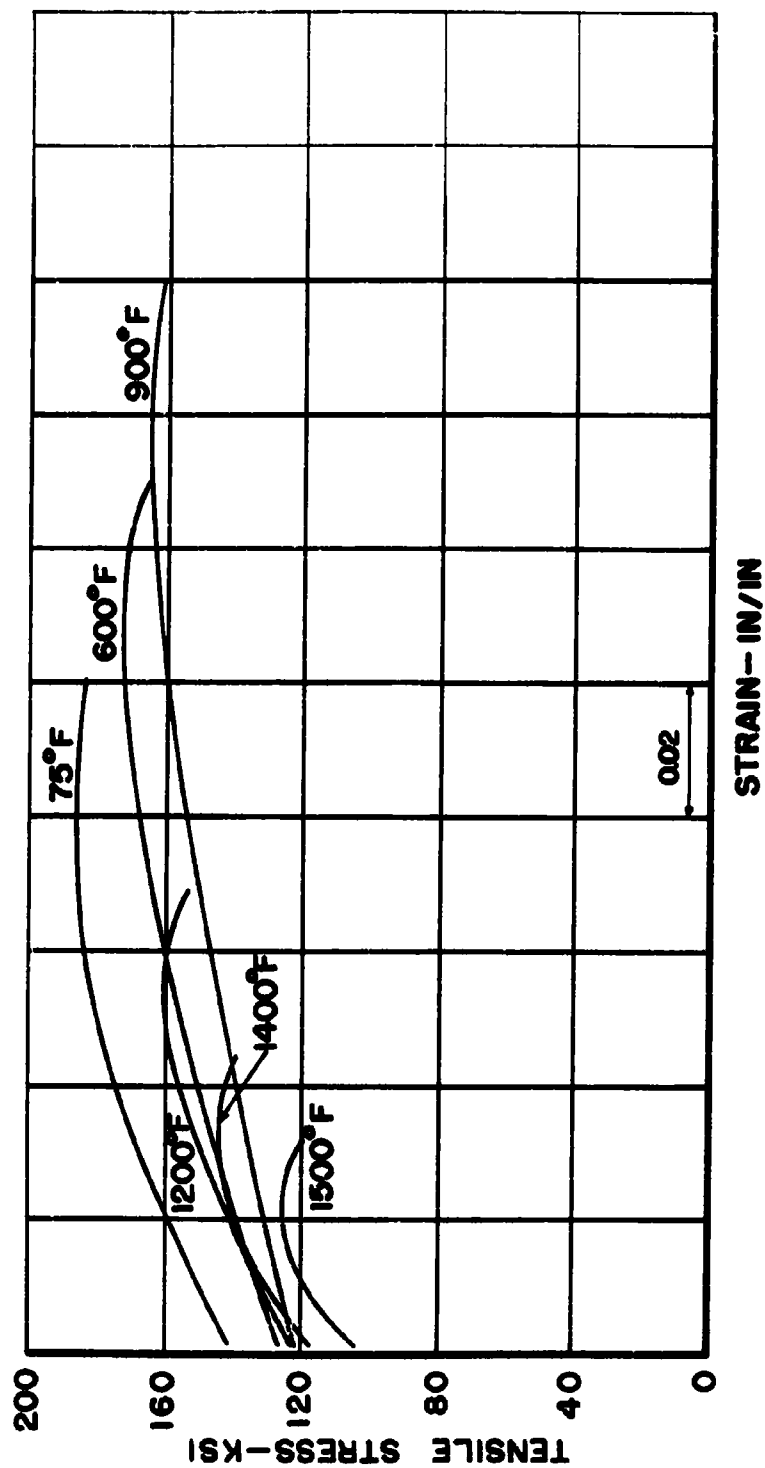


FIGURE 203. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF RENE 41 EXPOSED 0.5 HOURS

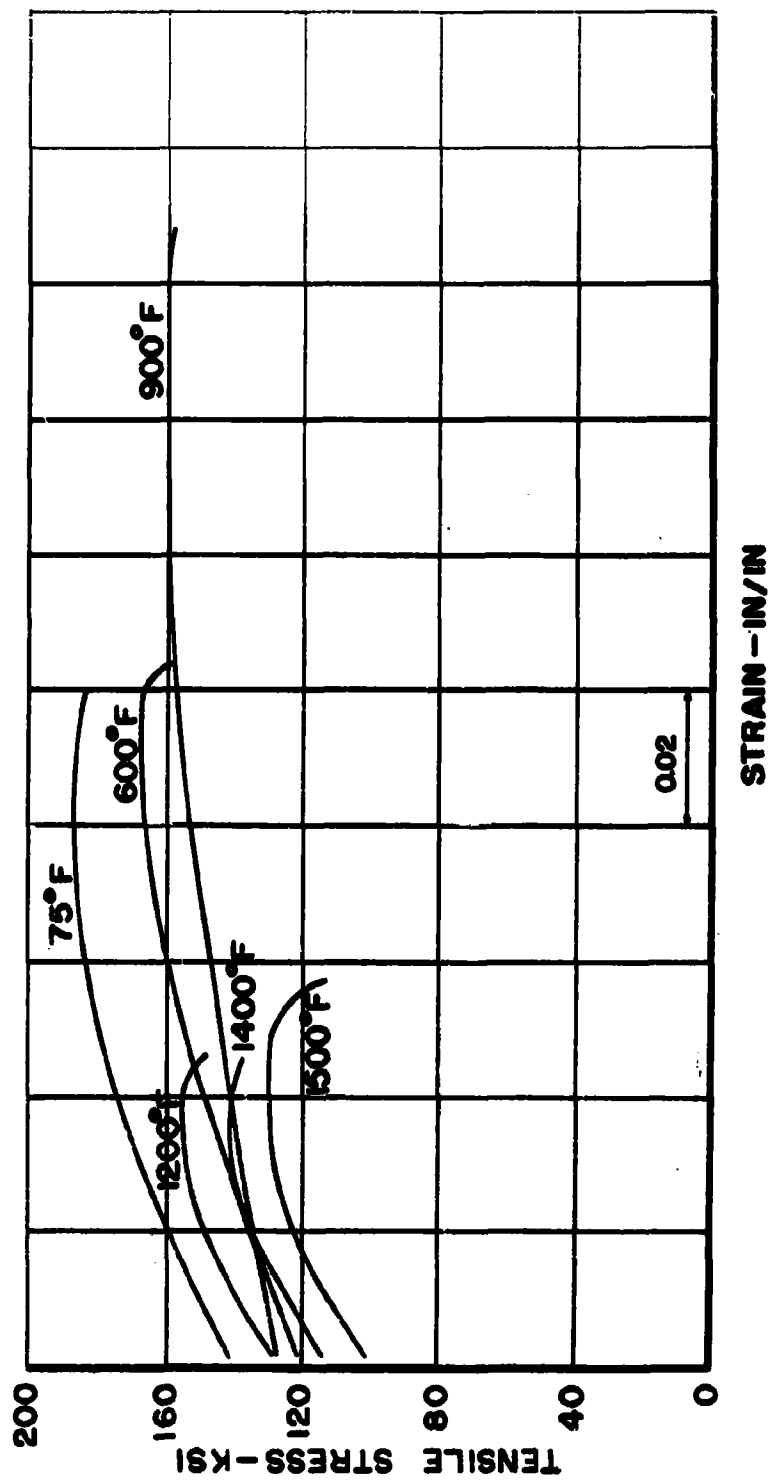


FIGURE 204. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF RENE 41 EXPOSED 10 HOURS

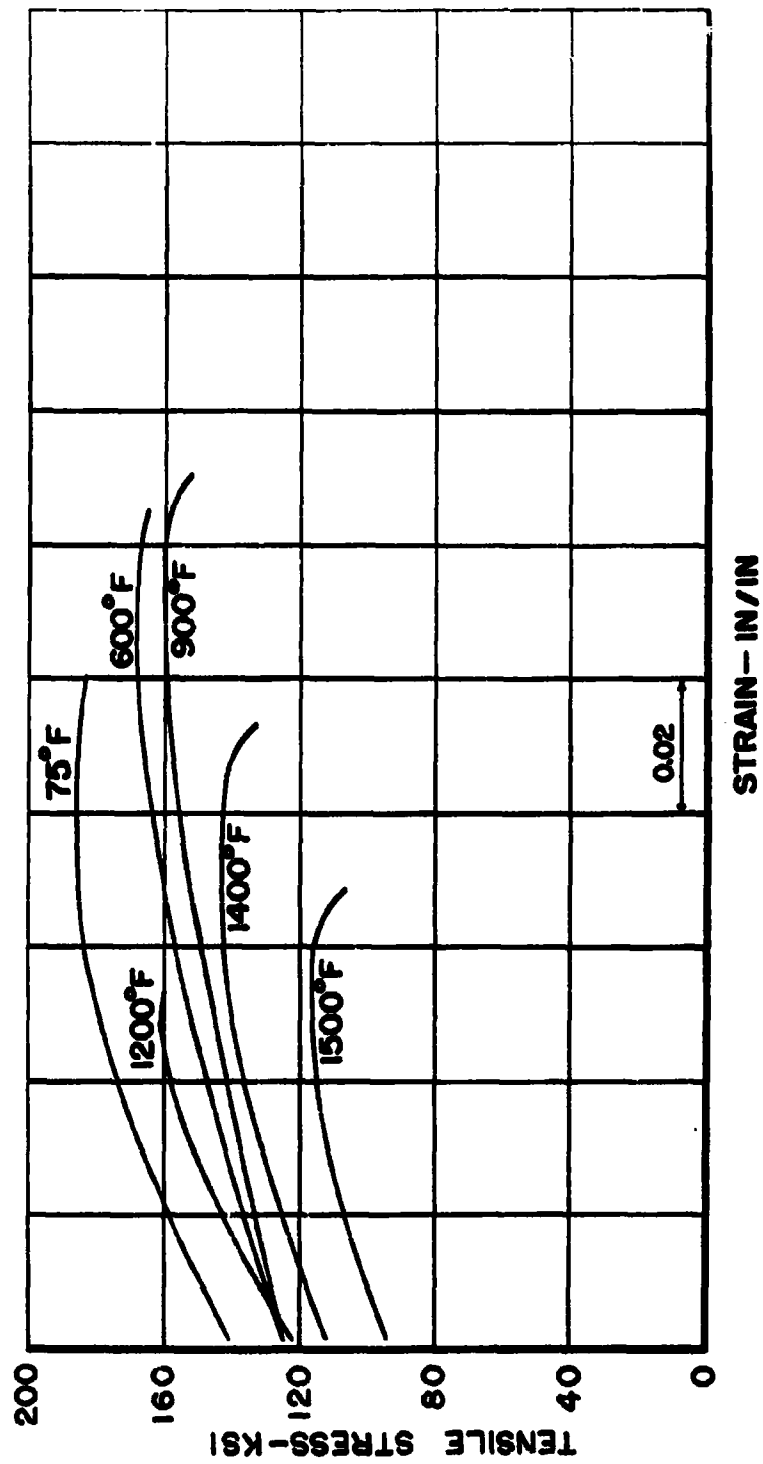


FIGURE 205. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF RENE 41 EXPOSED 100 HOURS

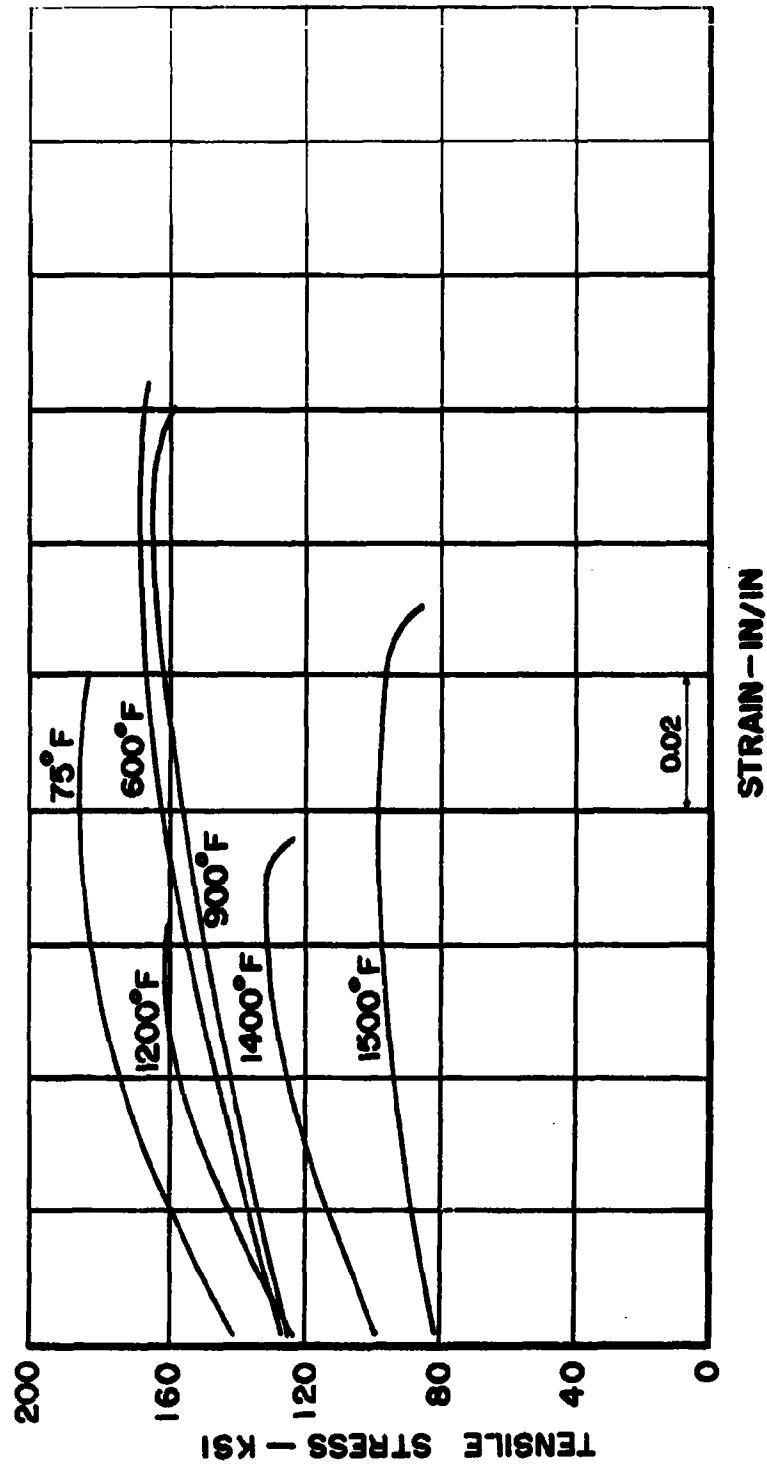


FIGURE 206. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF RENÉ 41 EXPOSED 1000 HOURS

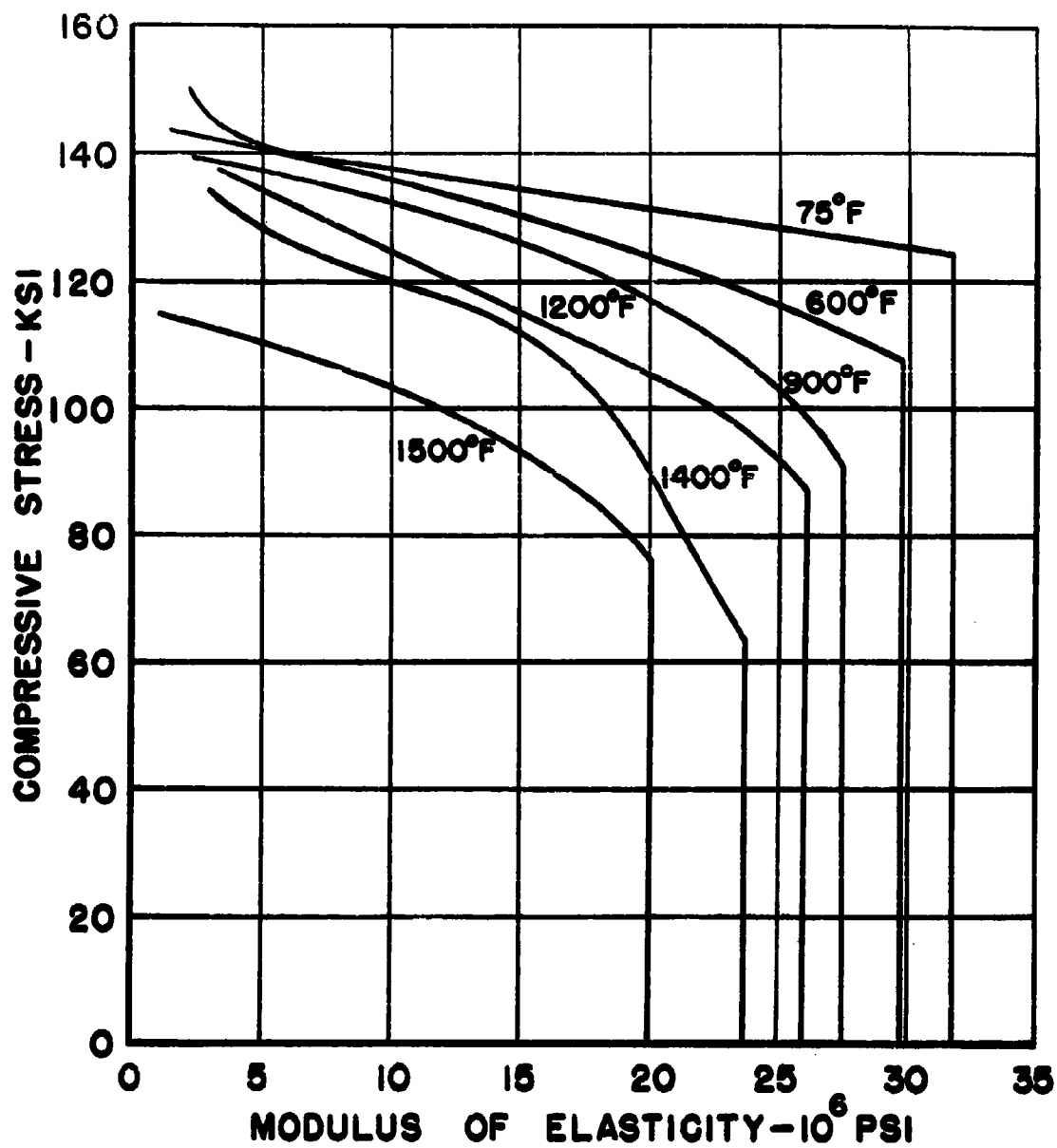


FIGURE 207. COMPRESSIVE TANGENT MODULUS CURVES OF RENÉ 41 EXPOSED 0.5 HOURS

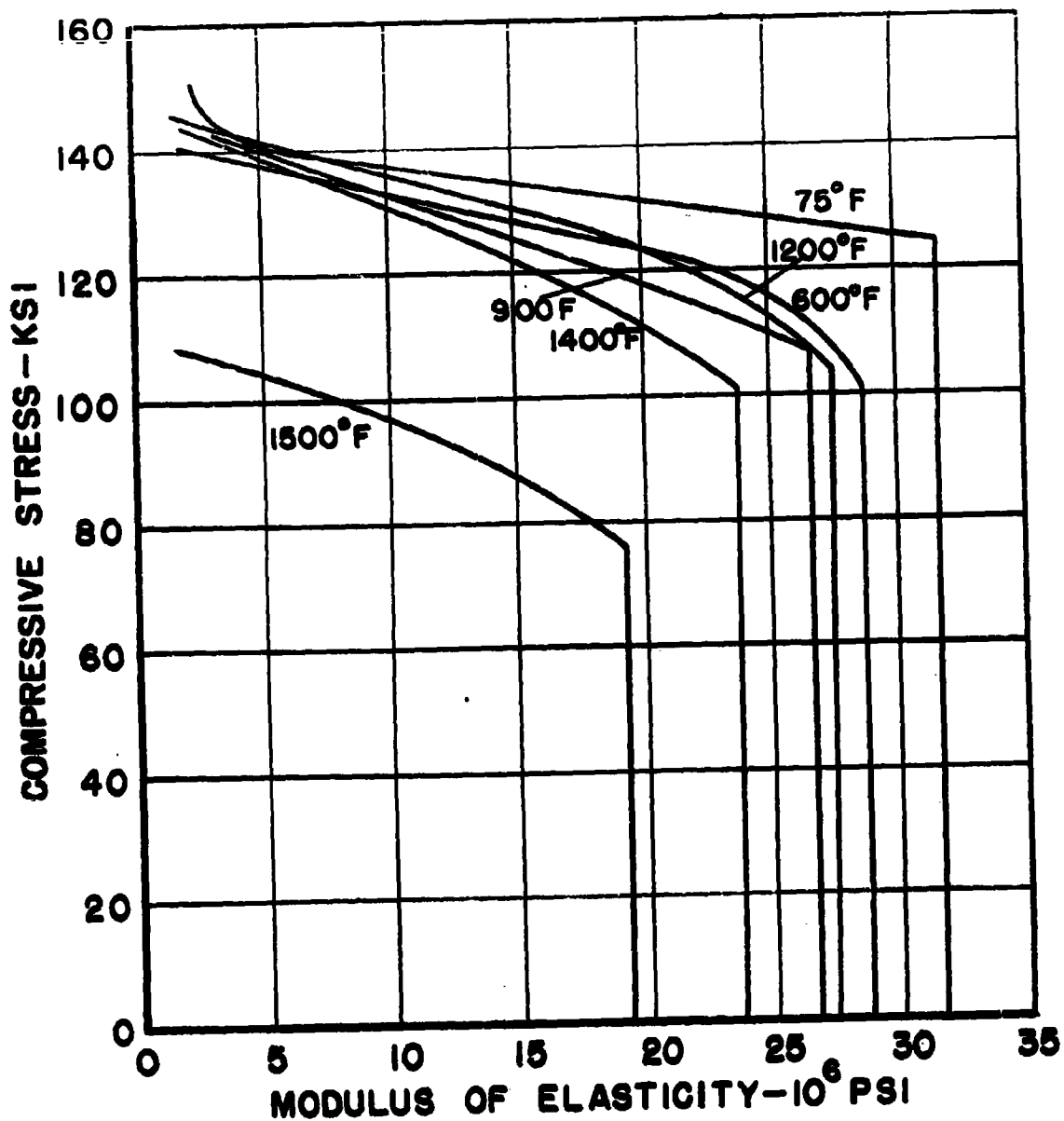


FIGURE 208. COMPRESSIVE TANGENT MODULUS CURVES
OF RENÉ 41 EXPOSED 10 HOURS

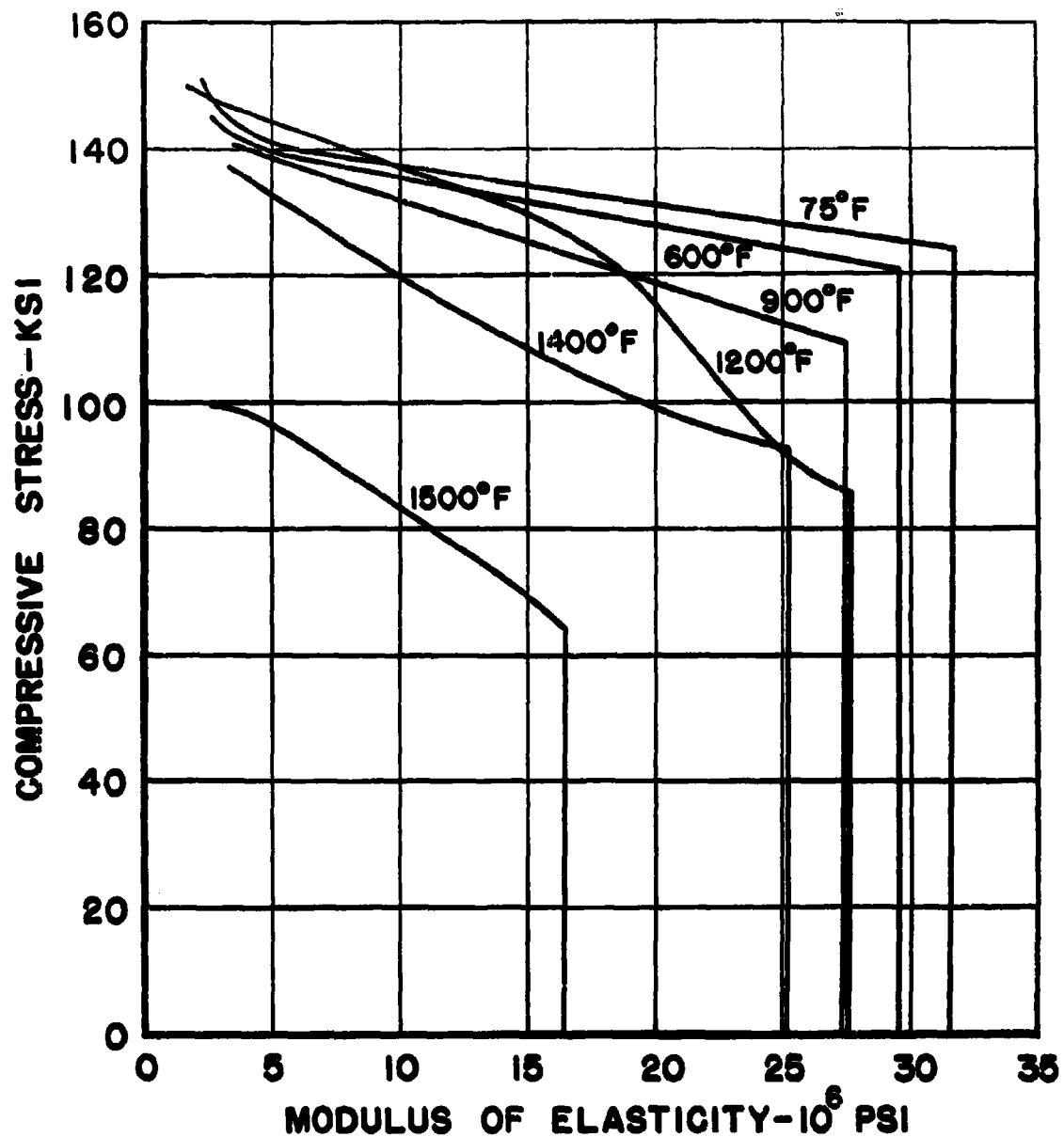


FIGURE 209. COMPRESSIVE TANGENT MODULUS CURVES
OF RENÉ 41 EXPOSED 100 HOURS

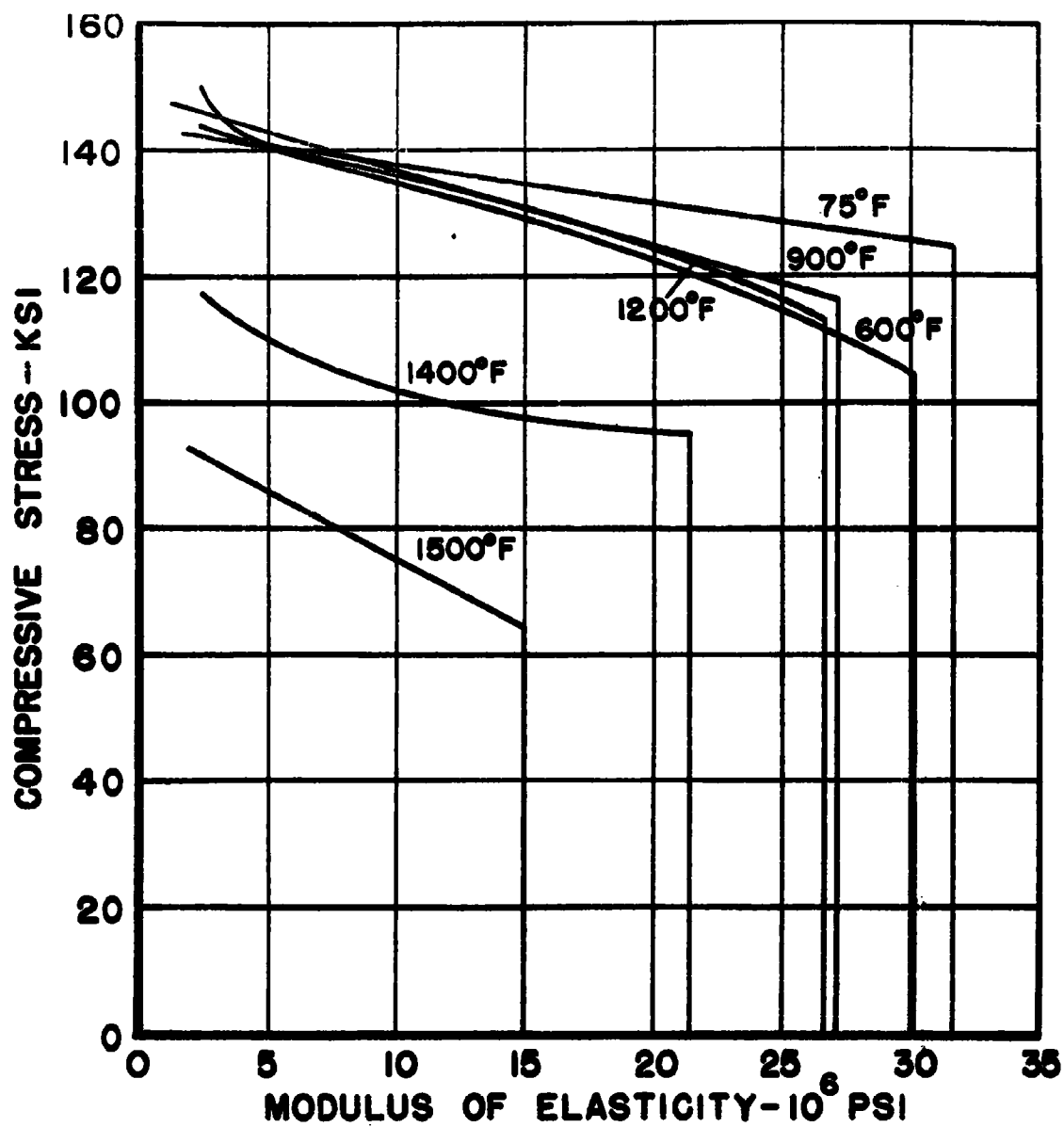


FIGURE 210. COMPRESSIVE TANGENT MODULUS CURVES OF RENÉ 41 EXPOSED 1000 HOURS

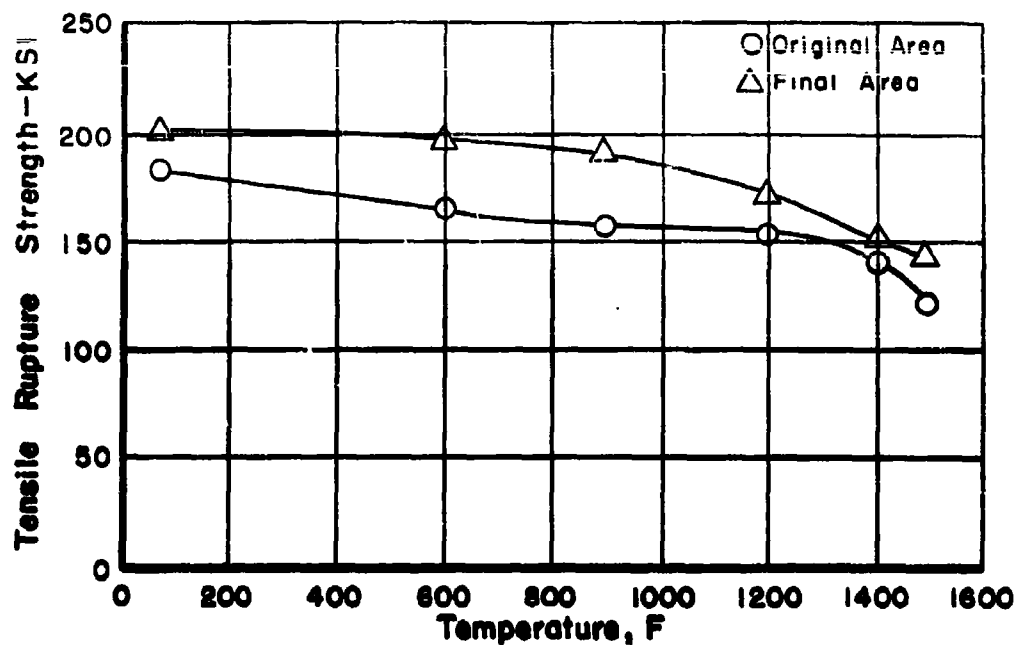


FIGURE 211. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENE 41 EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

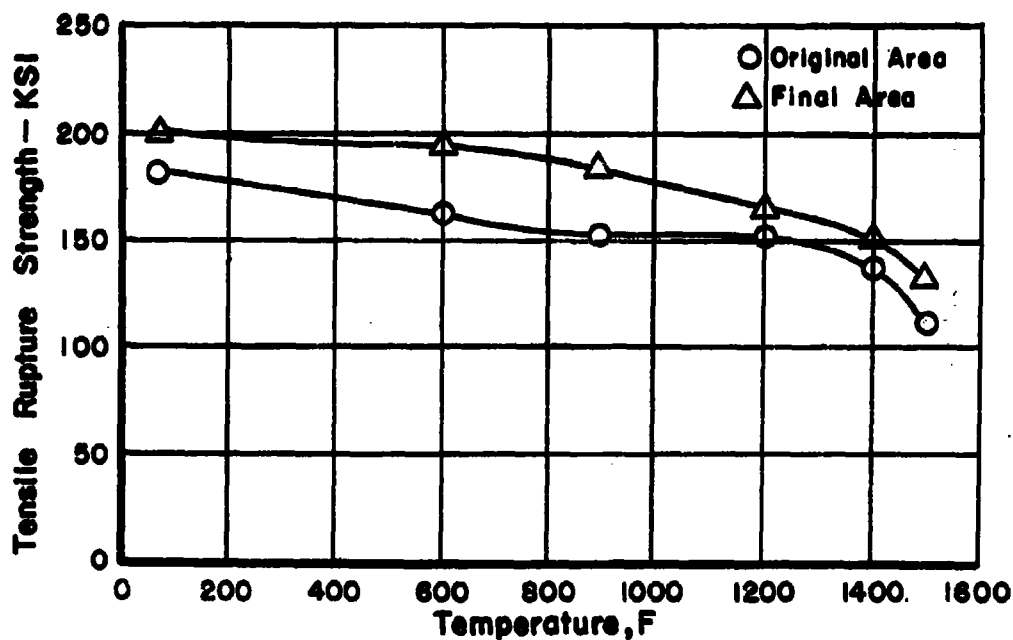


FIGURE 212. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENE 41 EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

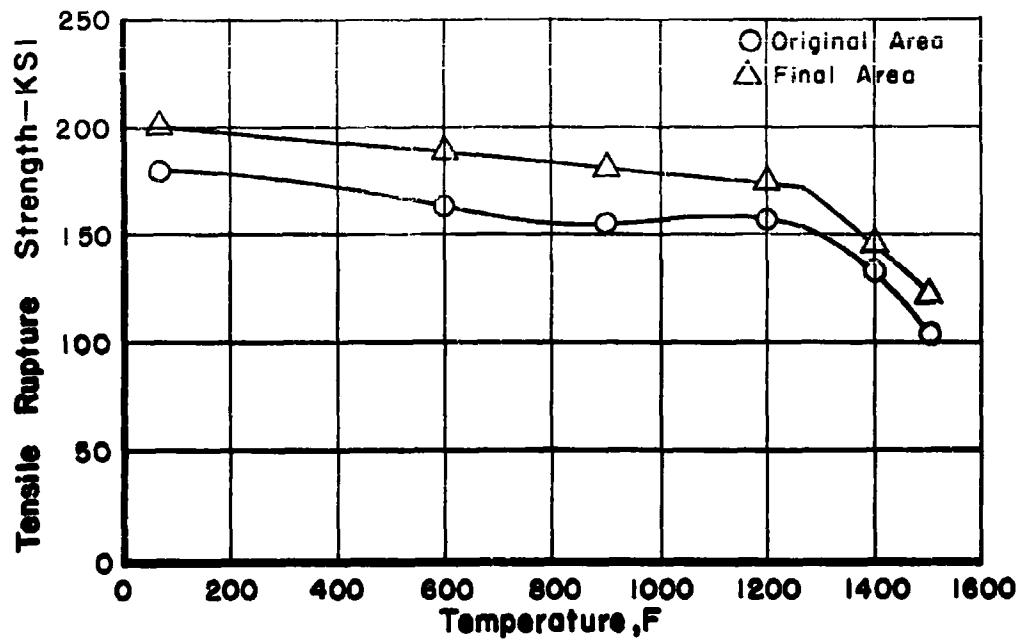


FIGURE 213. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENÉ 41 EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

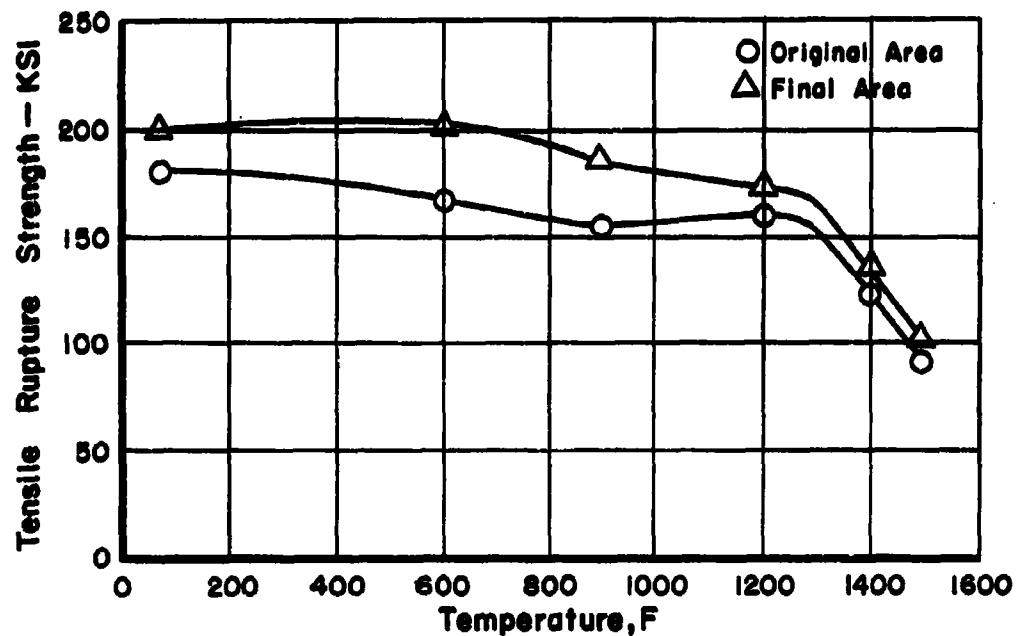


FIGURE 214. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF RENÉ 41 EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX IV

SUMMARY OF ROOM TEMPERATURE PROPERTIES OF N-155

Form: 0.050 Inch Sheet

Condition: Annealed

Properties:

Ultimate Tensile Strength	-	F_{tu}	=	117,100 psi
Tensile Yield Strength	-	F_{ty}	=	58,910 psi
Modulus of Elasticity	-	E	=	29.14×10^6 psi
Percent Elongation in 2 inches			=	49.3
Notched Tensile Strength	-	F_{tu}	=	110,770 psi
Compressive Yield Strength	-	F_{cy}	=	52,370 psi
Compressive Modulus of Elasticity	-	E_c	=	29.76×10^6 psi
Ultimate Bearing Strength				
(e/D = 1.5)	-	F_{bru}	=	198,130 psi
(e/D = 2.0)	-	F_{bru}	=	259,200 psi
Bearing Yield Strength				
(e/D = 1.5)	-	F_{bry}	=	89,070 psi
(e/D = 2.0)	-	F_{bry}	=	116,800 psi
Ultimate Shear Strength	-	F_{su}	=	84,010 psi

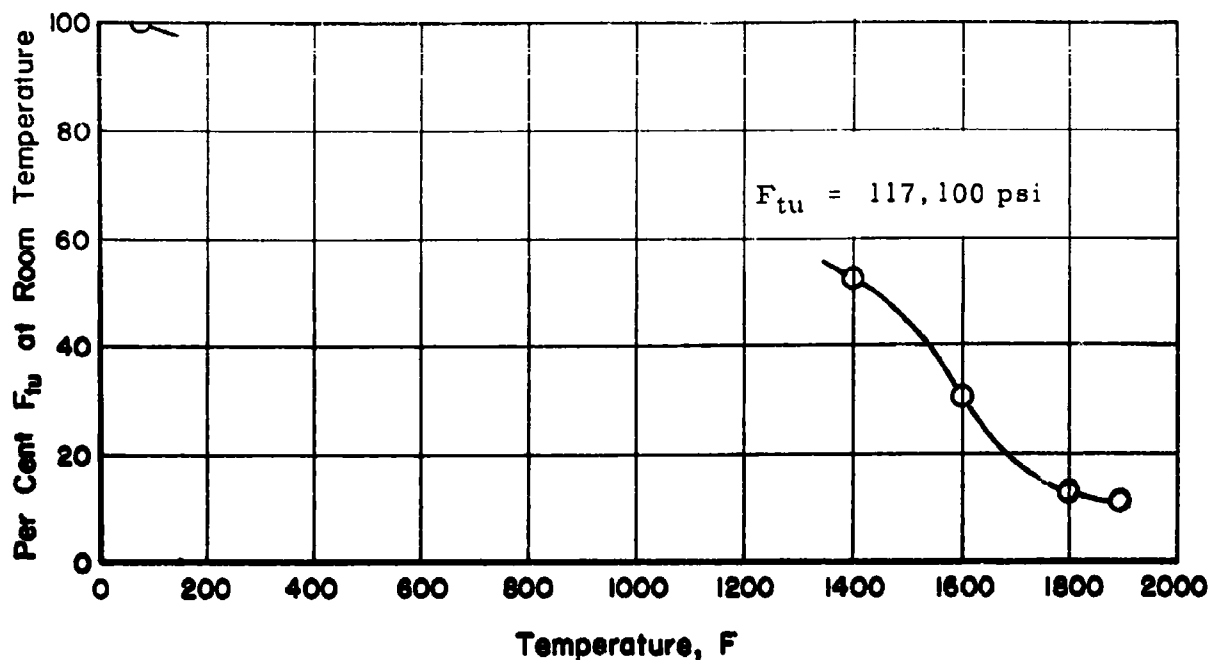


FIGURE 215. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 0.5 HOURS

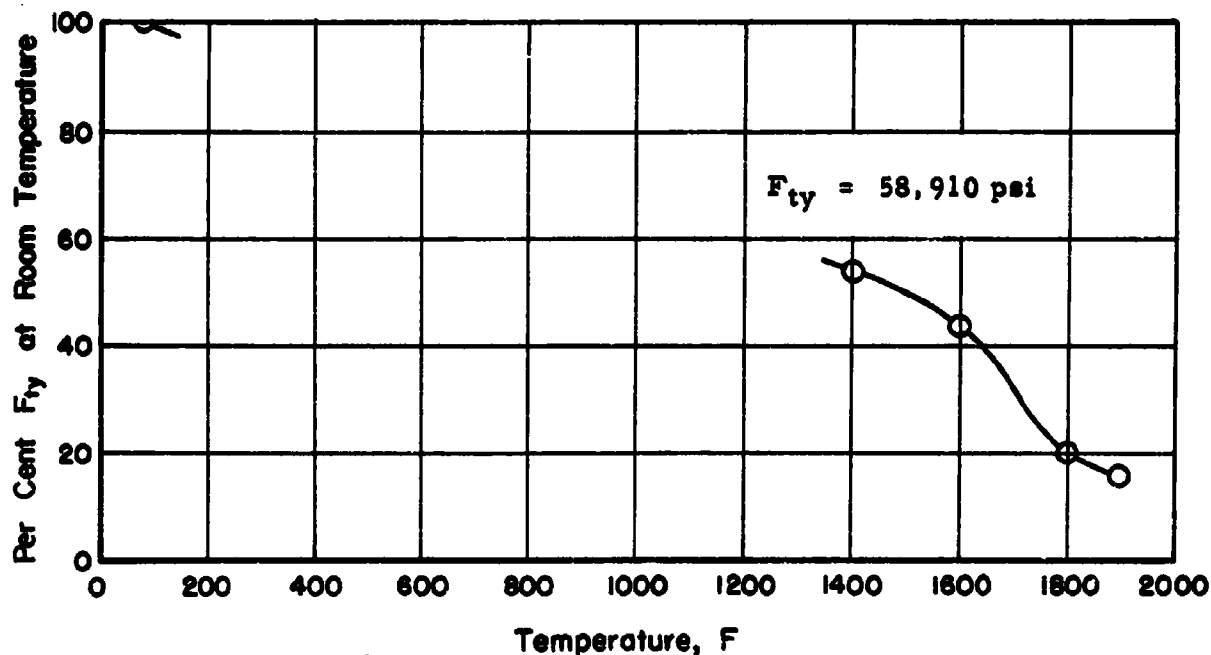


FIGURE 216. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

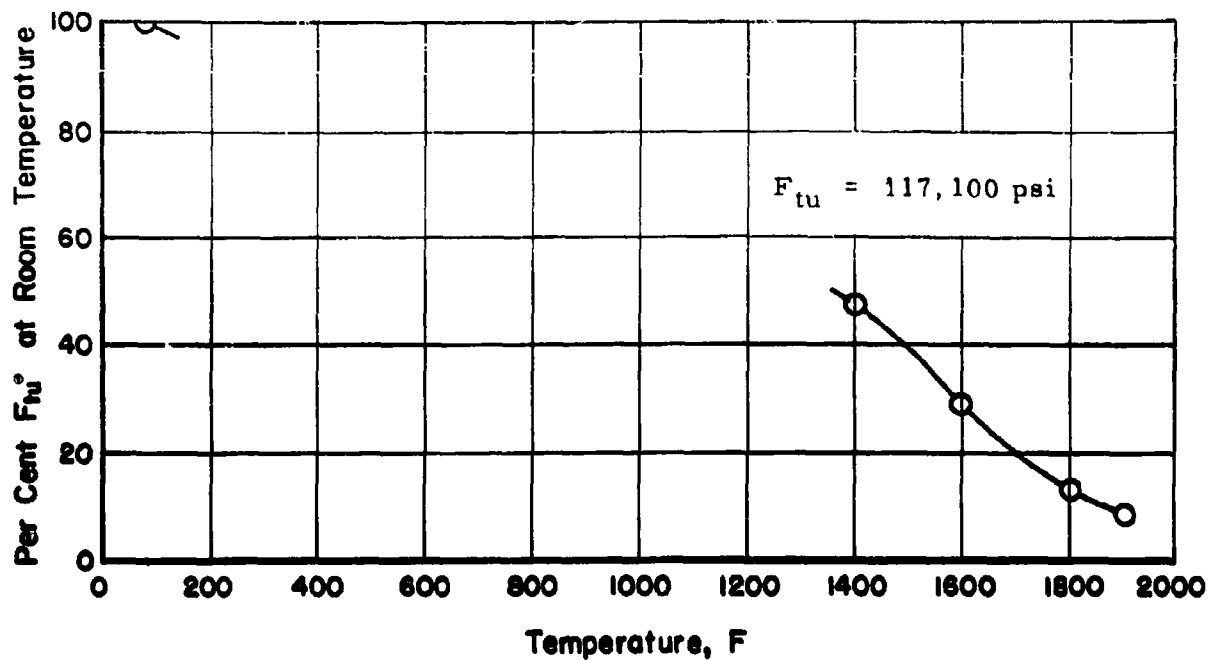


FIGURE 217. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 10 HOURS

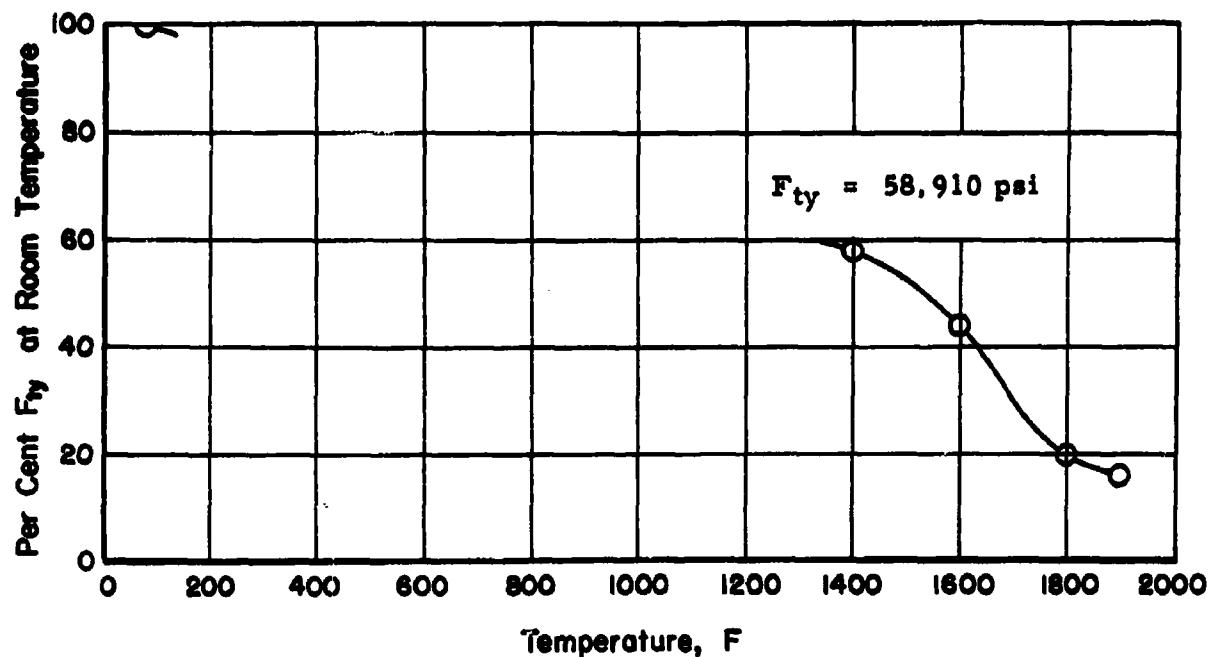


FIGURE 218. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

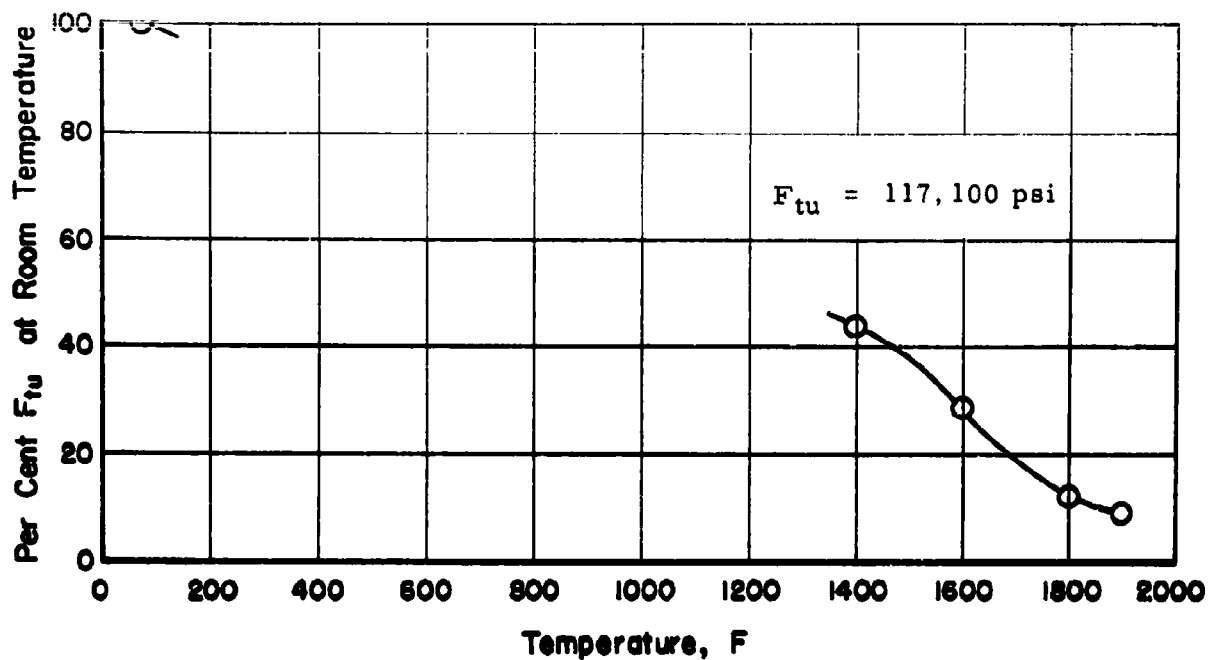


FIGURE 219. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 100 HOURS

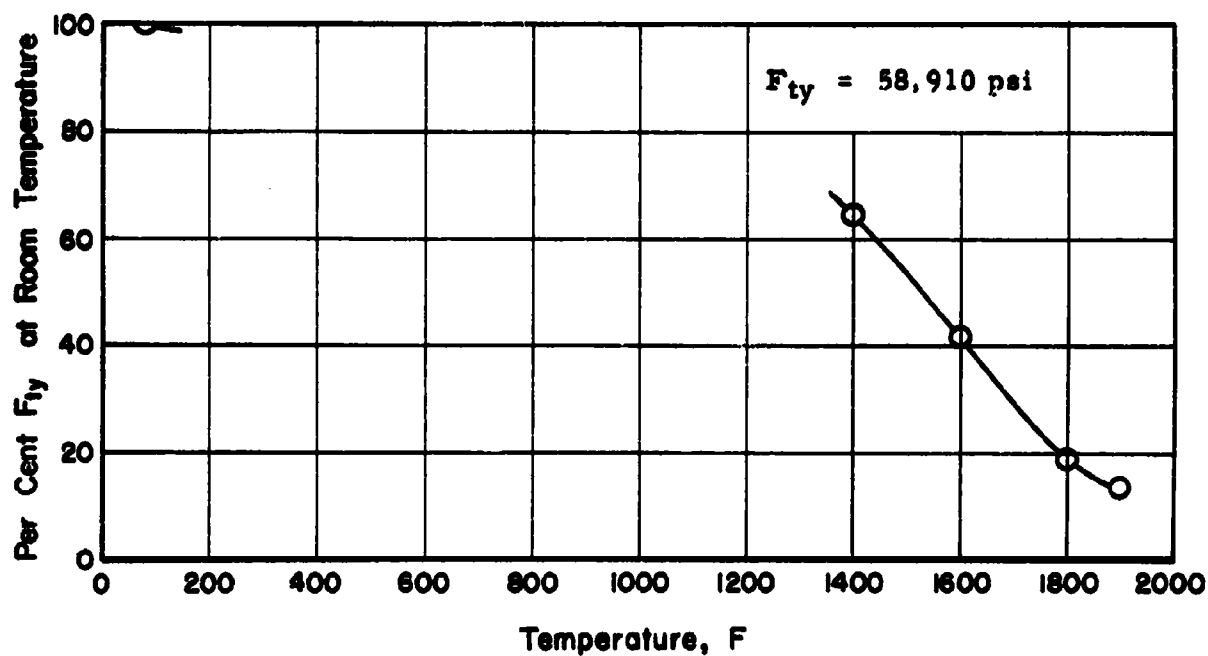


FIGURE 220. EFFECT OF TEMPERATURE ON TENSILE YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

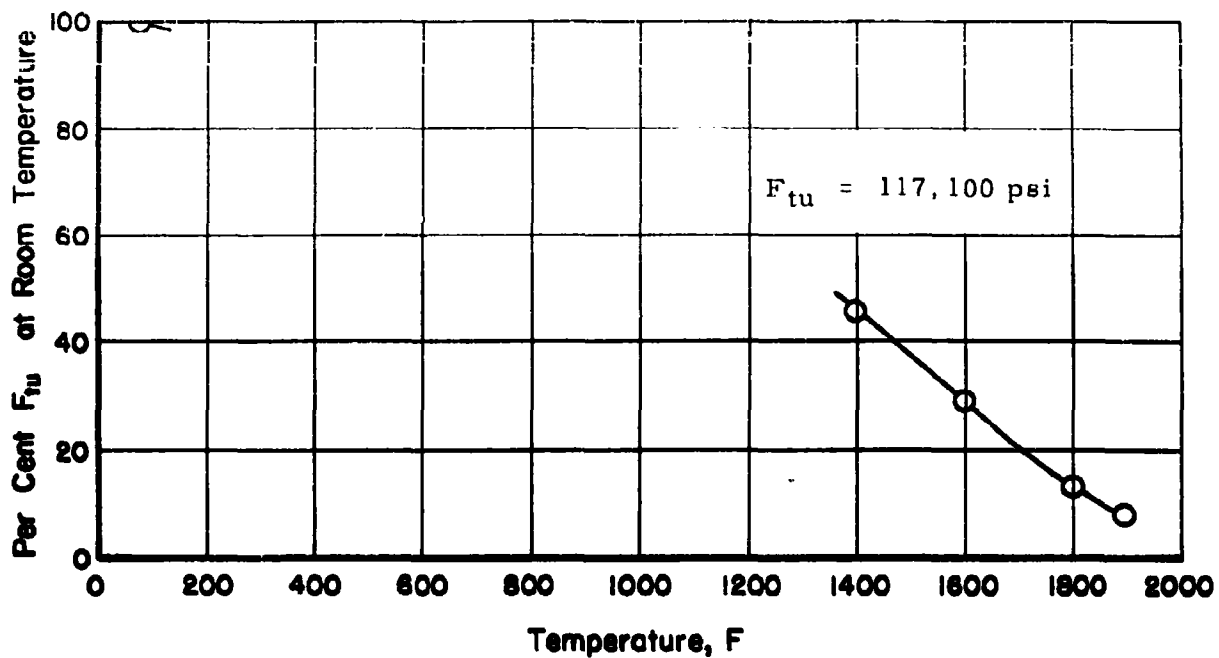


FIGURE 221. EFFECT OF TEMPERATURE ON ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 1000 HOURS

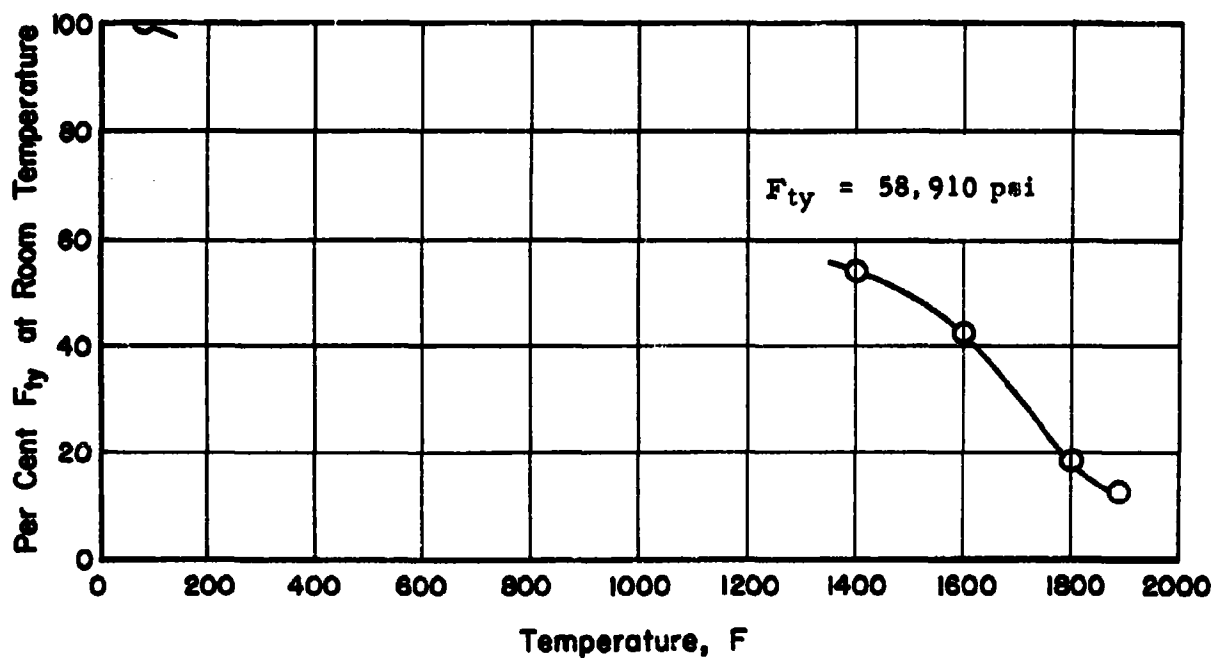


FIGURE 222. EFFECT OF TEMPERATURE ON ULTIMATE YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

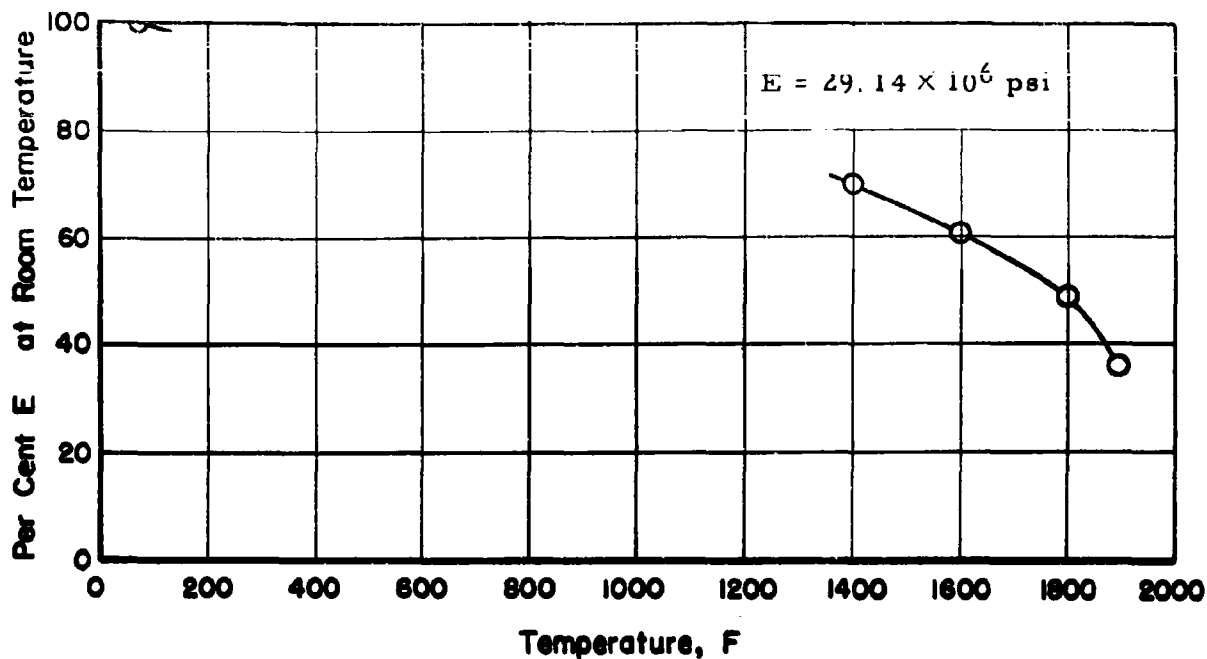


FIGURE 223. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 0.5 HOURS

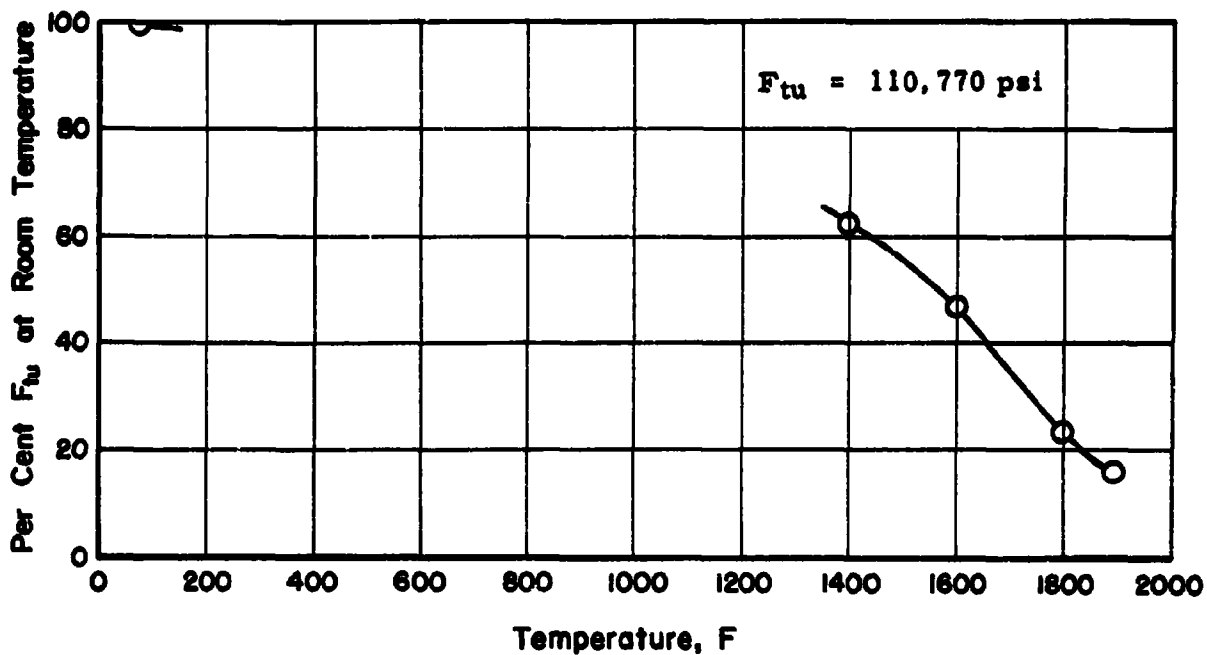


FIGURE 224. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 0.5 HOURS

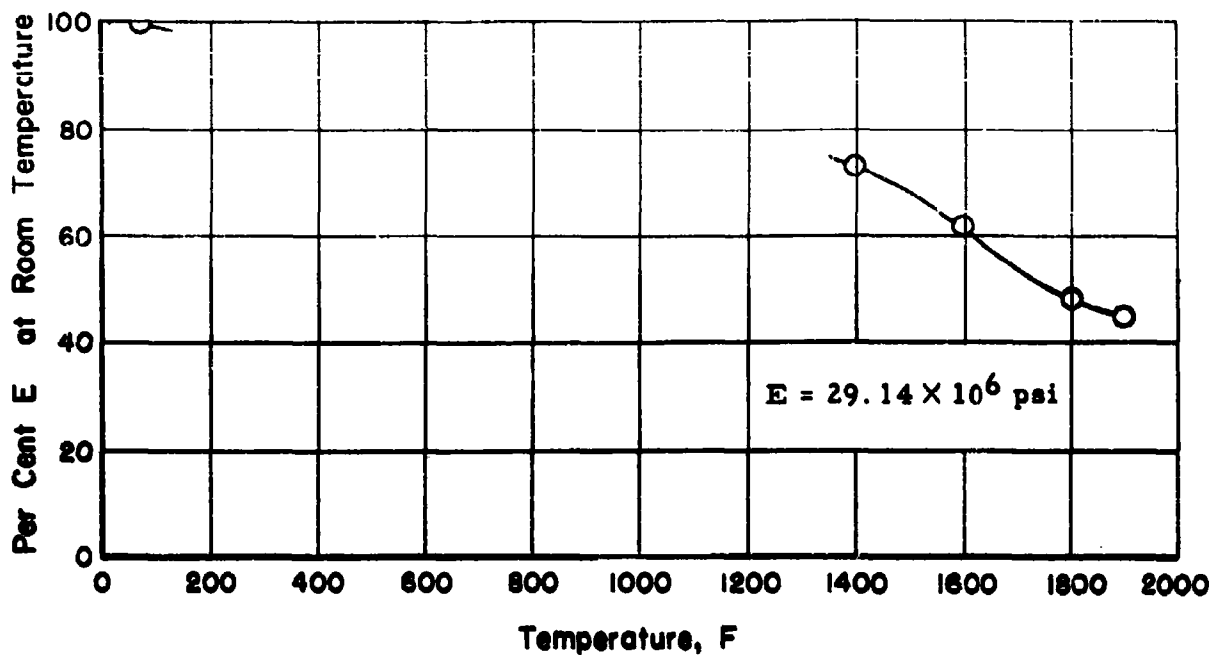


FIGURE 225. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 10 HOURS

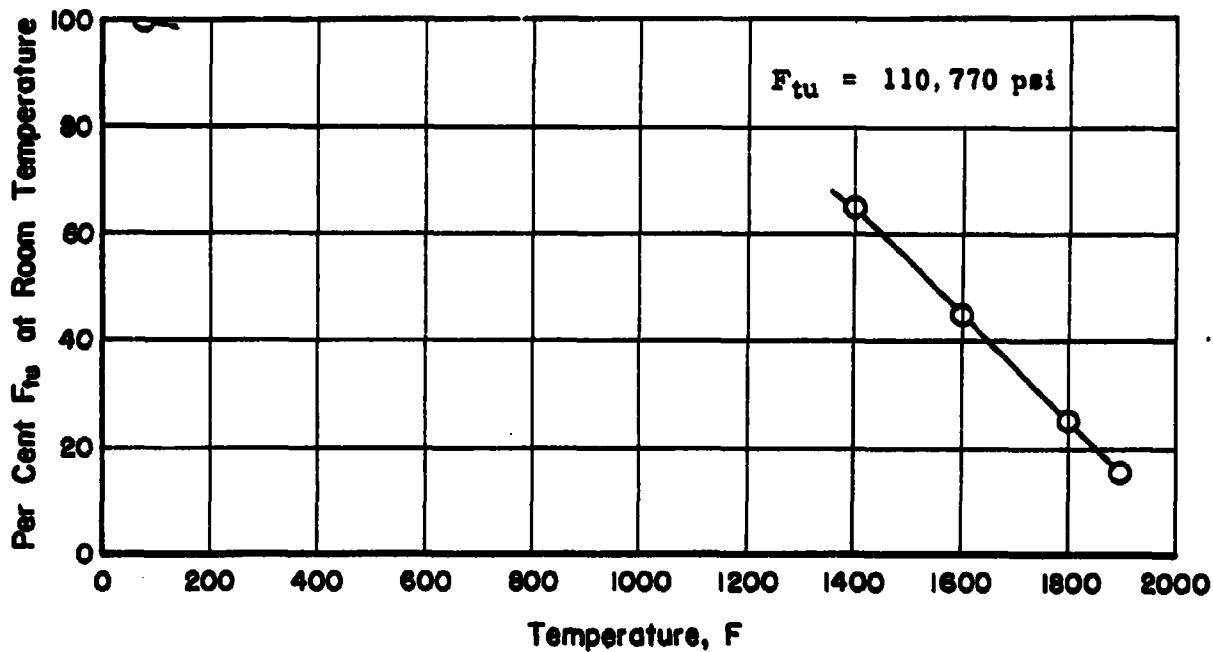


FIGURE 226. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 10 HOURS

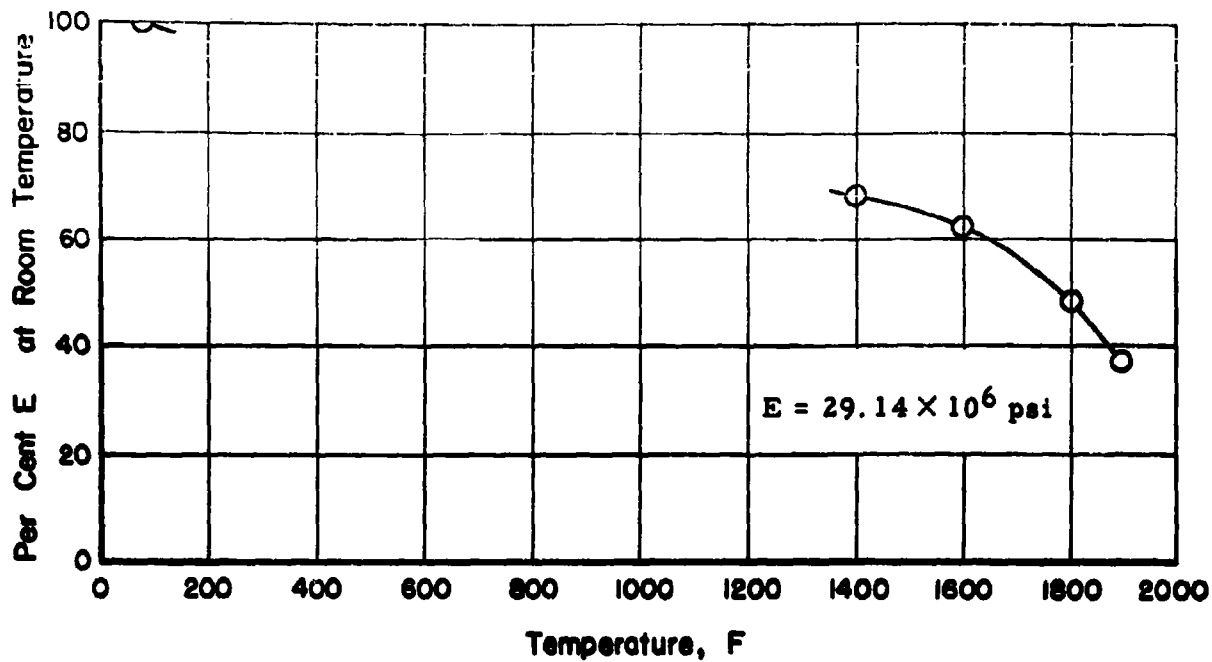


FIGURE 227. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 100 HOURS

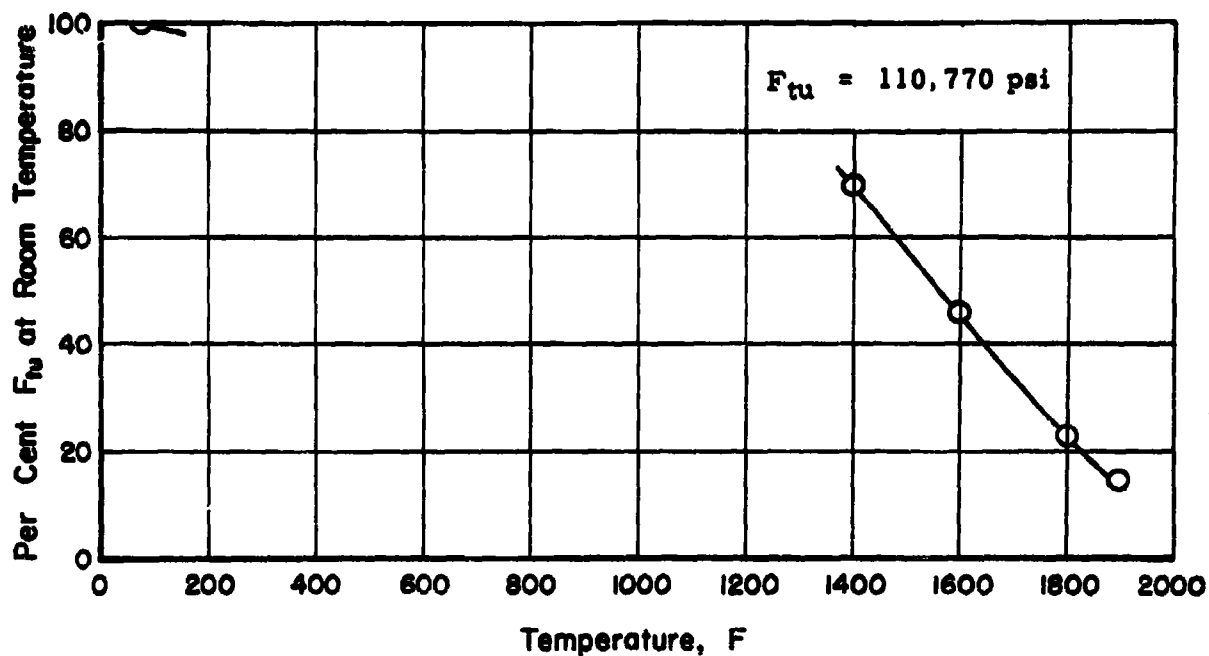


FIGURE 228. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 100 HOURS

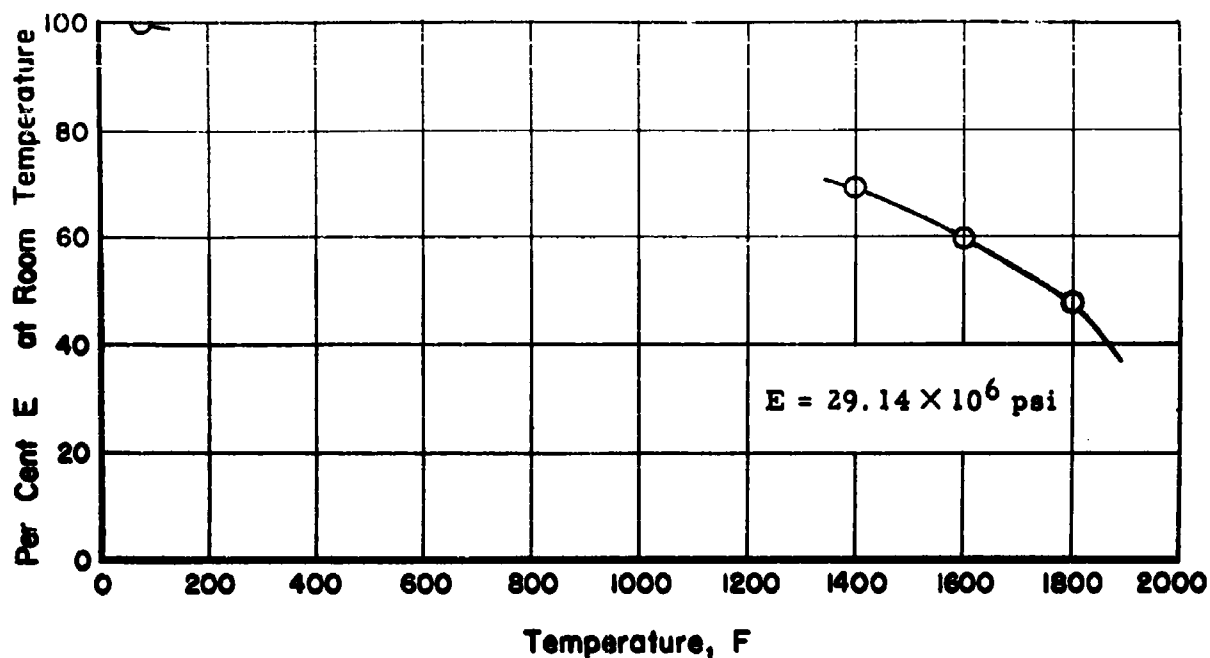


FIGURE 229. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF N-155 EXPOSED 1000 HOURS

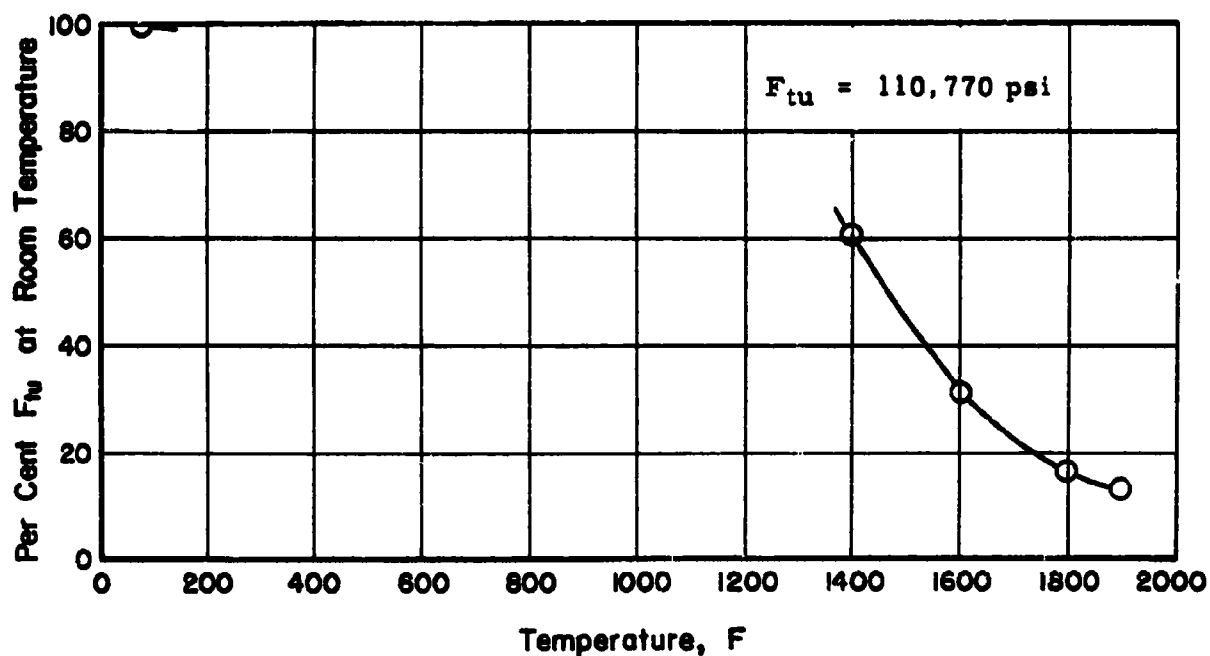


FIGURE 230. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF N-155 EXPOSED 1000 HOURS

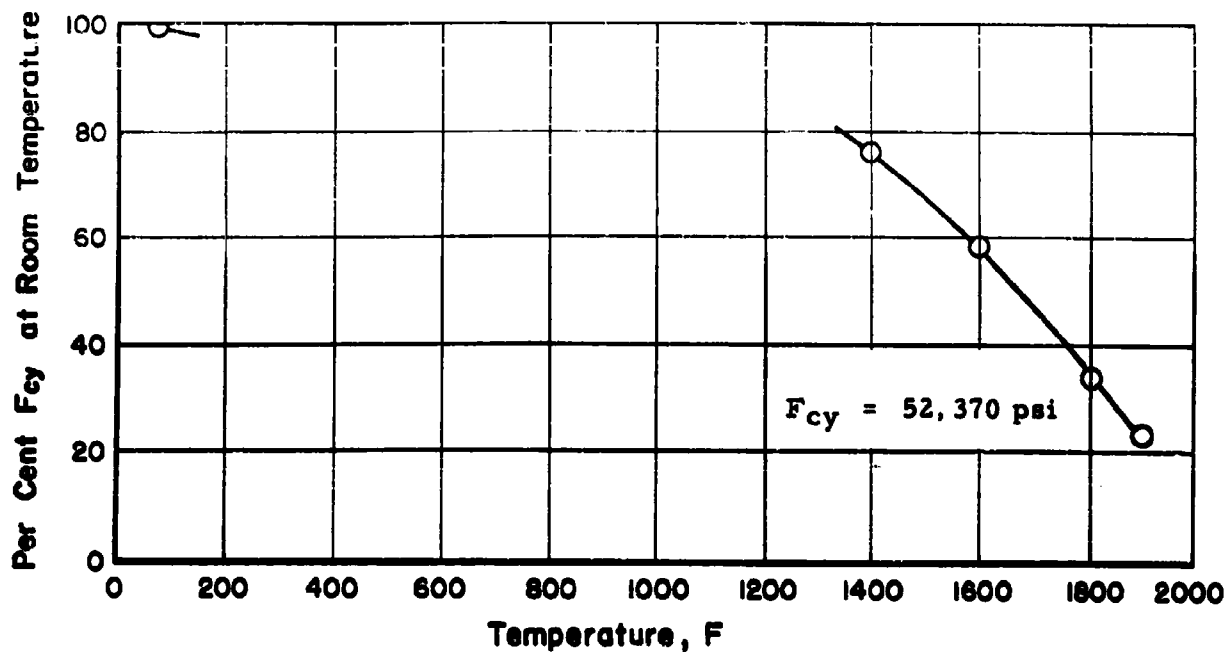


FIGURE 231. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

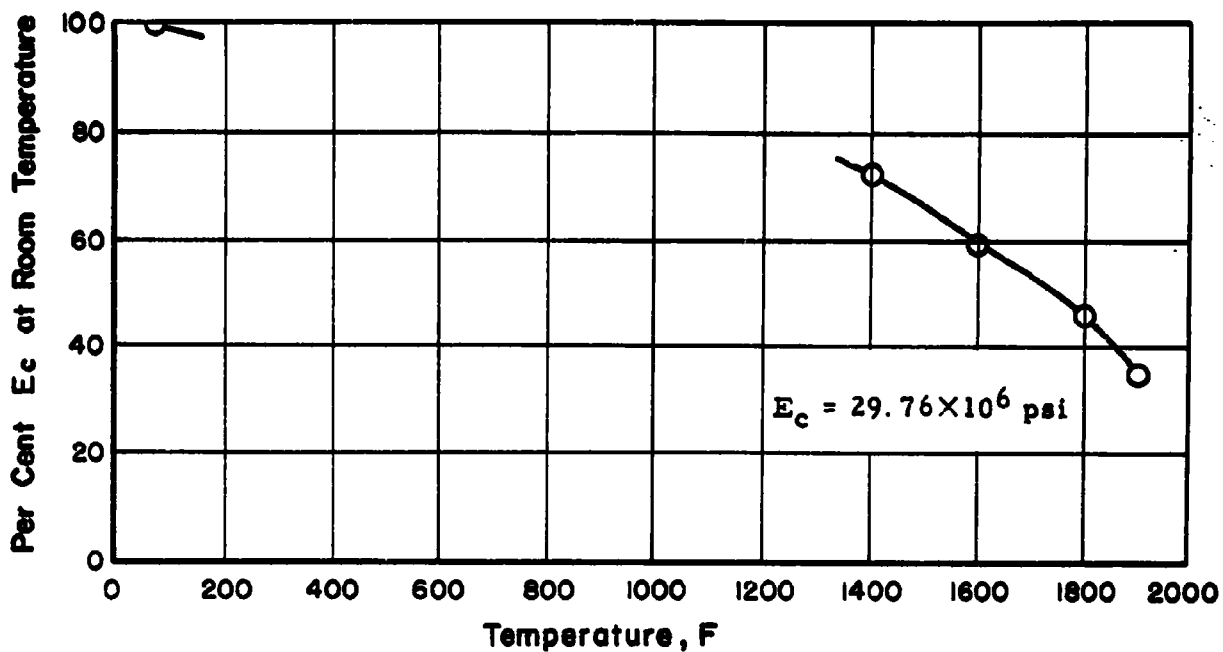


FIGURE 232. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 0.5 HOURS

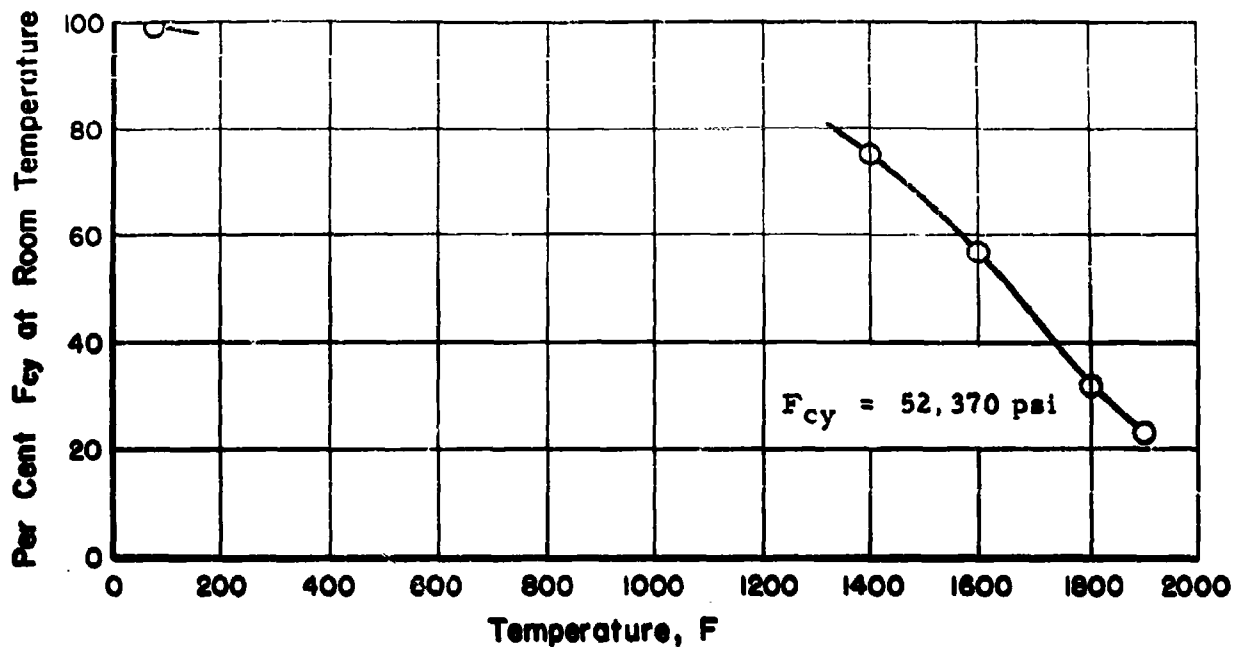


FIGURE 233. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

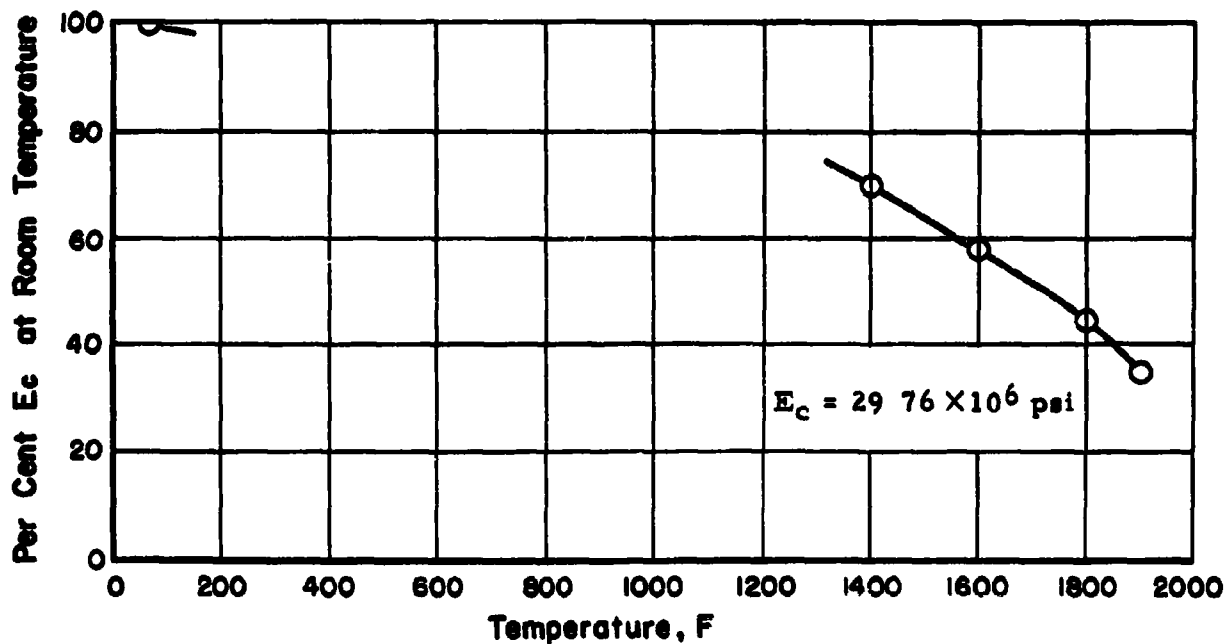


FIGURE 234. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 10 HOURS

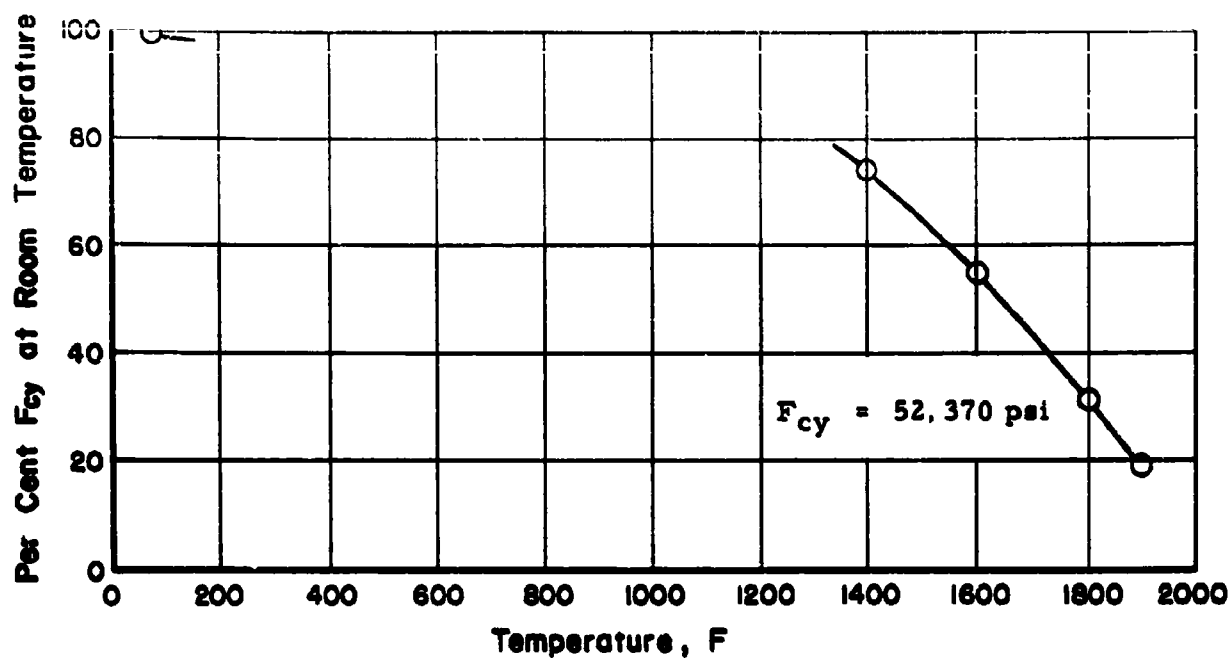


FIGURE 235. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

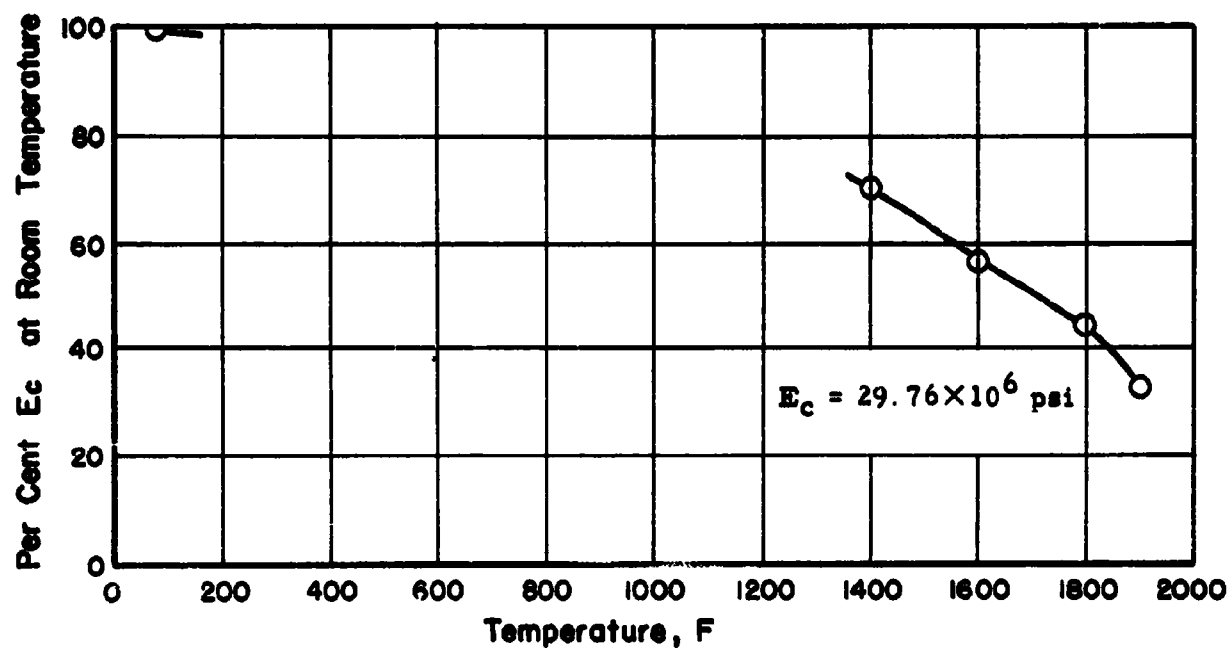


FIGURE 236. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 100 HOURS

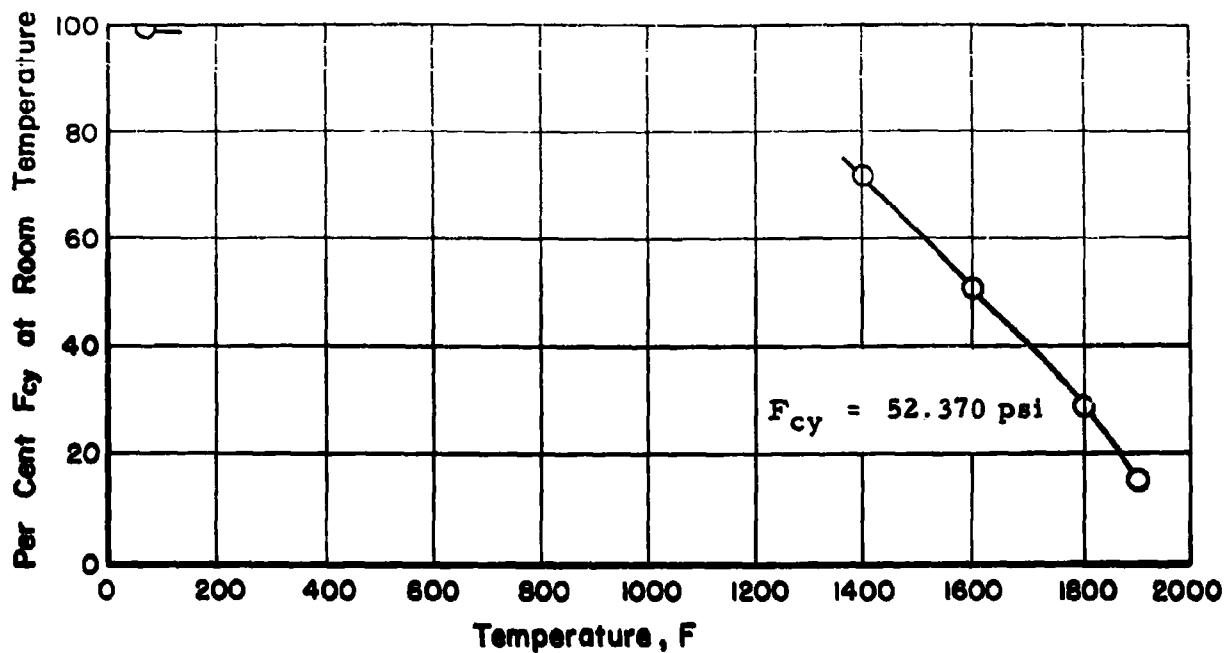


FIGURE 237. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

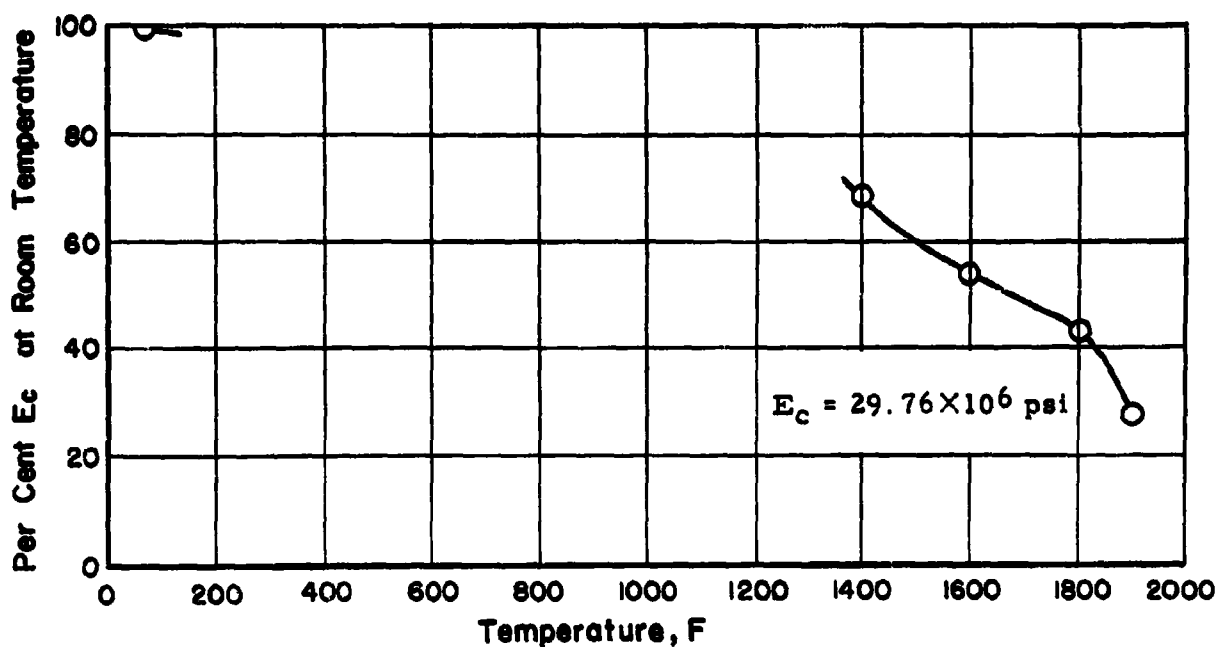


FIGURE 238. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF N-155 EXPOSED 1000 HOURS

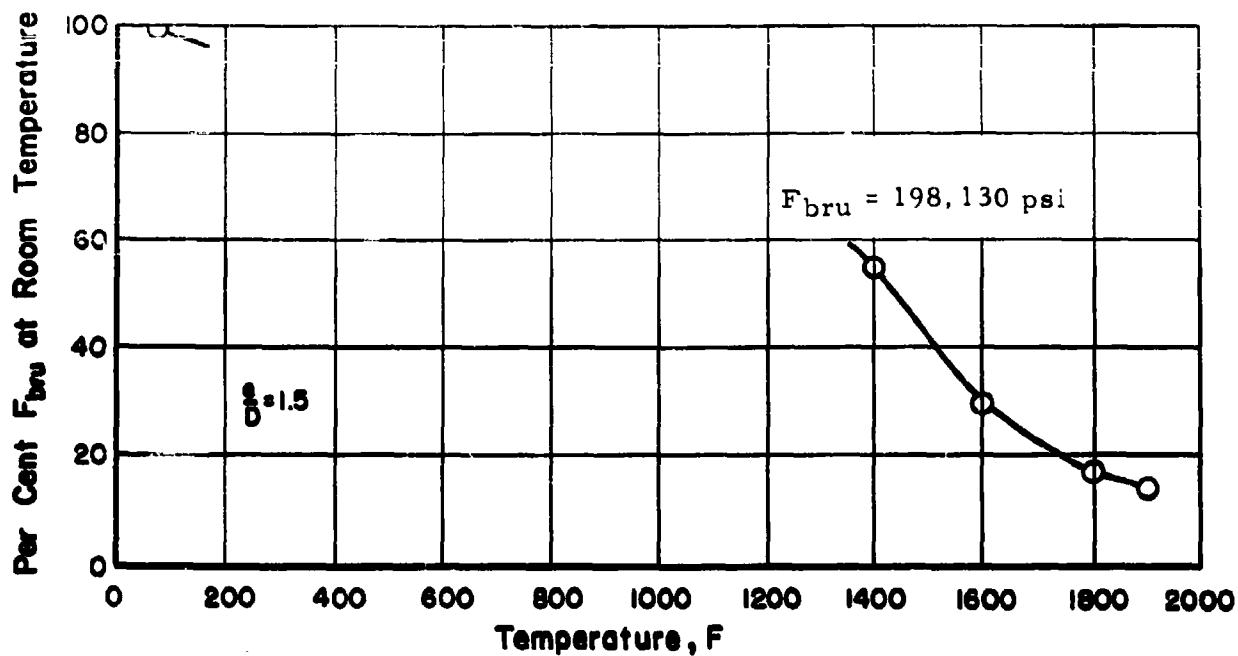


FIGURE 239. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 0.5 HOURS

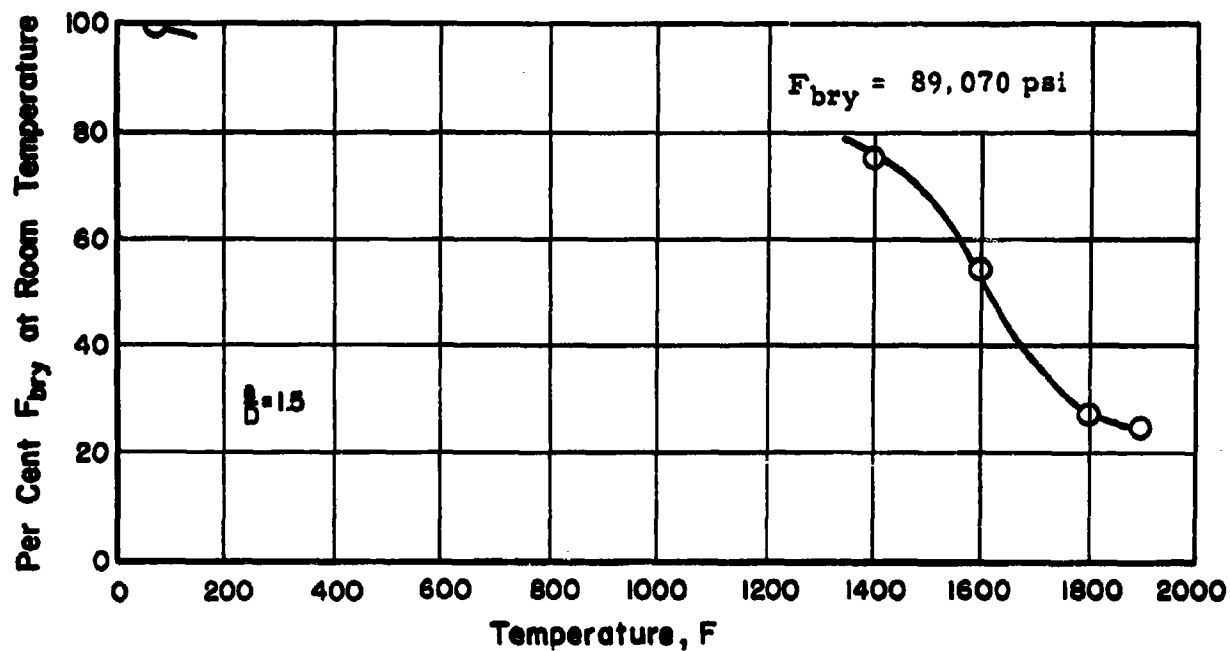


FIGURE 240. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

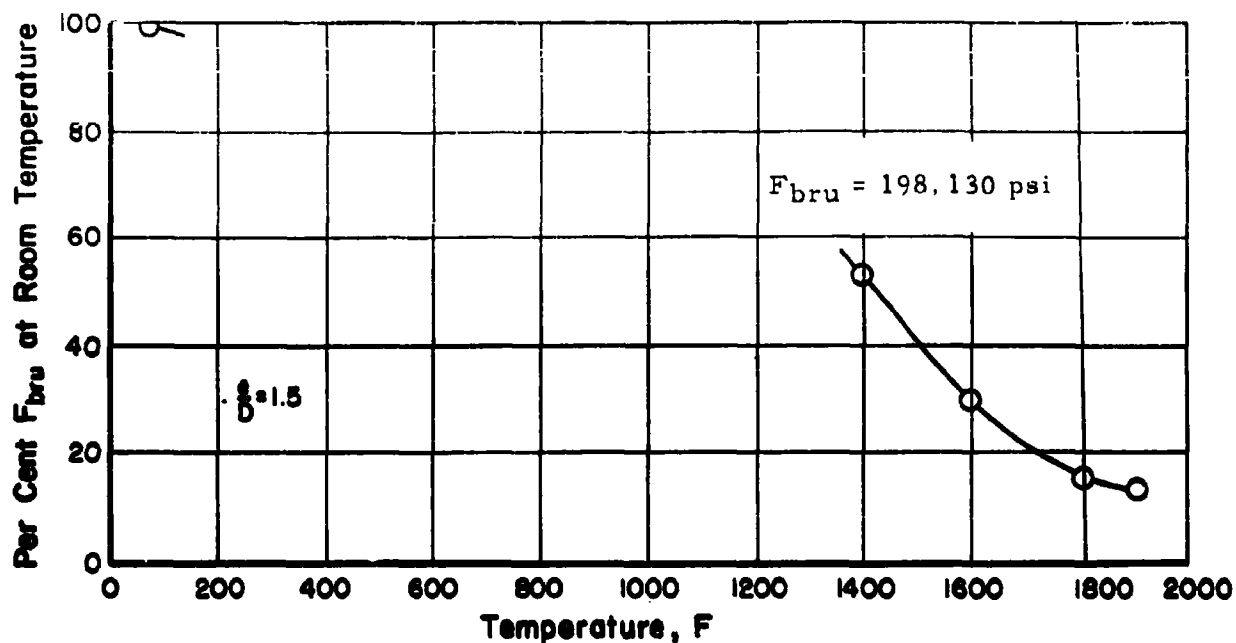


FIGURE 241. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 10 HOURS

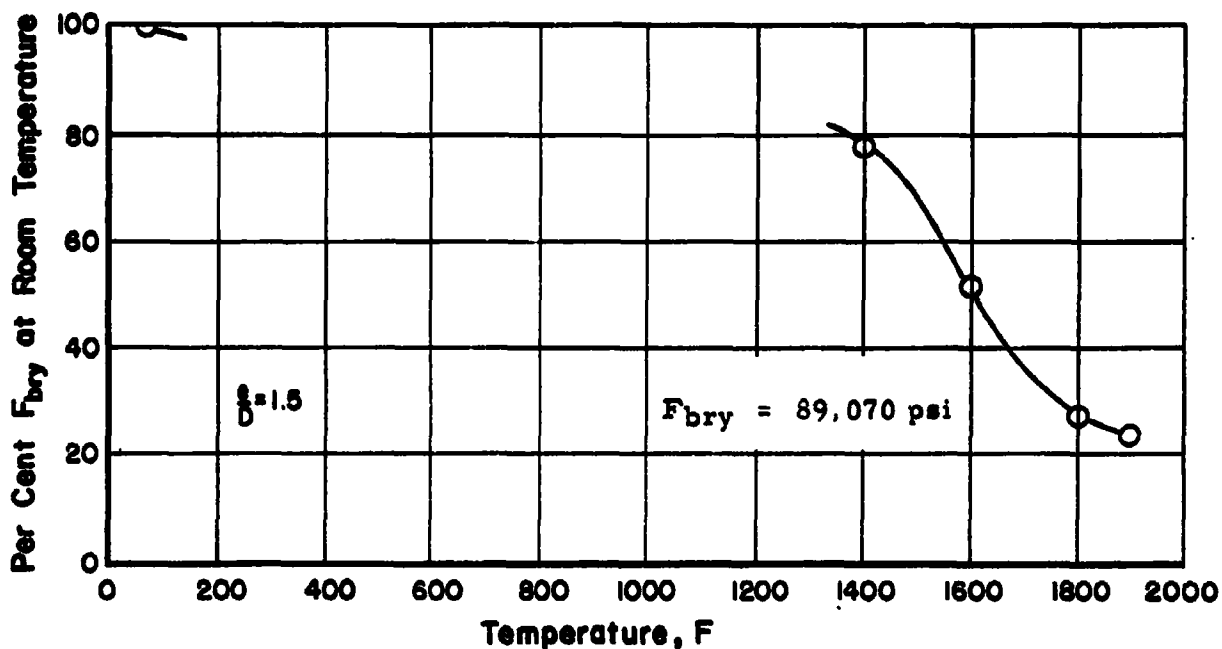


FIGURE 242. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

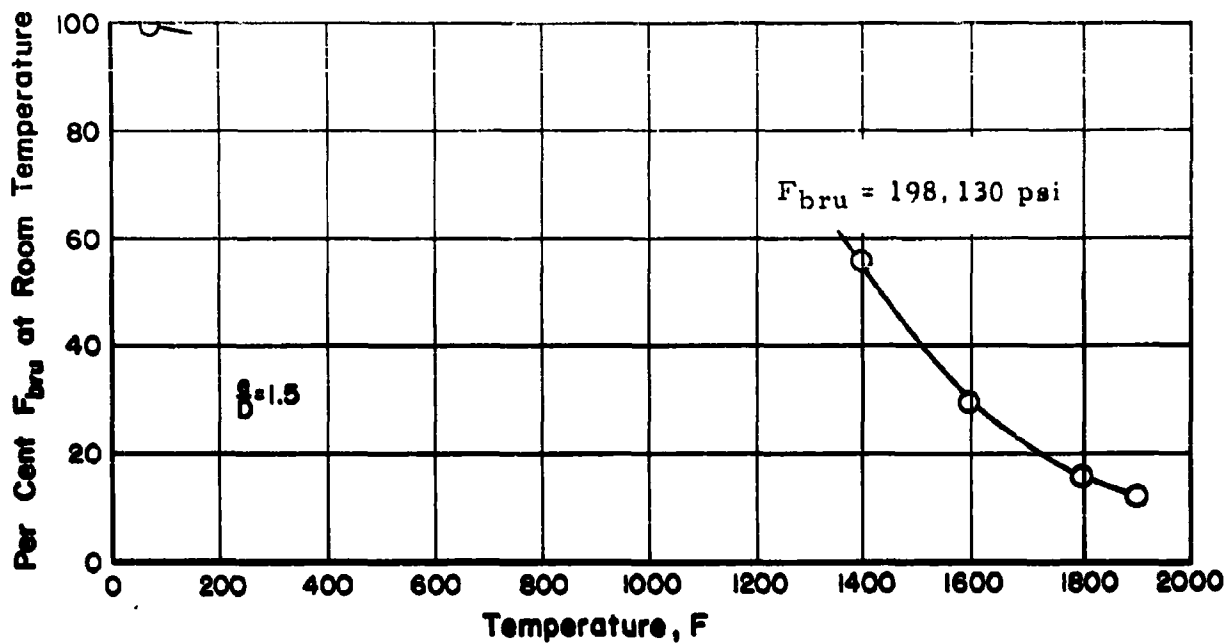


FIGURE 243. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 100 HOURS

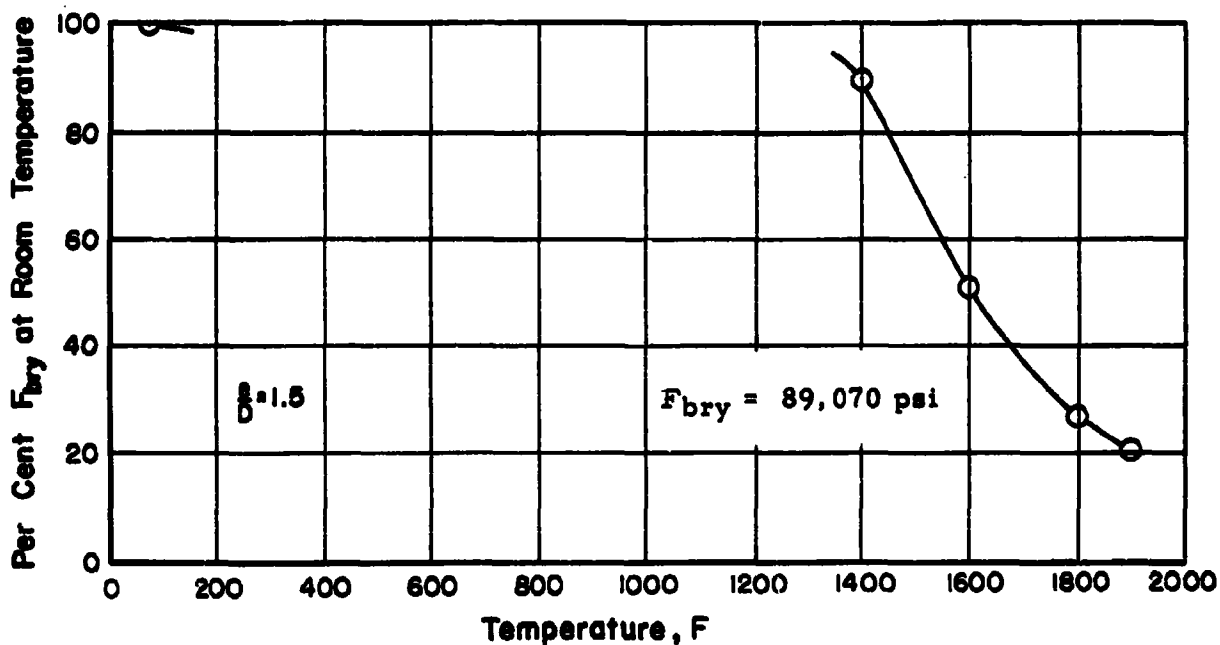


FIGURE 244. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

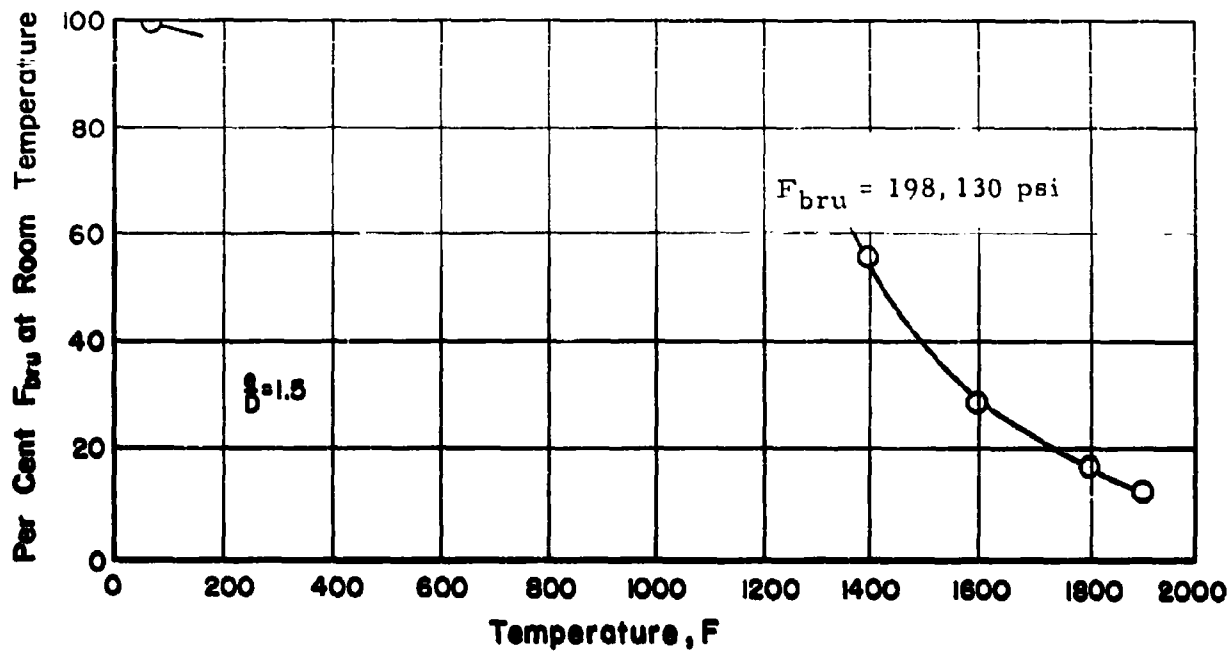


FIGURE 245. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 1000 HOURS

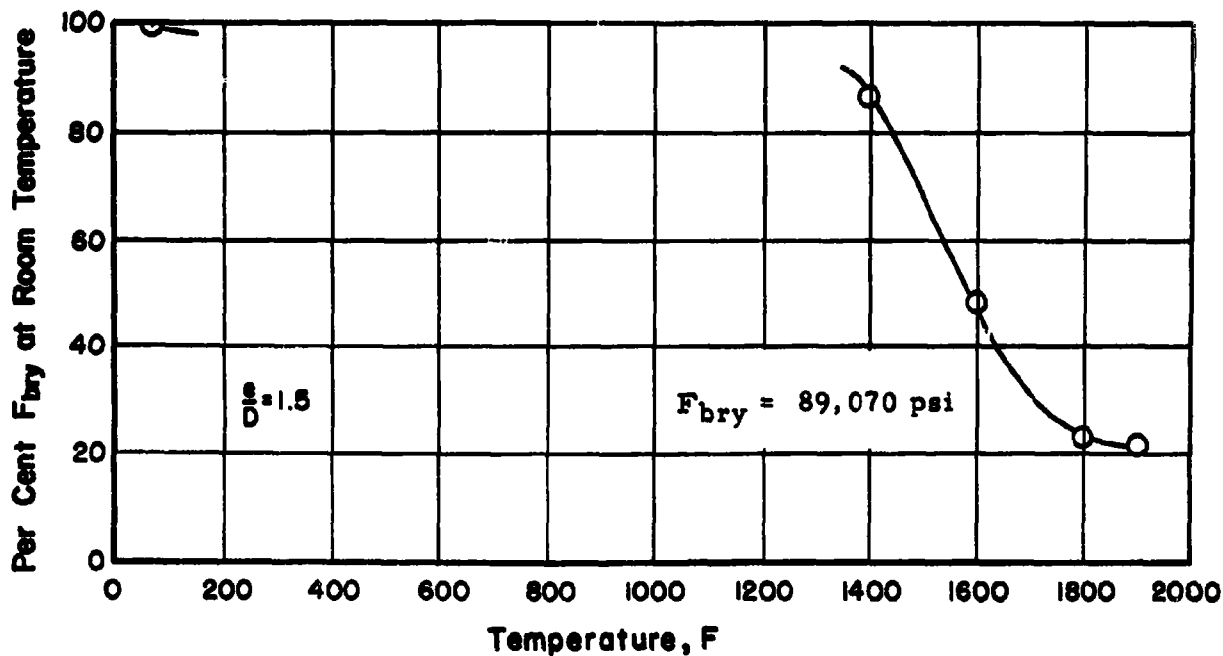


FIGURE 246. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

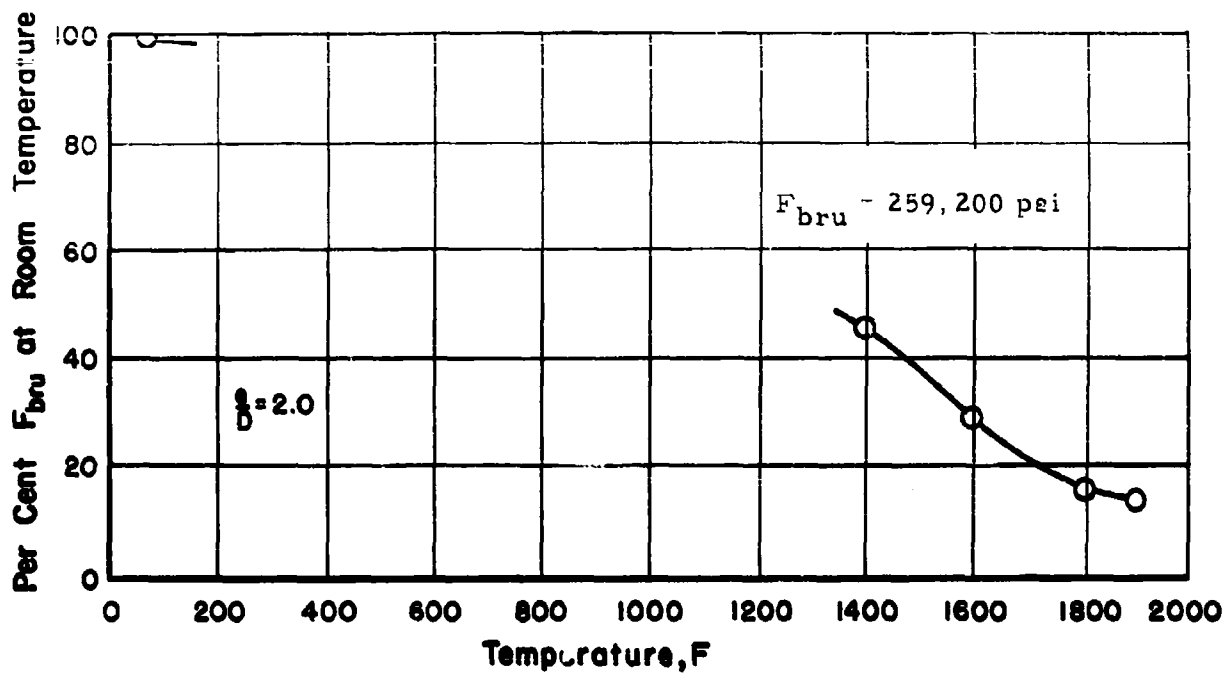


FIGURE 247. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 0.5 HOURS

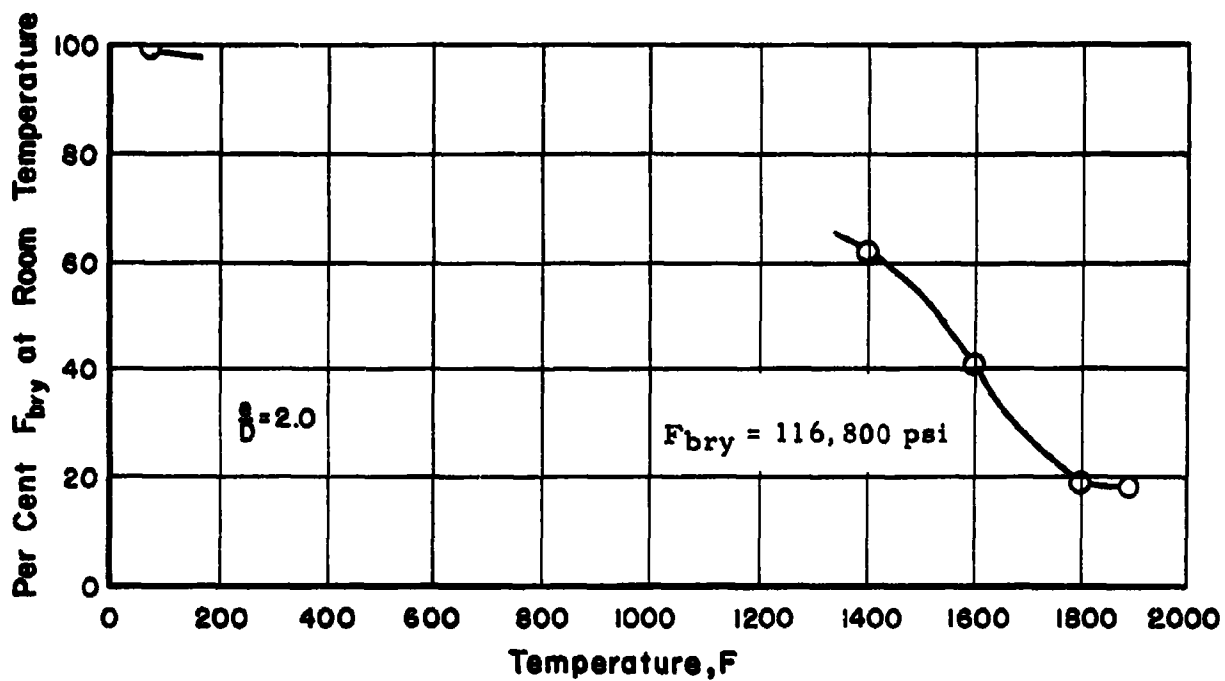


FIGURE 248. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 0.5 HOURS

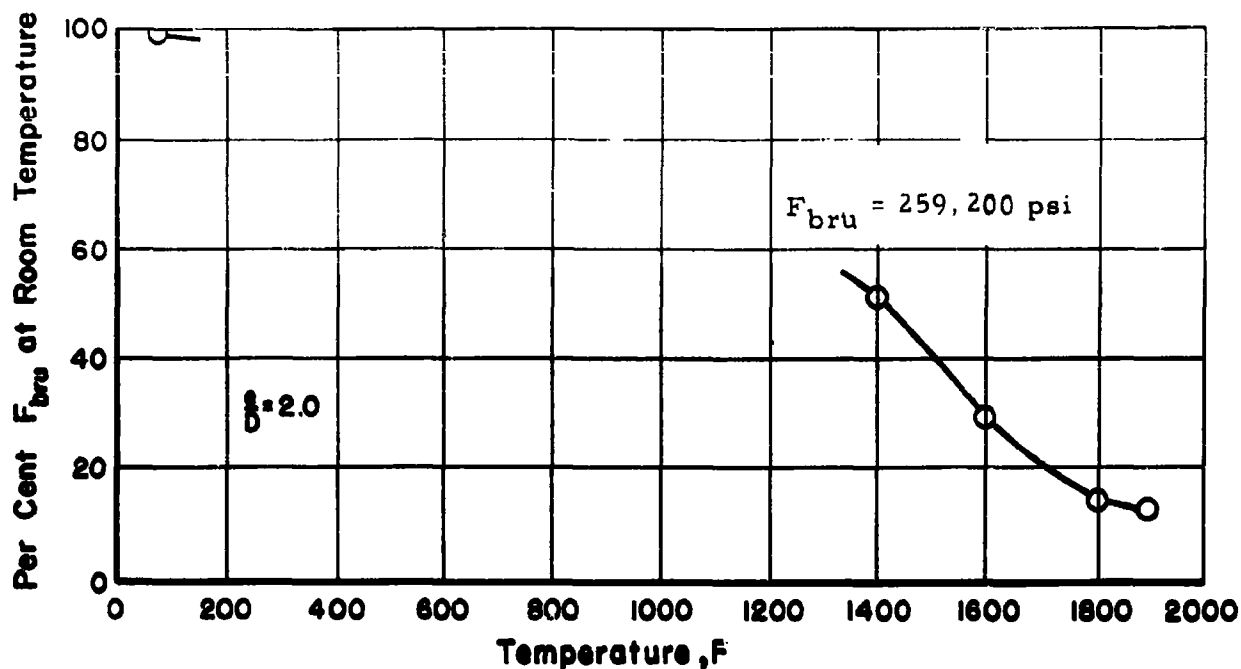


FIGURE 249. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 10 HOURS

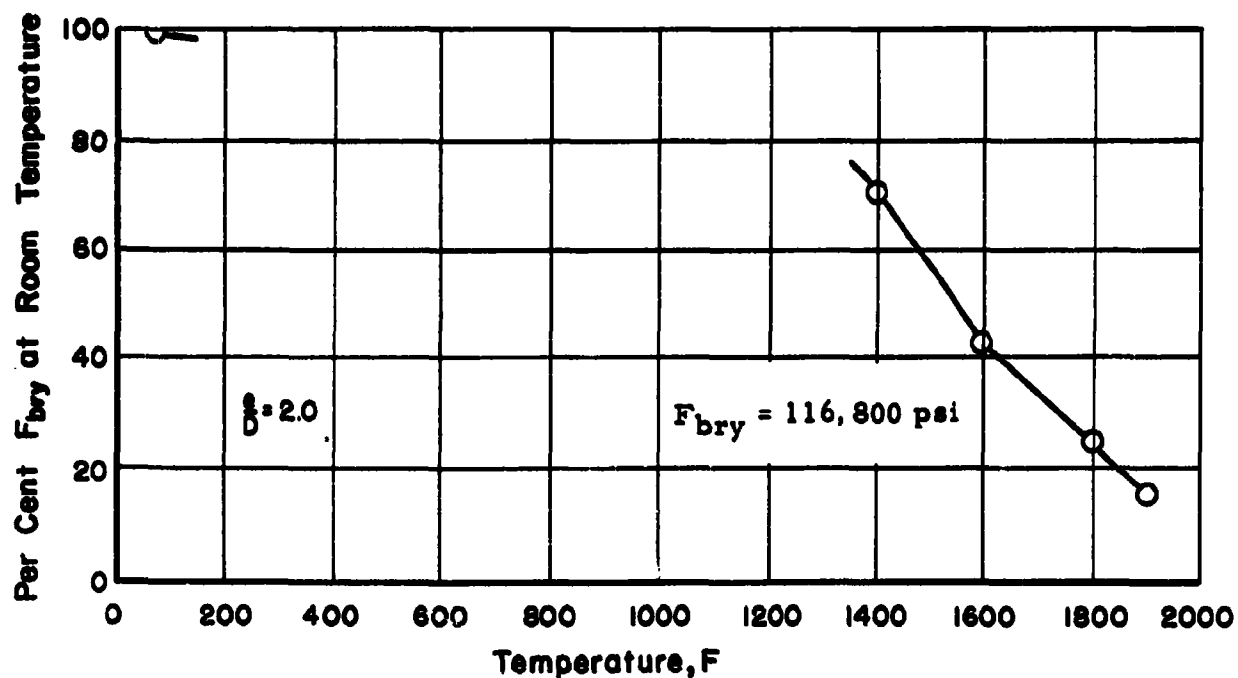


FIGURE 250. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 10 HOURS

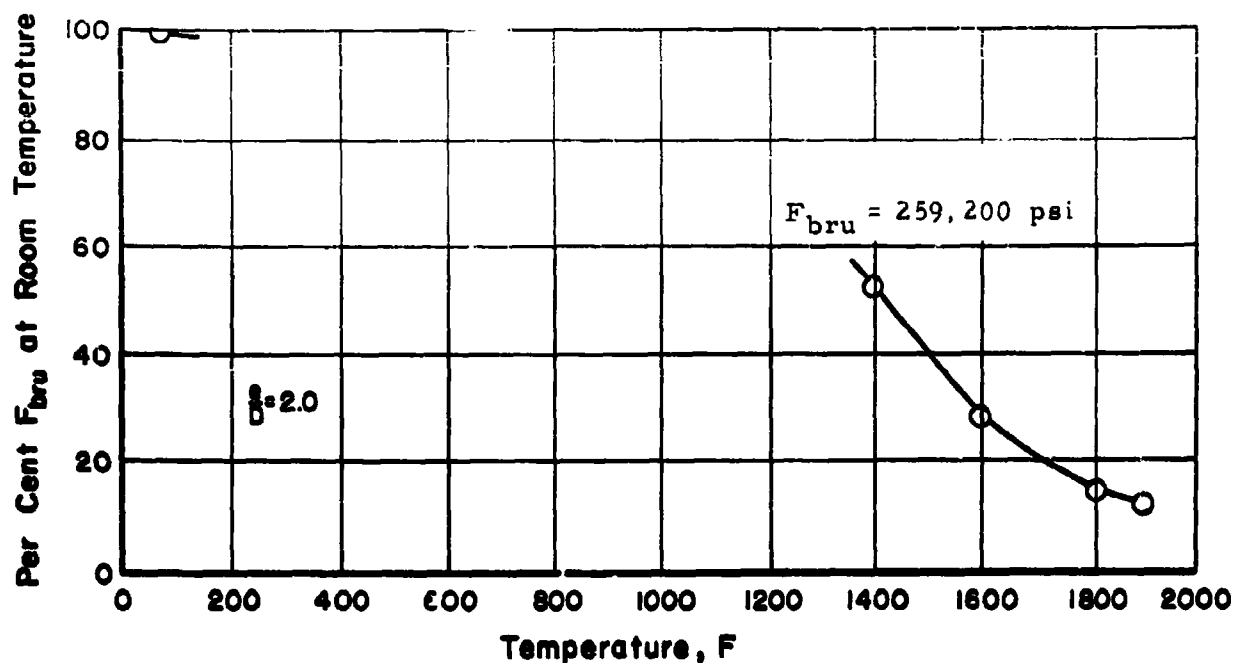


FIGURE 251. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 100 HOURS

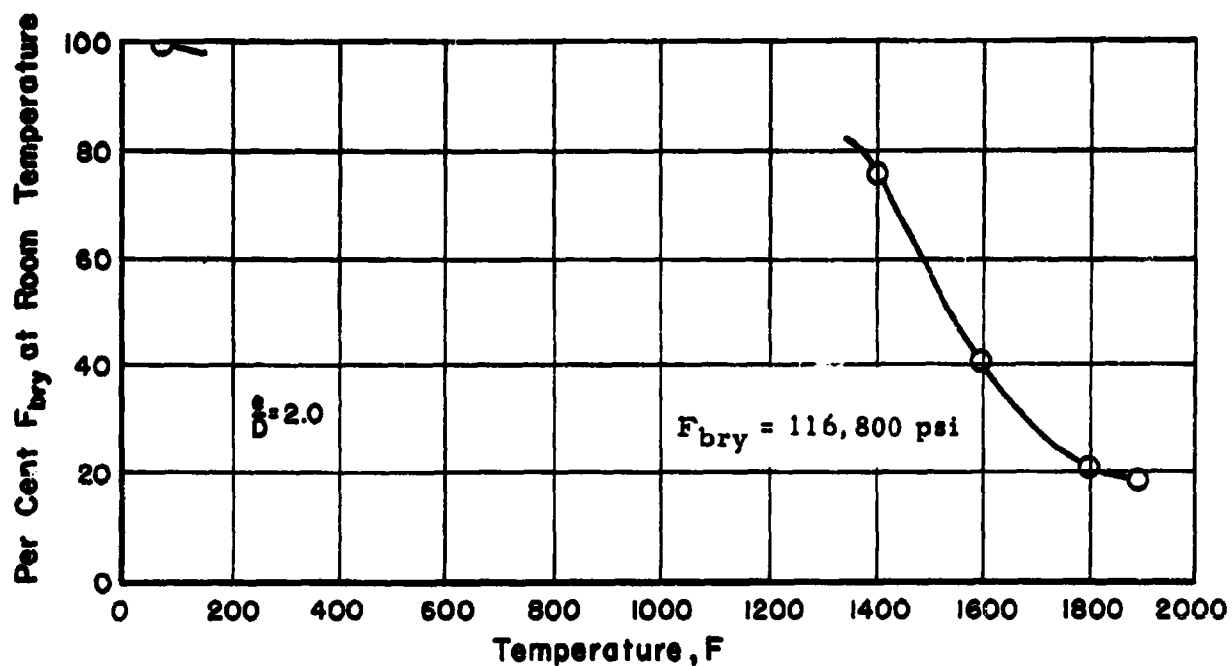


FIGURE 252. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 100 HOURS

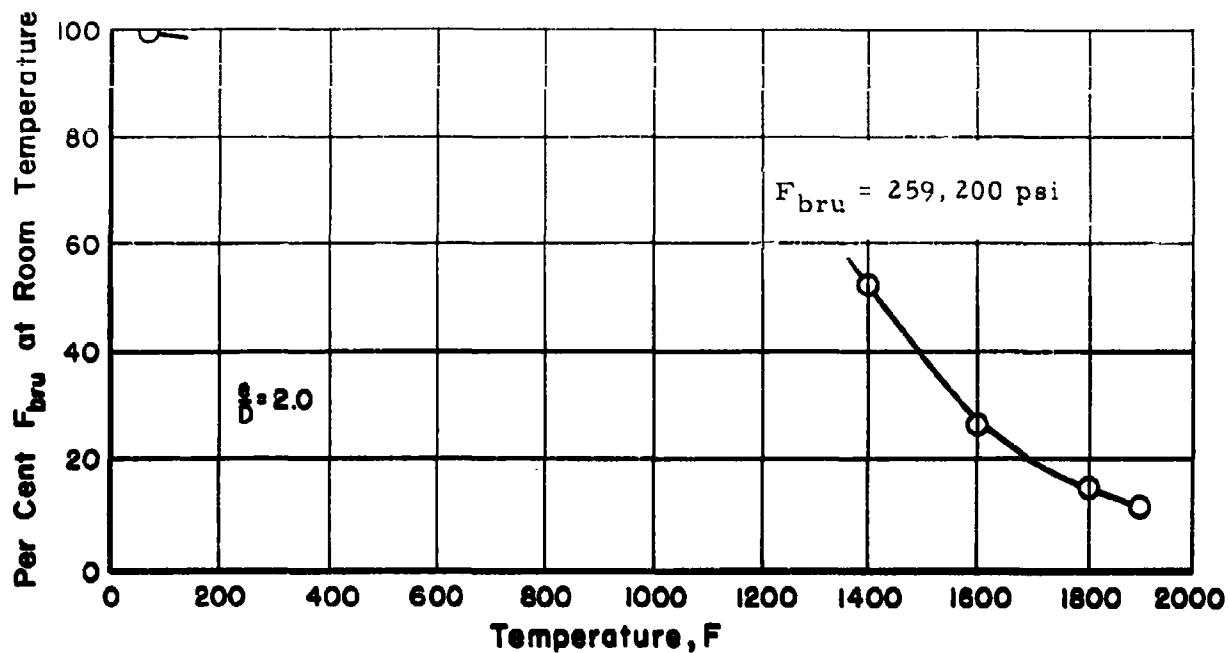


FIGURE 253. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF N-155 EXPOSED 1000 HOURS

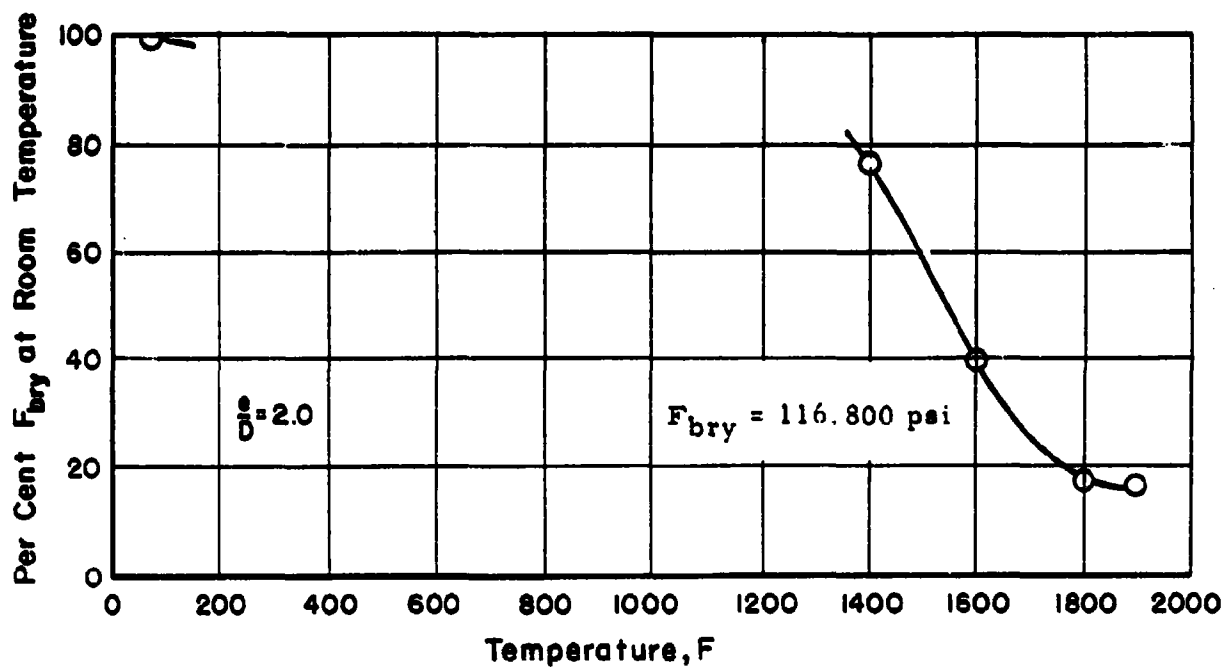


FIGURE 254. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF N-155 EXPOSED 1000 HOURS

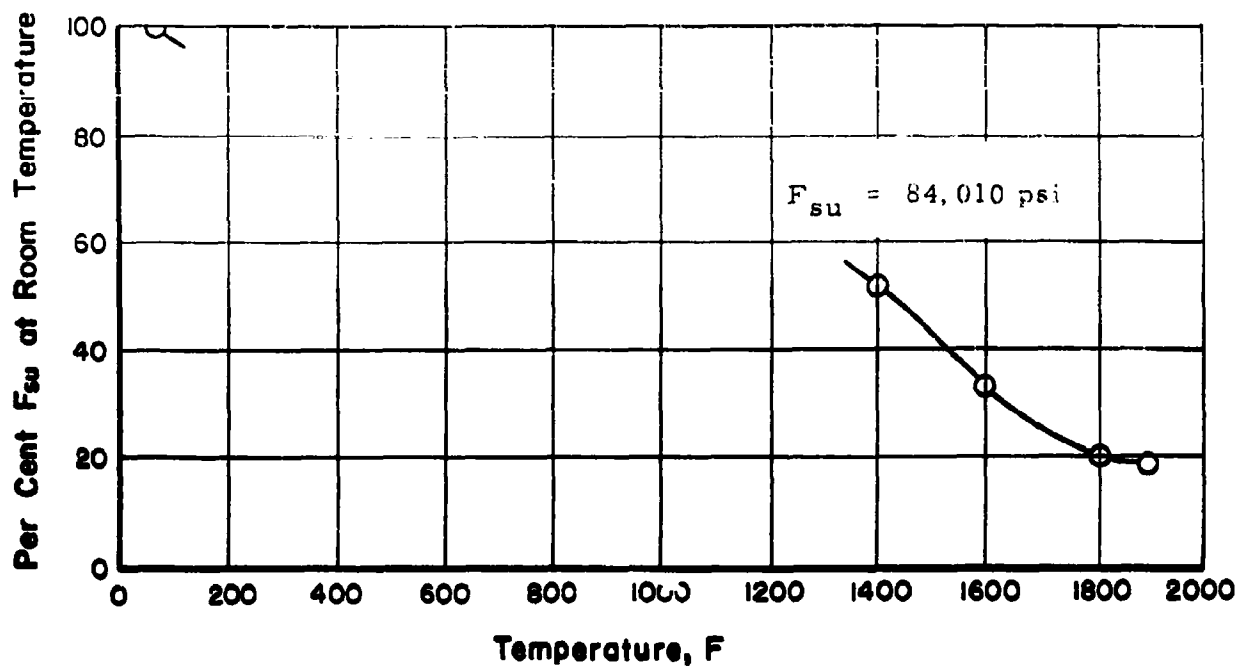


FIGURE 255. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 0.5 HOURS

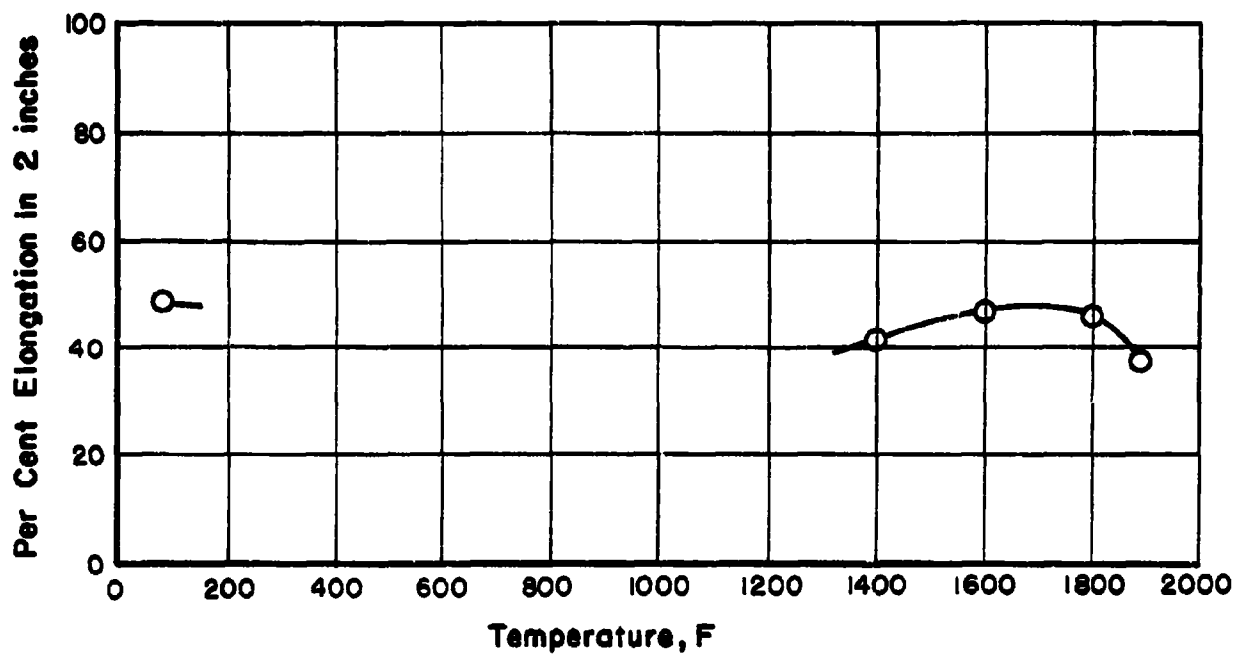


FIGURE 256. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 0.5 HOURS

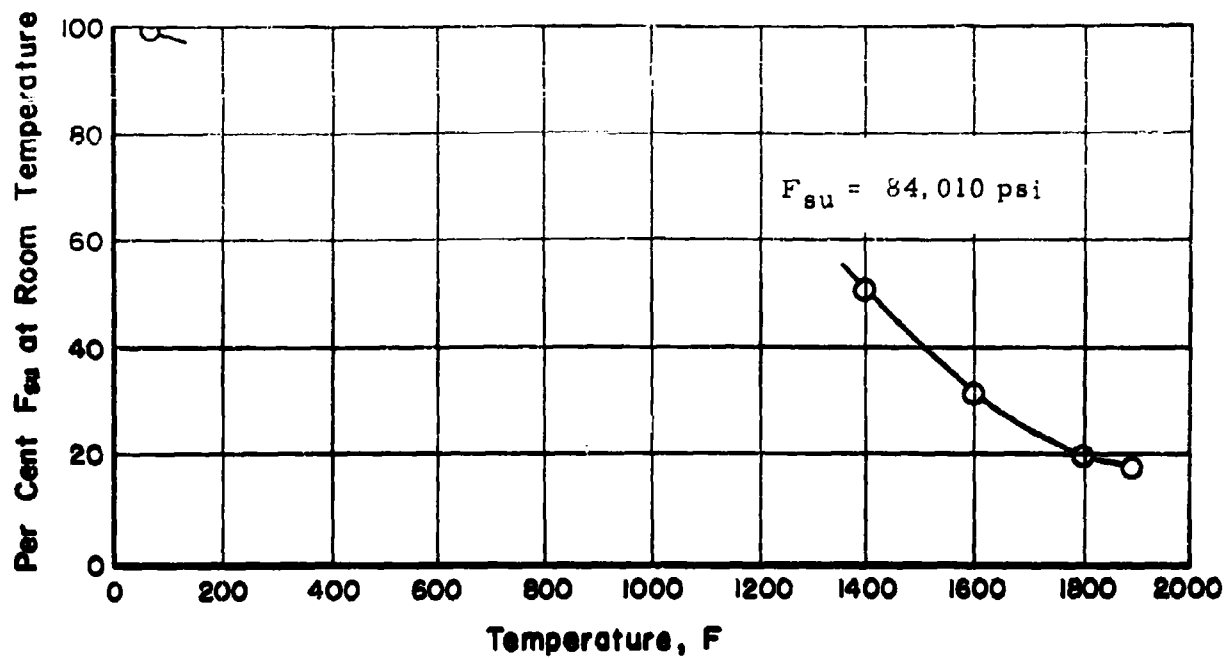


FIGURE 257. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 10 HOURS

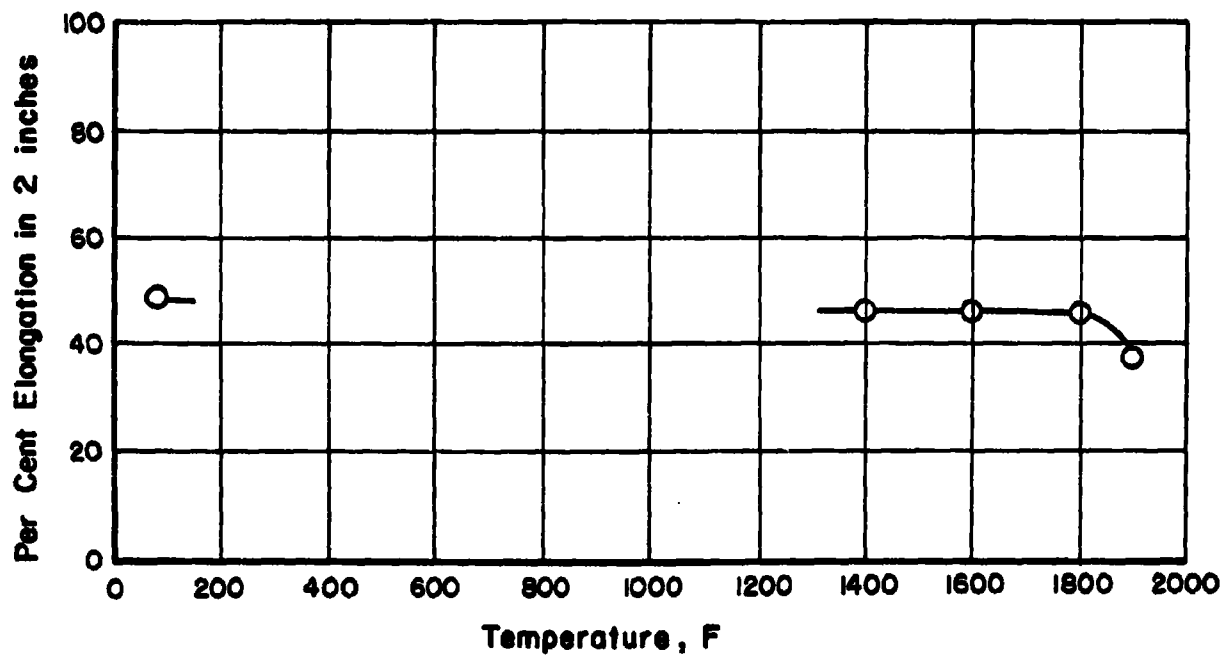


FIGURE 258. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 10 HOURS

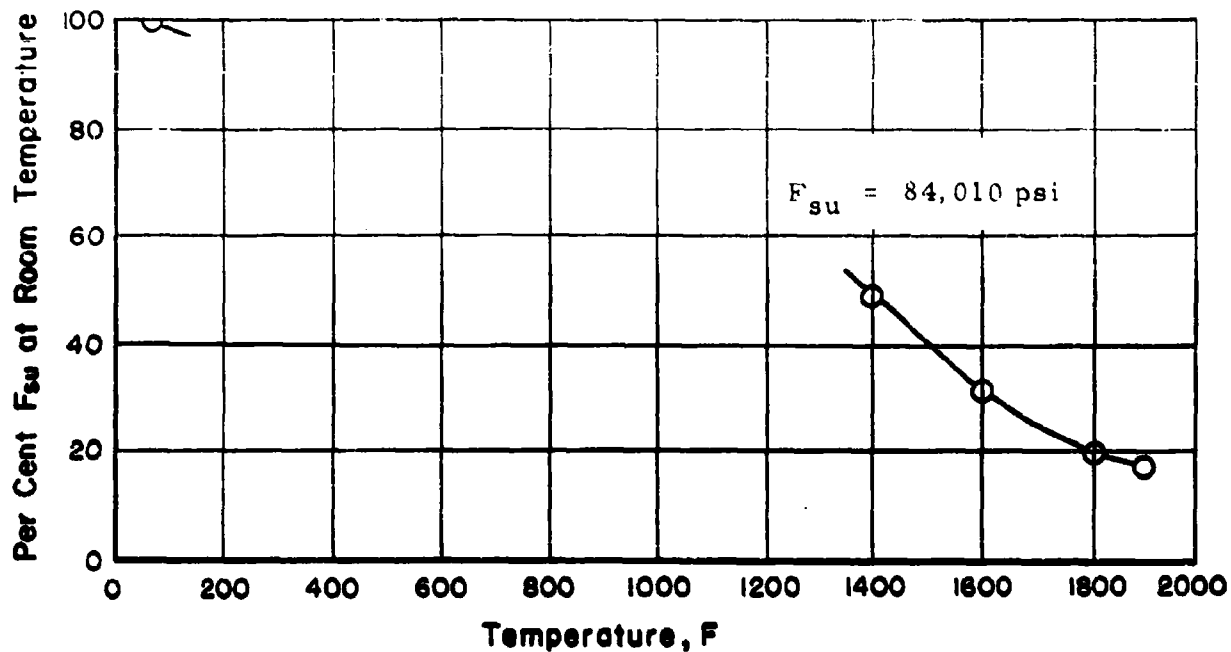


FIGURE 259. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 100 HOURS

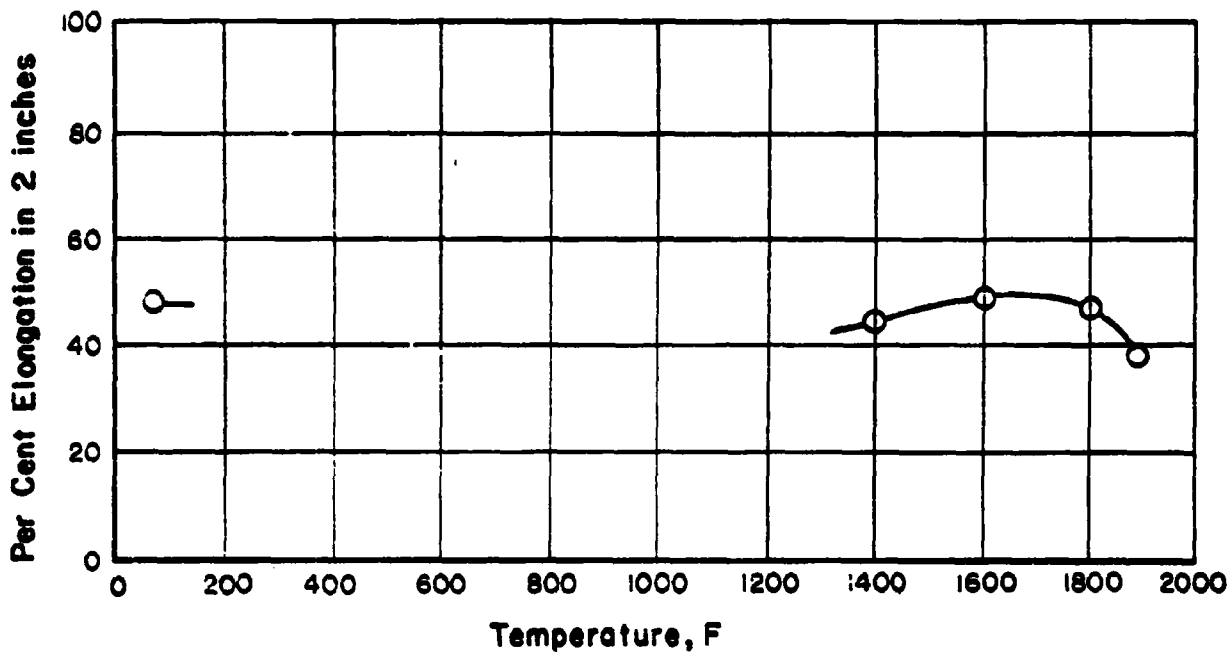


FIGURE 260. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 100 HOURS

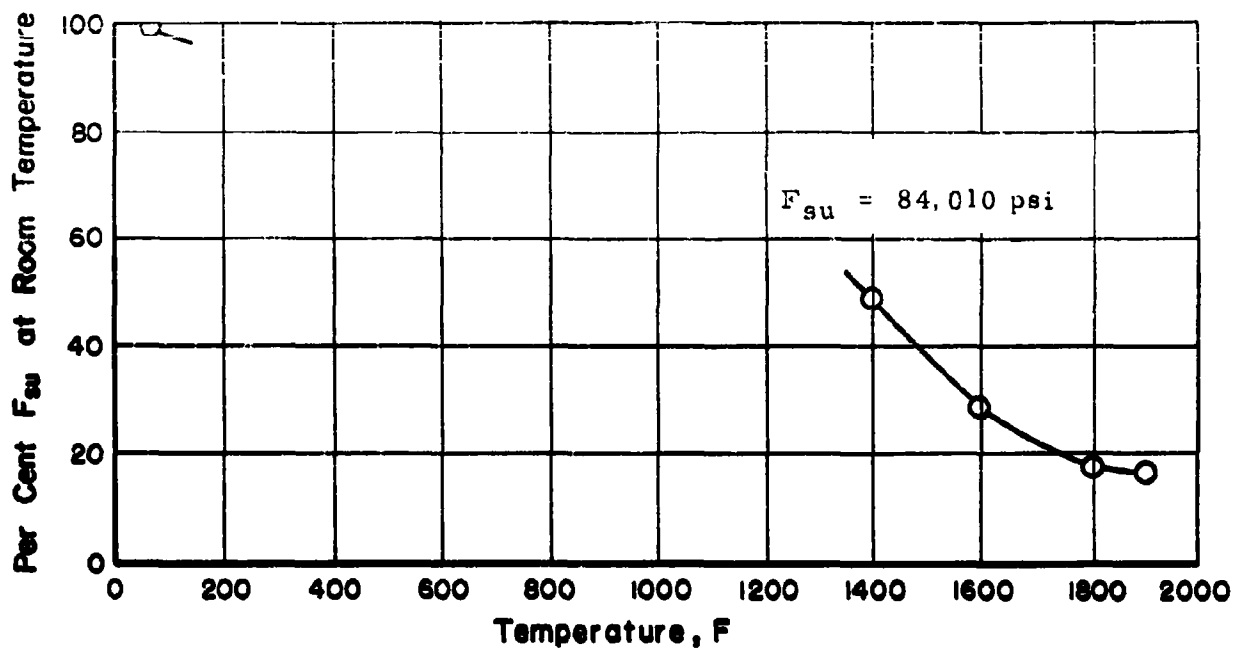


FIGURE 261. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF N-155 EXPOSED 1000 HOURS

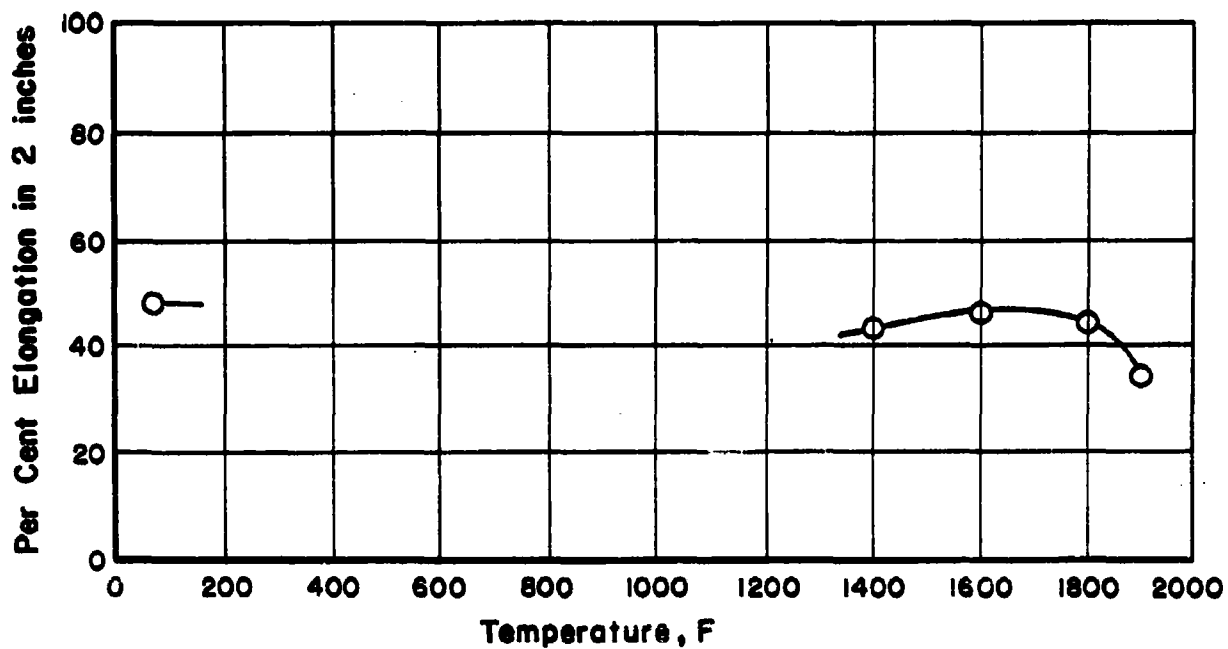


FIGURE 262. EFFECT OF TEMPERATURE ON ELONGATION OF N-155 EXPOSED 1000 HOURS

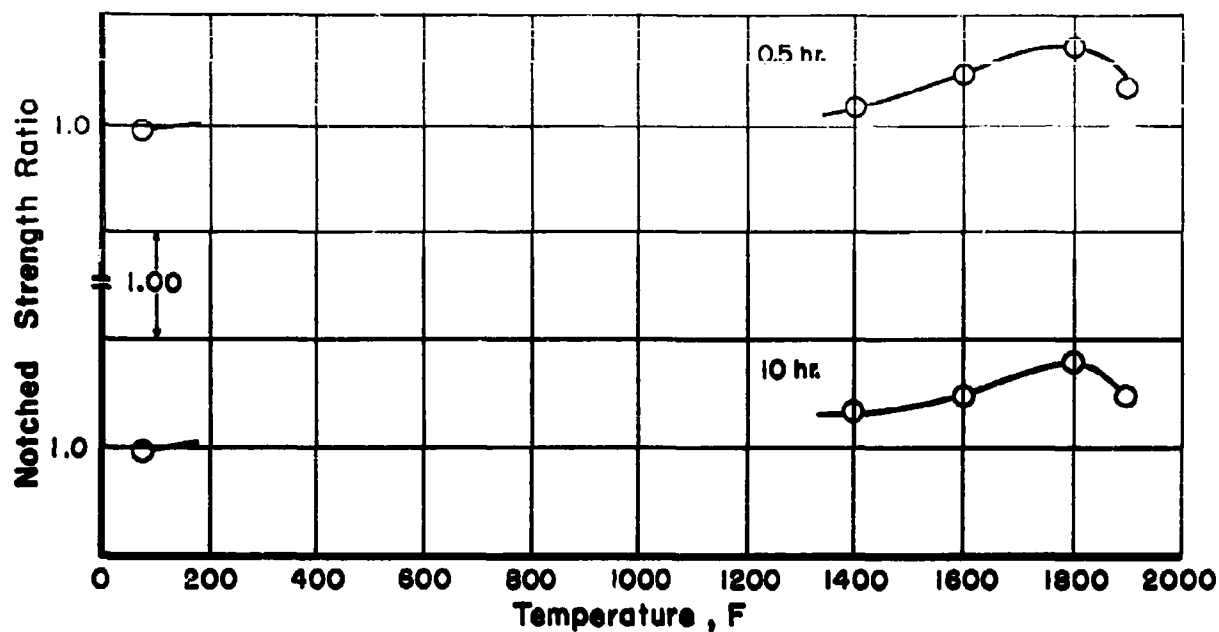


FIGURE 263. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF N-155 EXPOSED 0.5 AND 10 HOURS

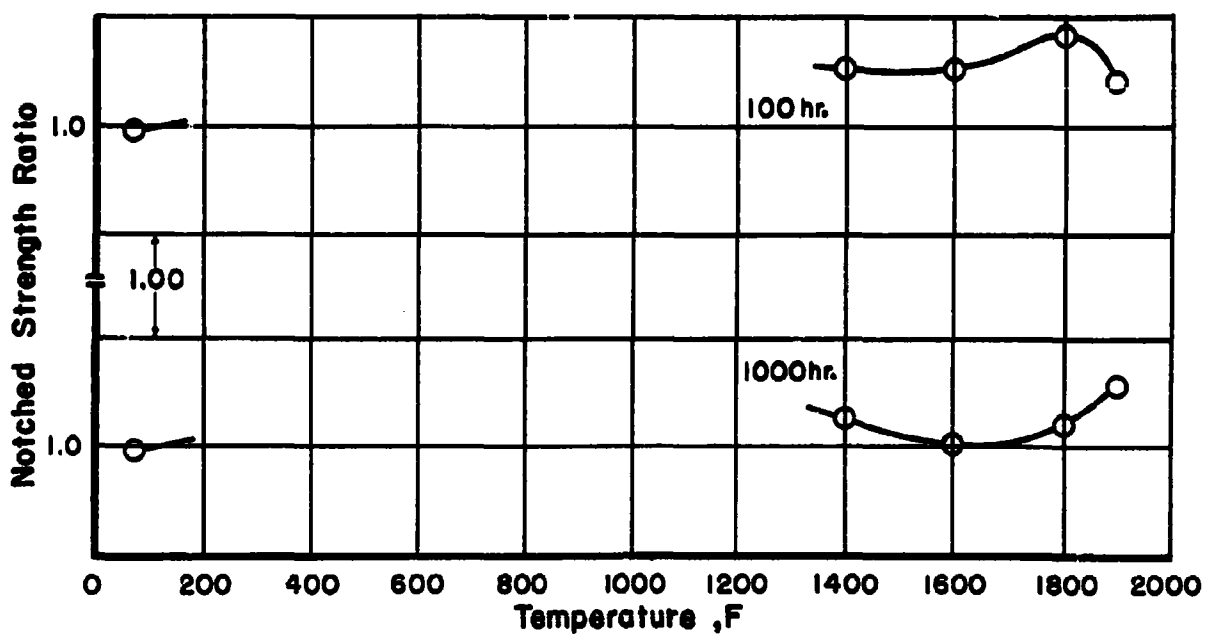


FIGURE 264. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF N-155 EXPOSED 100 AND 1000 HOURS

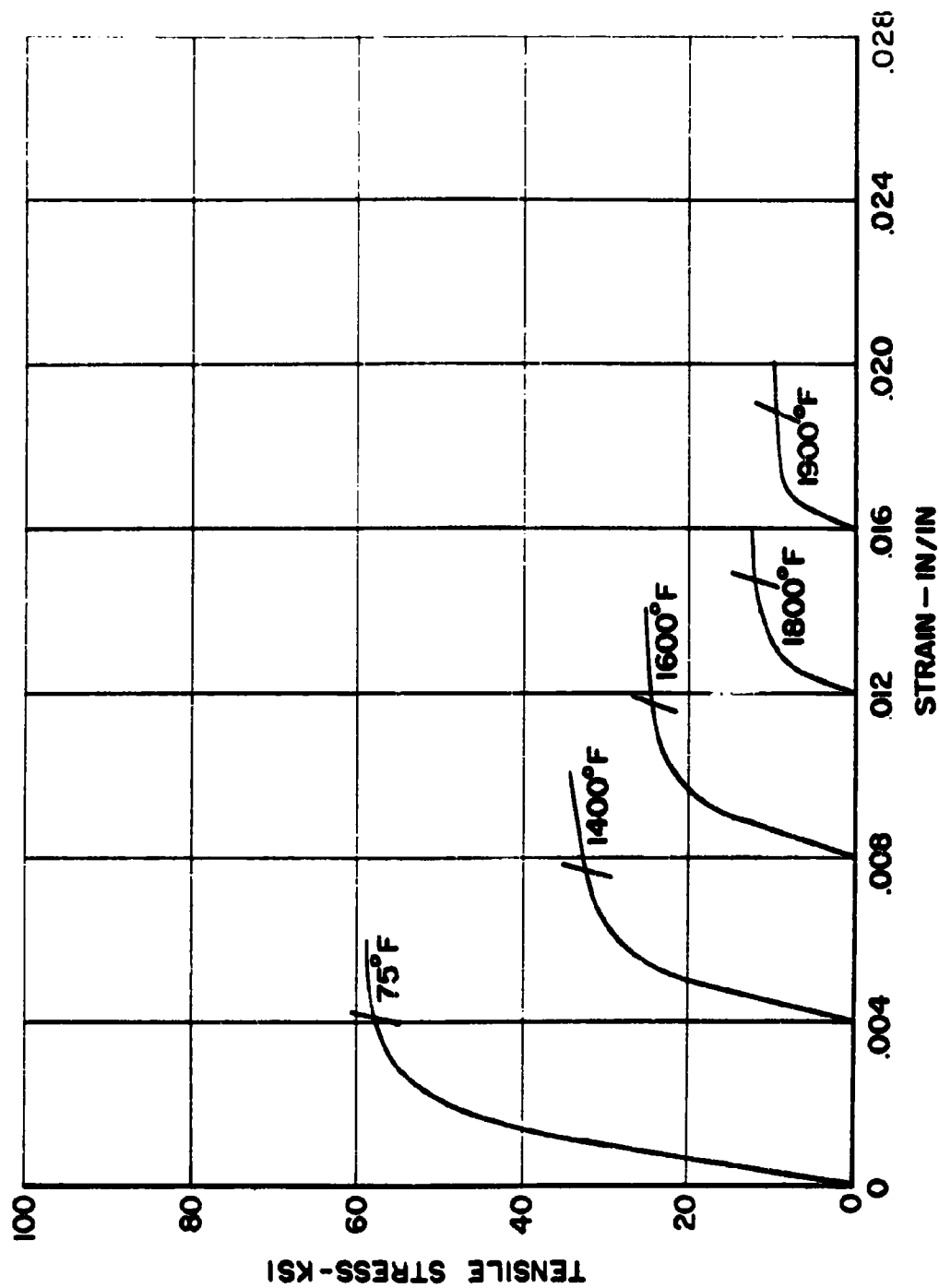


FIGURE 265. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 0.5 HOURS

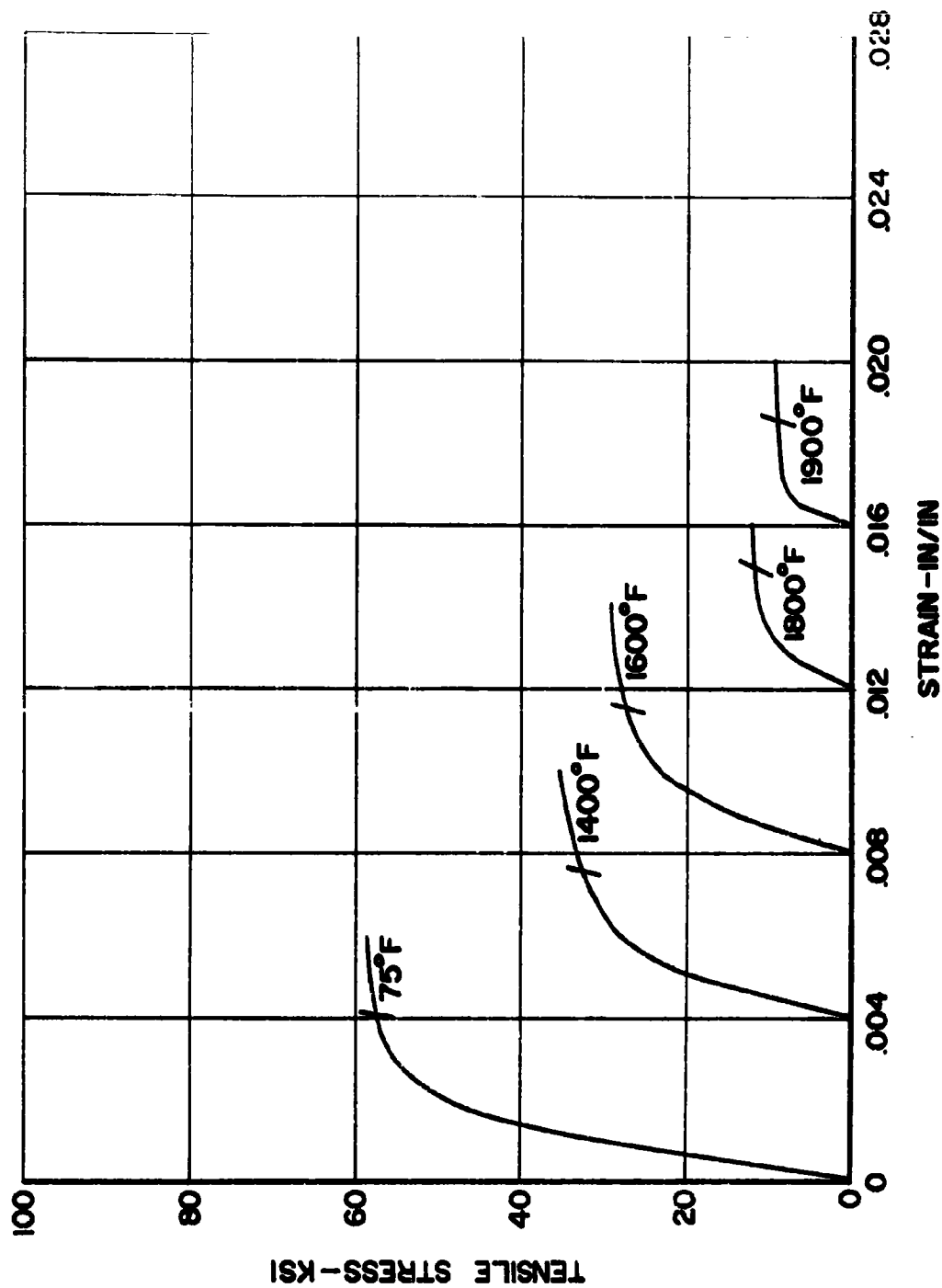


FIGURE 266. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 10 HOURS

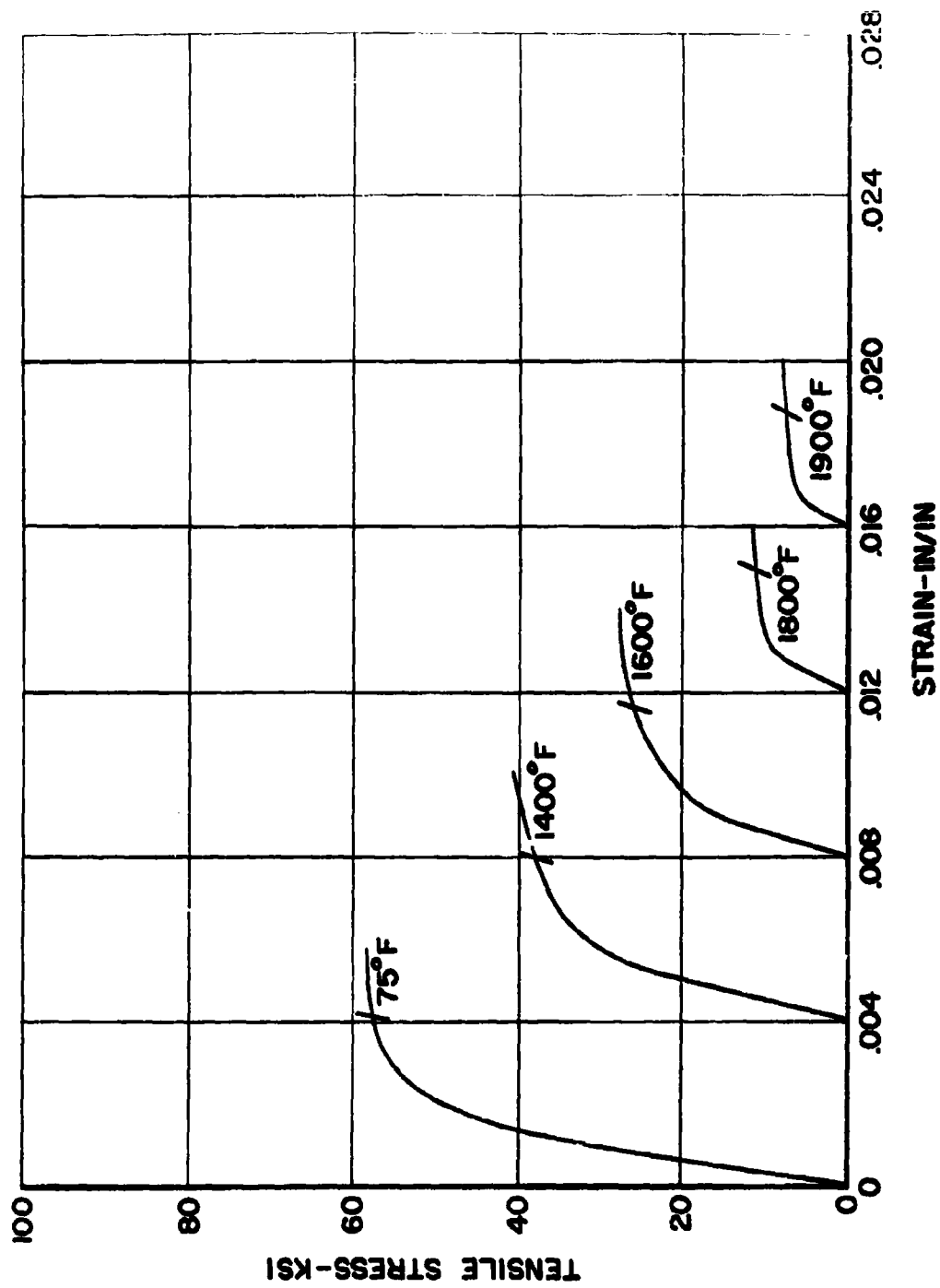


FIGURE 267. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 100 HOURS

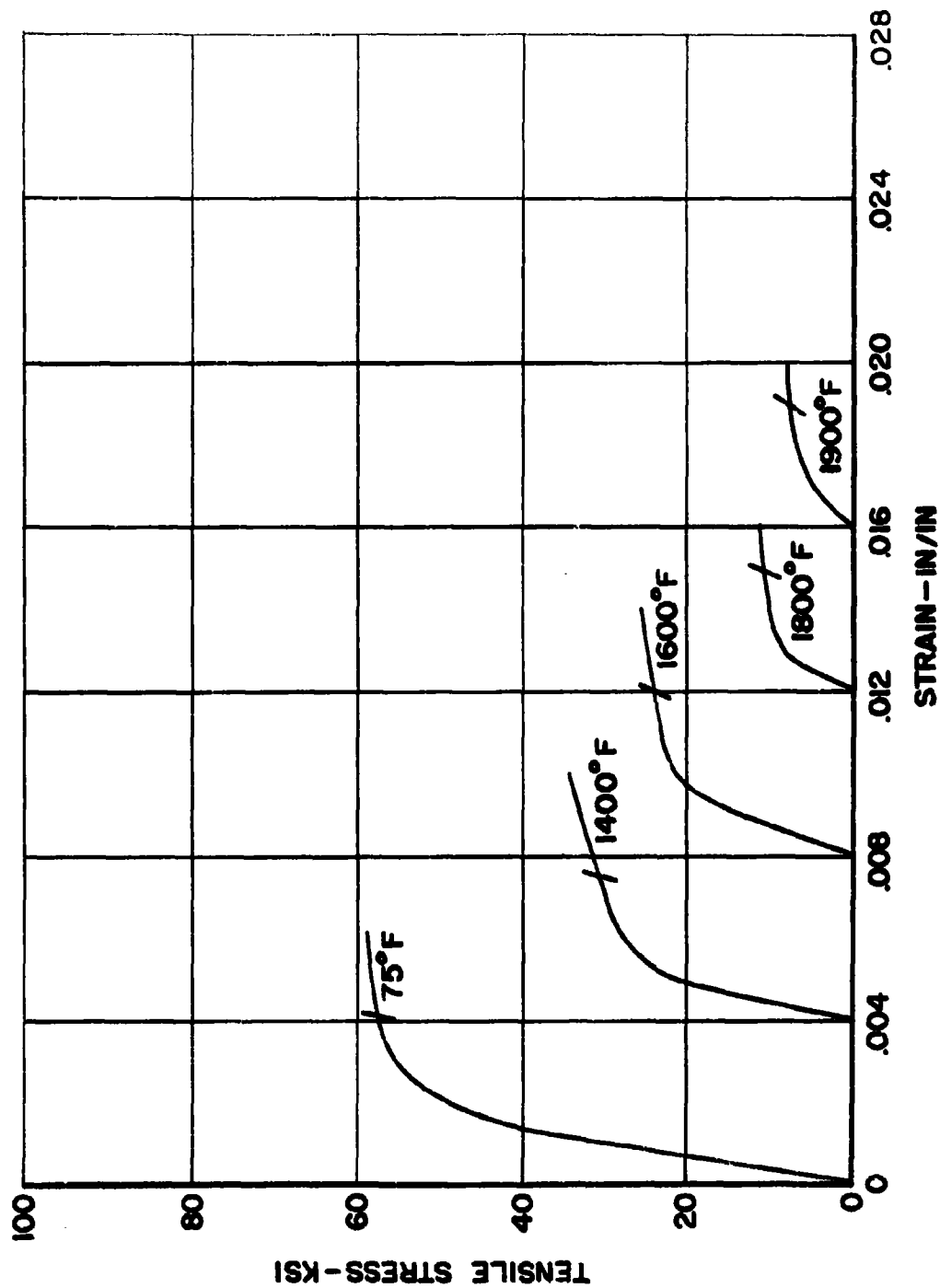


FIGURE 268. TENSILE STRESS-STRAIN CURVES OF N-155 EXPOSED 1000 HOURS

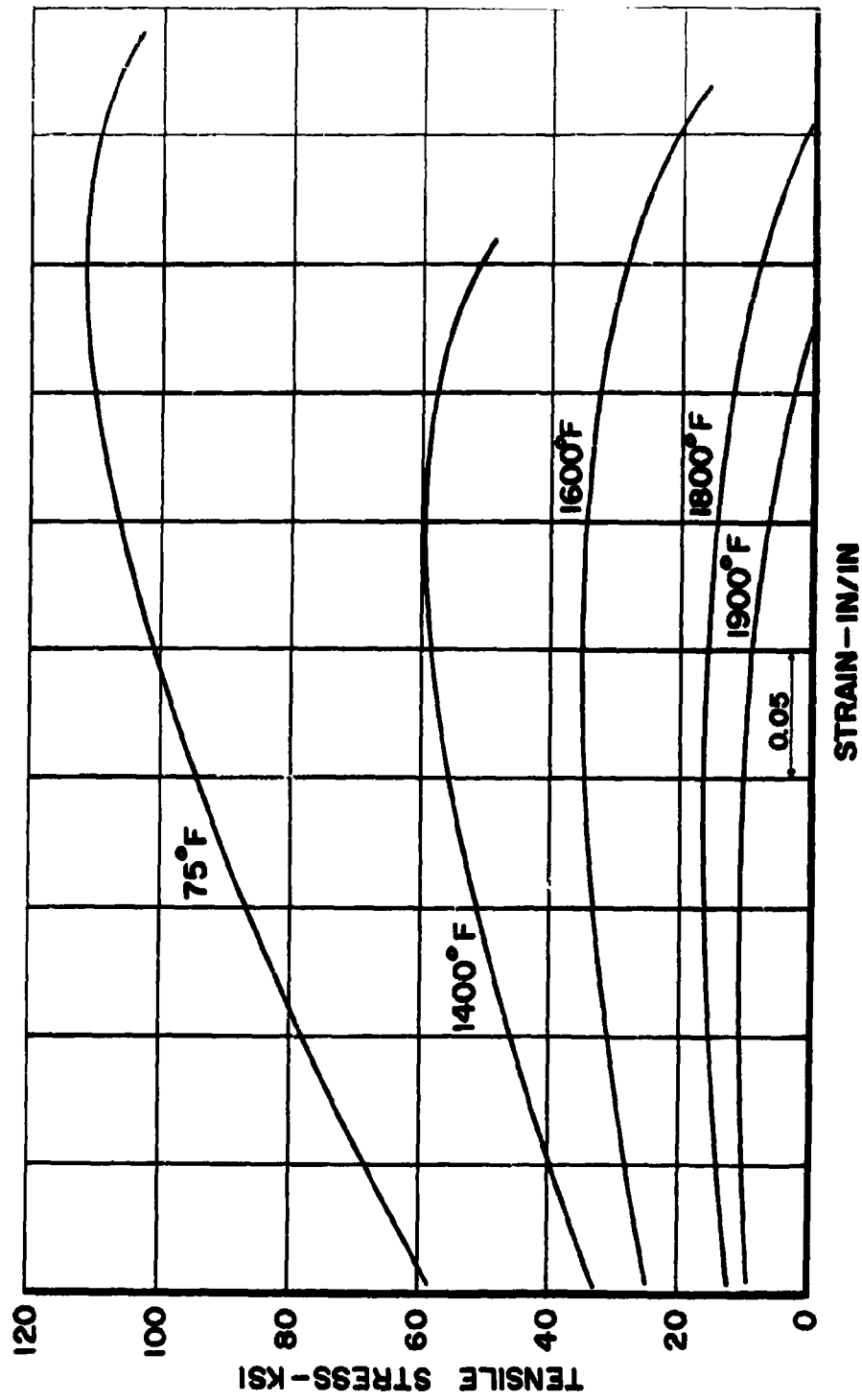


FIGURE 269. TENSILE POSTYIELD STRESS-STRAIN CURVES OF N-155 EXPOSED 0.5 HOURS

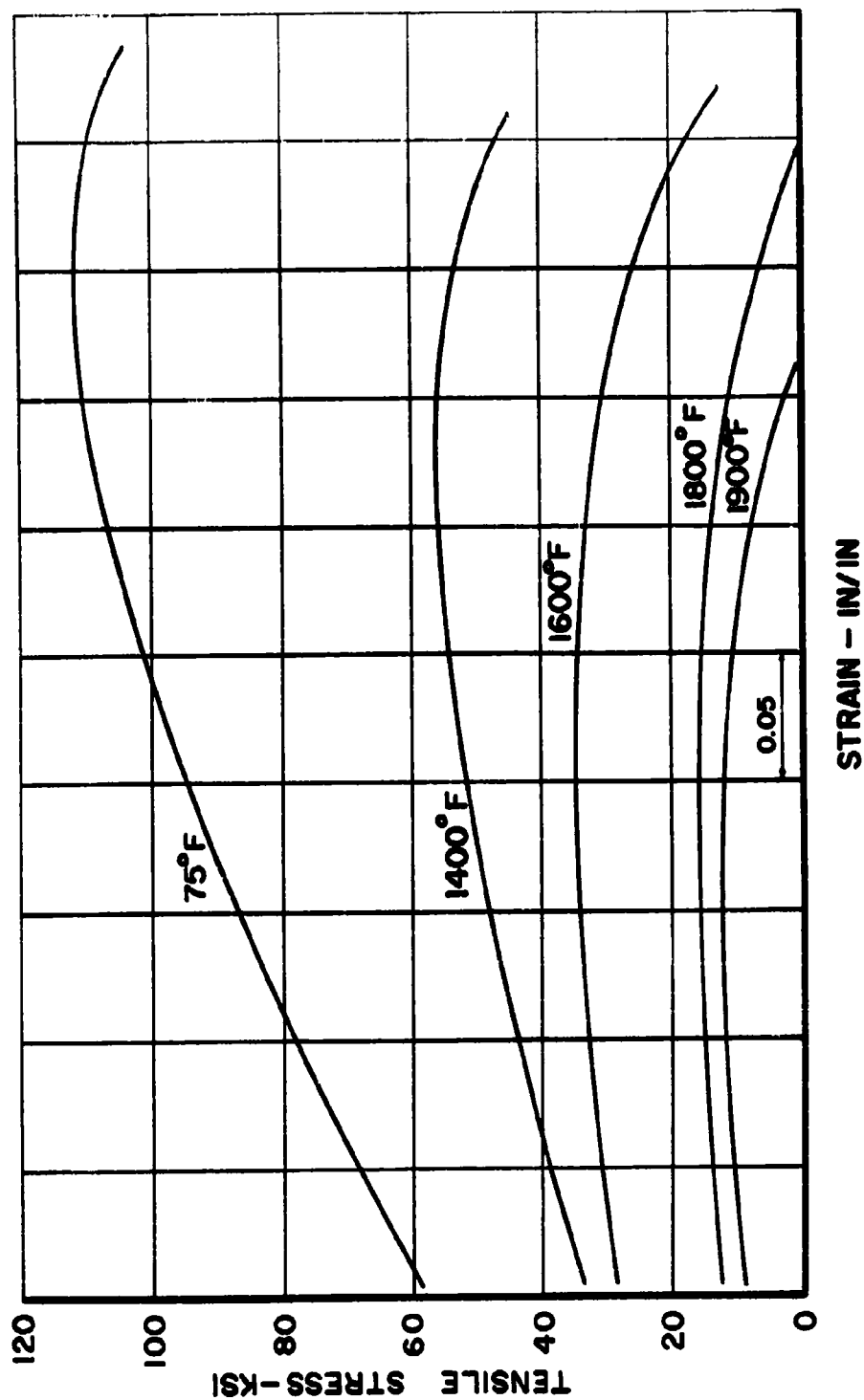


FIGURE 270. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF N-155 EXPOSED 10 HOURS

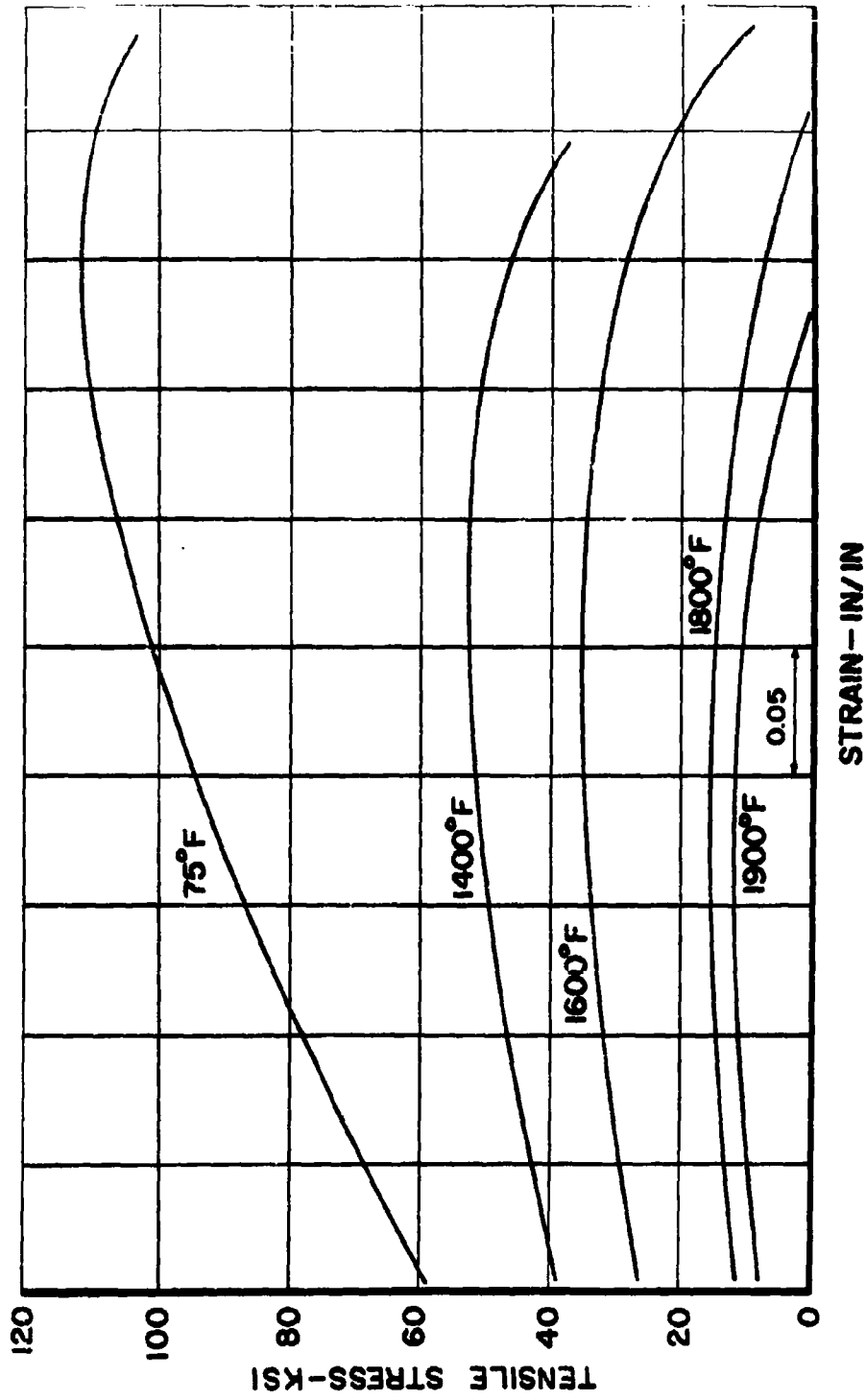


FIGURE 271. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF N-155 EXPOSED 100 HOURS

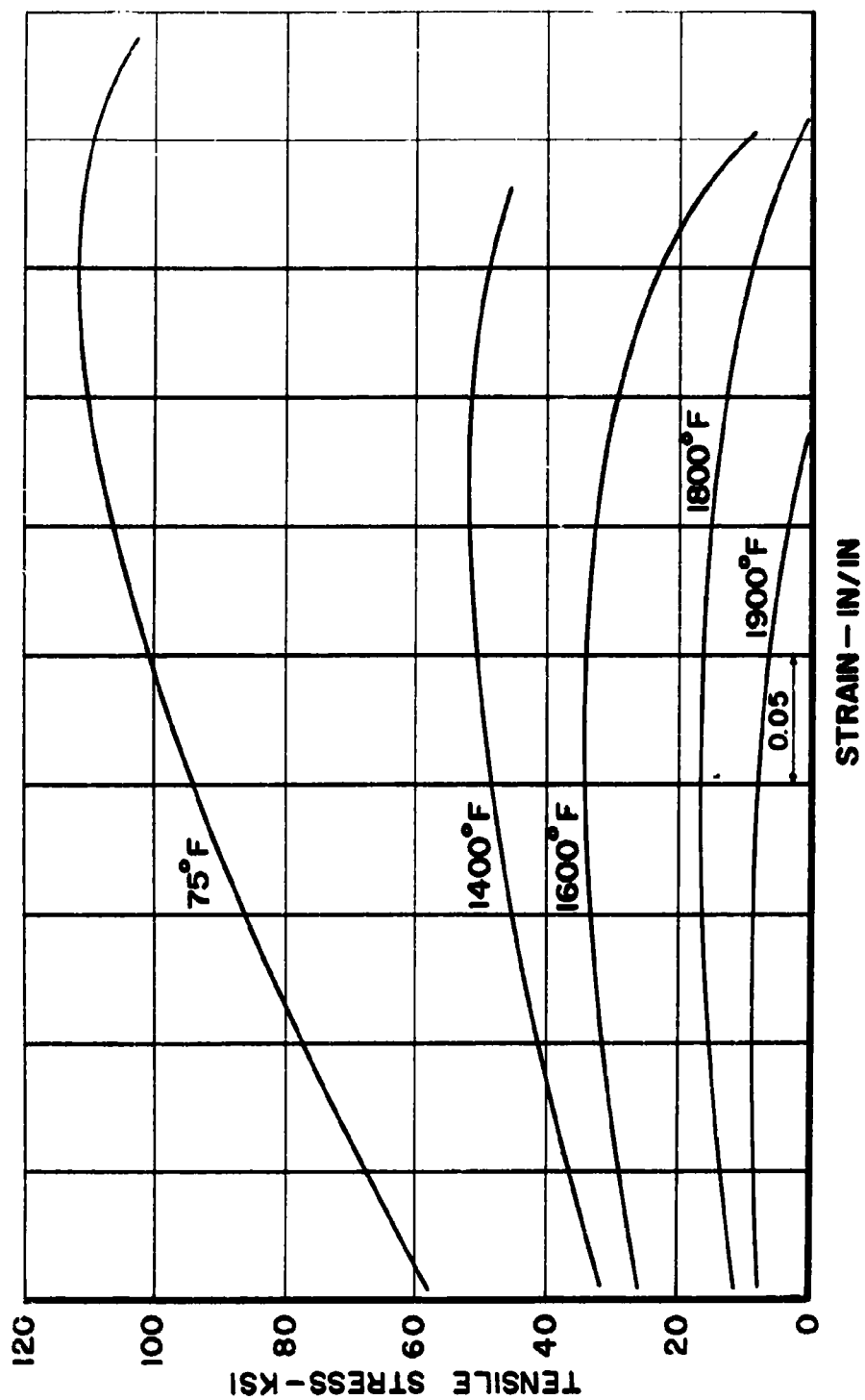


FIGURE 272. TENSILE POSTYIELD STRESS-STRAIN CURVES
OF N-155 EXPOSED 1000 HOURS

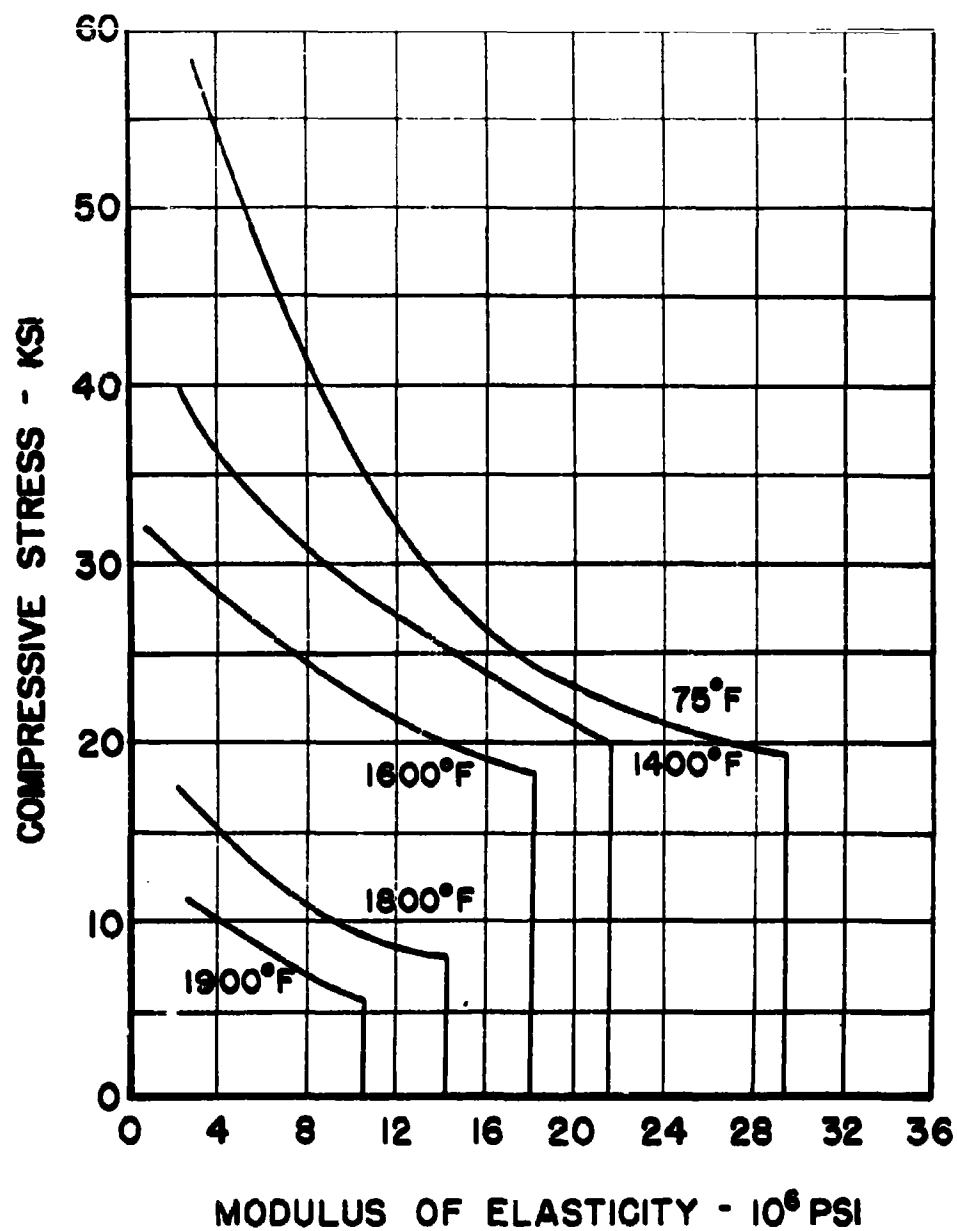


FIGURE 273. COMPRESSIVE TANGENT MODULUS CURVES OF N-155 EXPOSED 0.5 HOURS

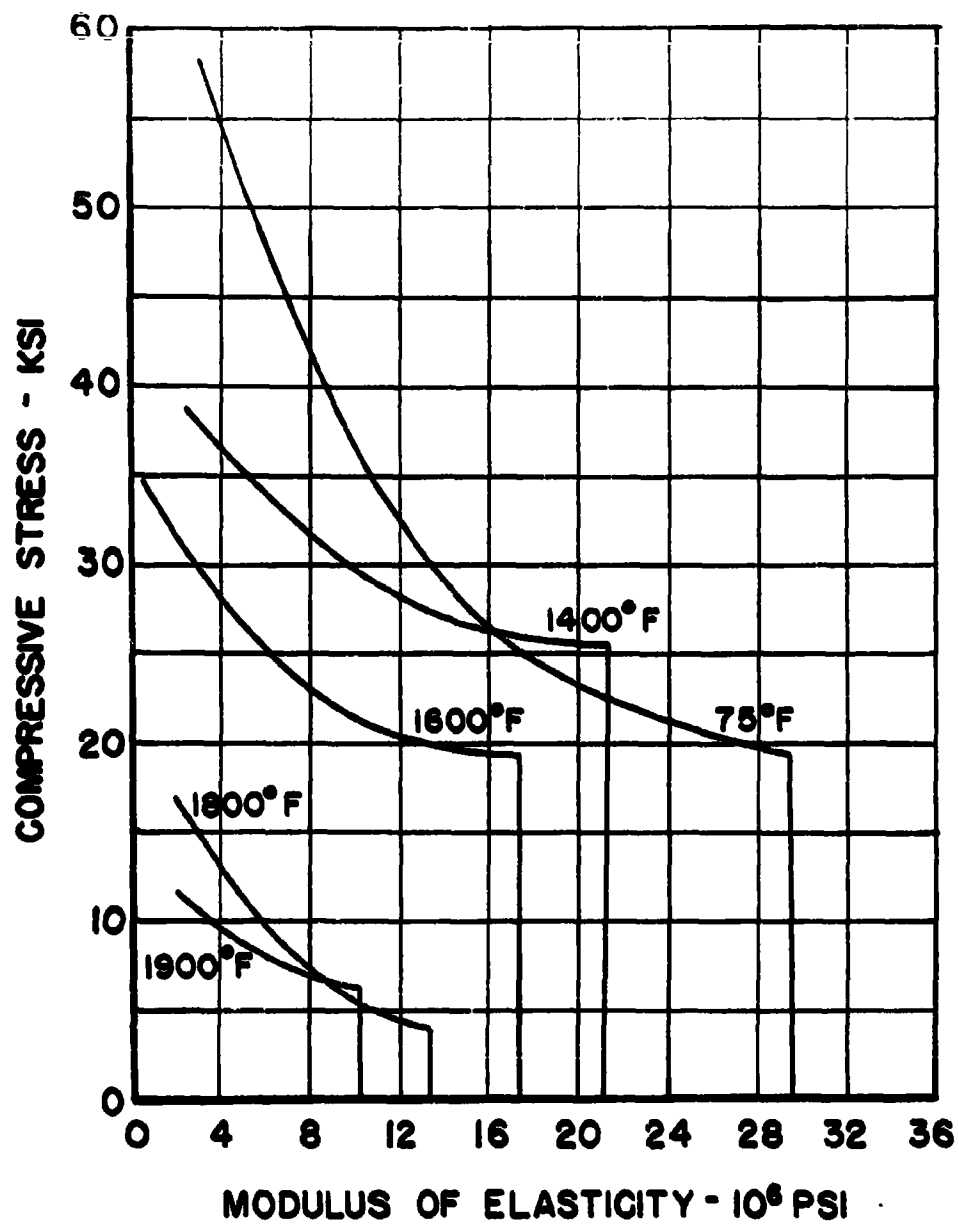


FIGURE 274. COMPRESSIVE TANGENT MODULUS CURVES
OF N-155 EXPOSED 10 HOURS

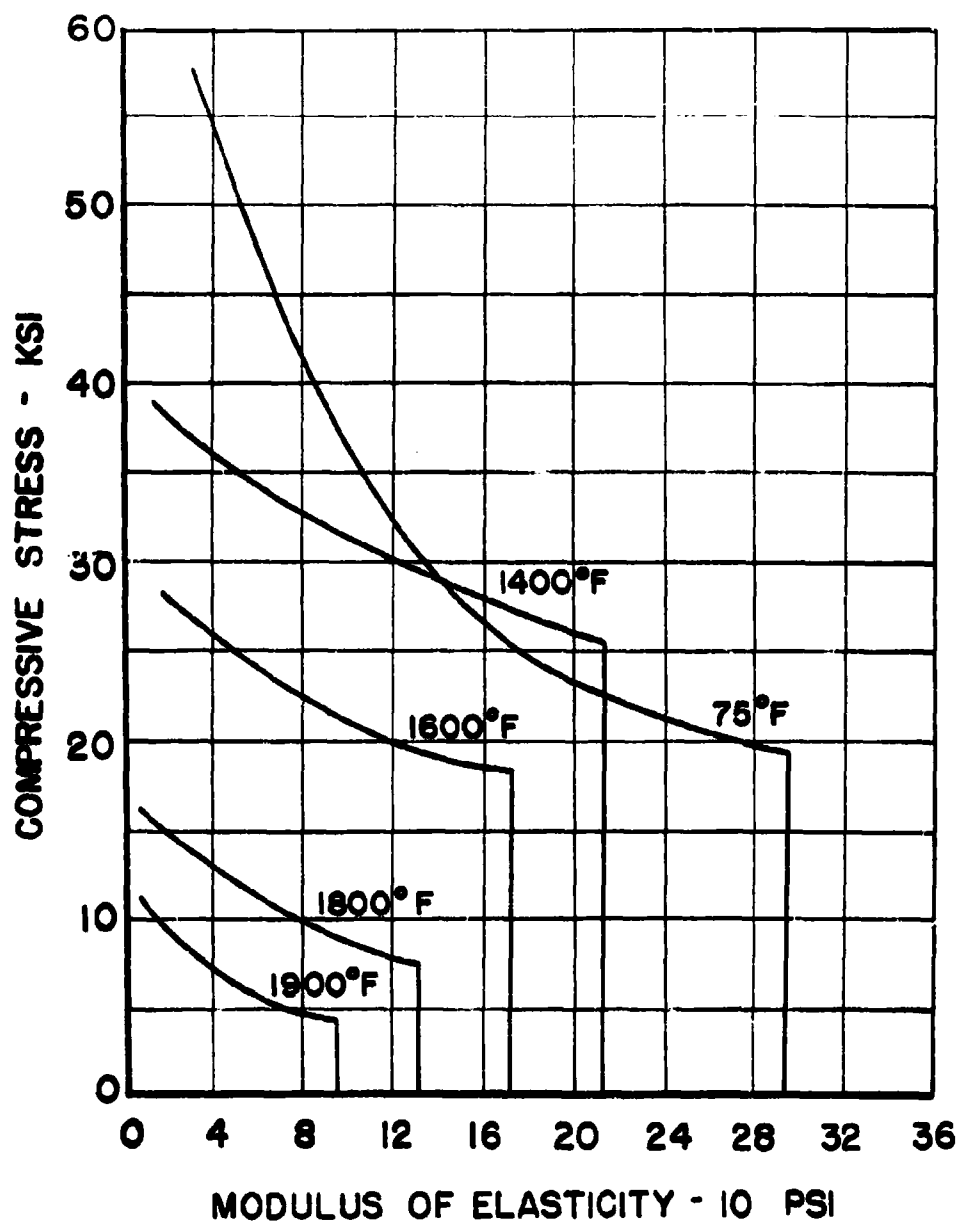


FIGURE 275. COMPRESSIVE TANGENT MODULUS CURVES
OF N-155 EXPOSED 100 HOURS

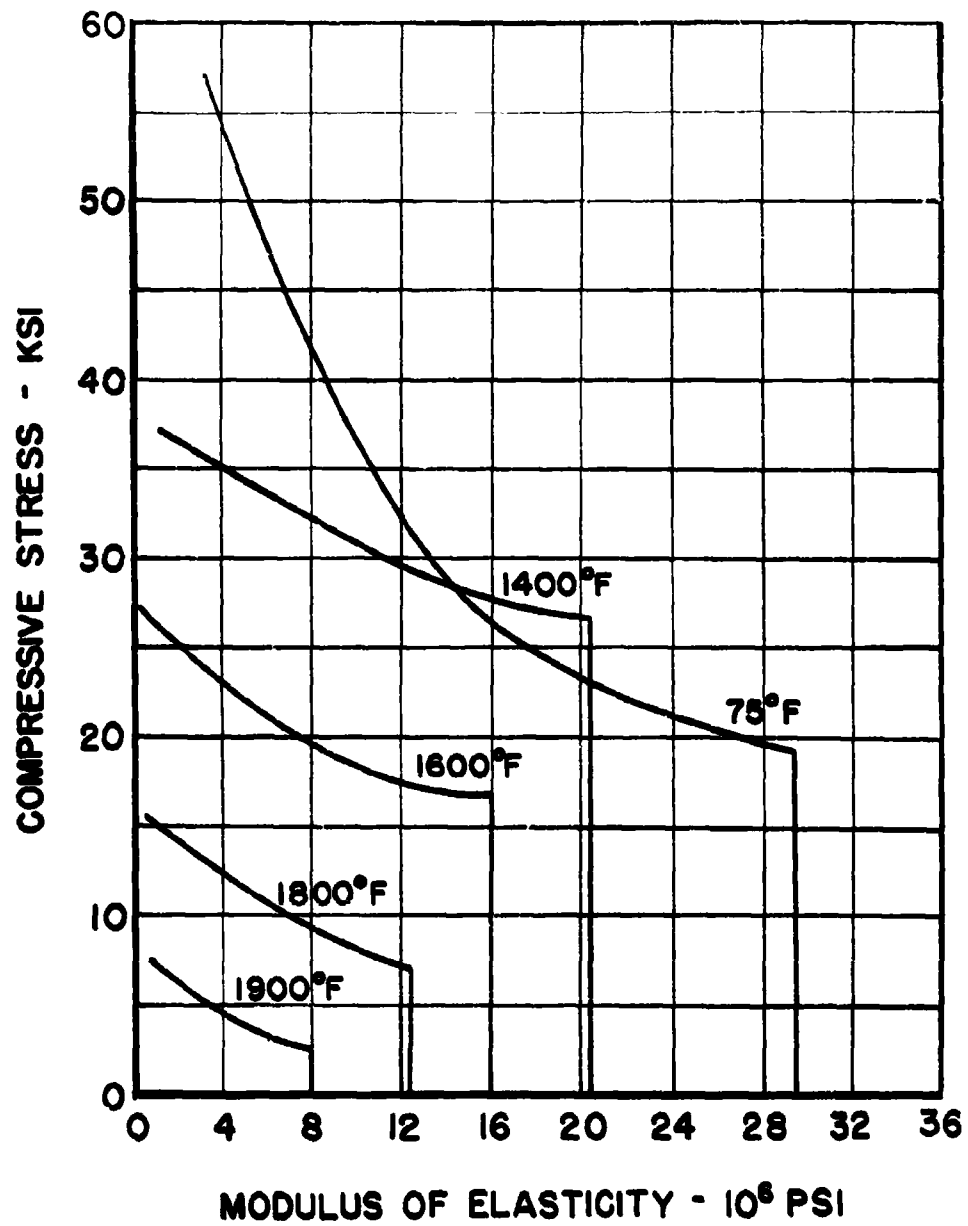


FIGURE 276. COMPRESSIVE TANGENT MODULUS CURVES
OF N-155 EXPOSED 1000 HOURS

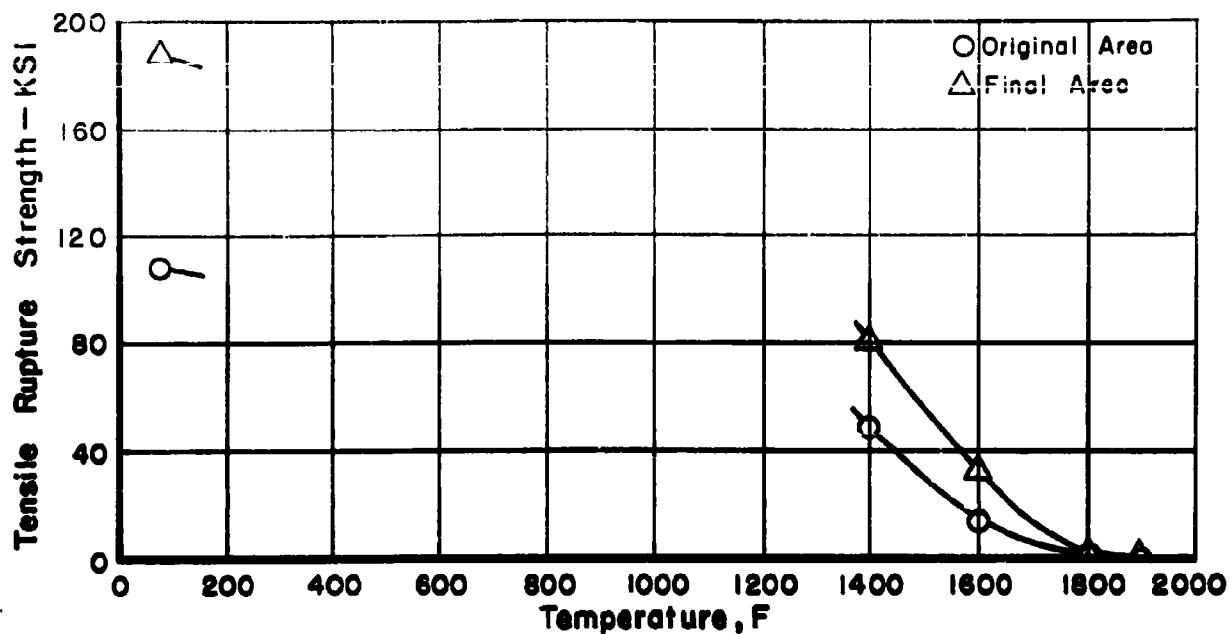


FIGURE 277. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

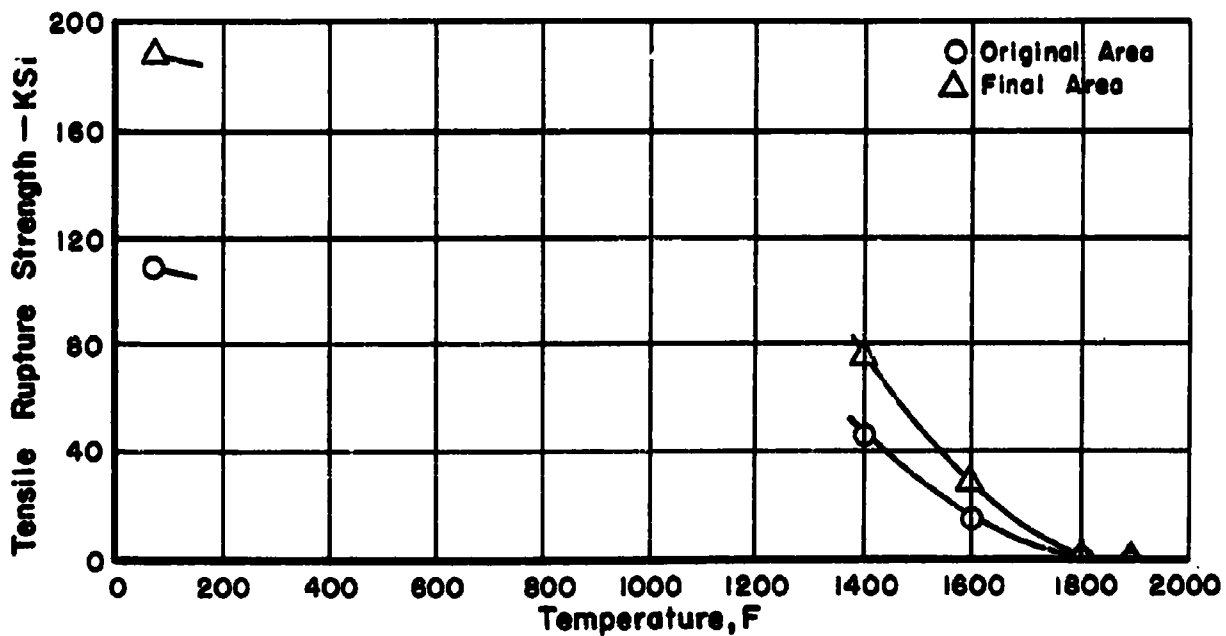


FIGURE 278. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

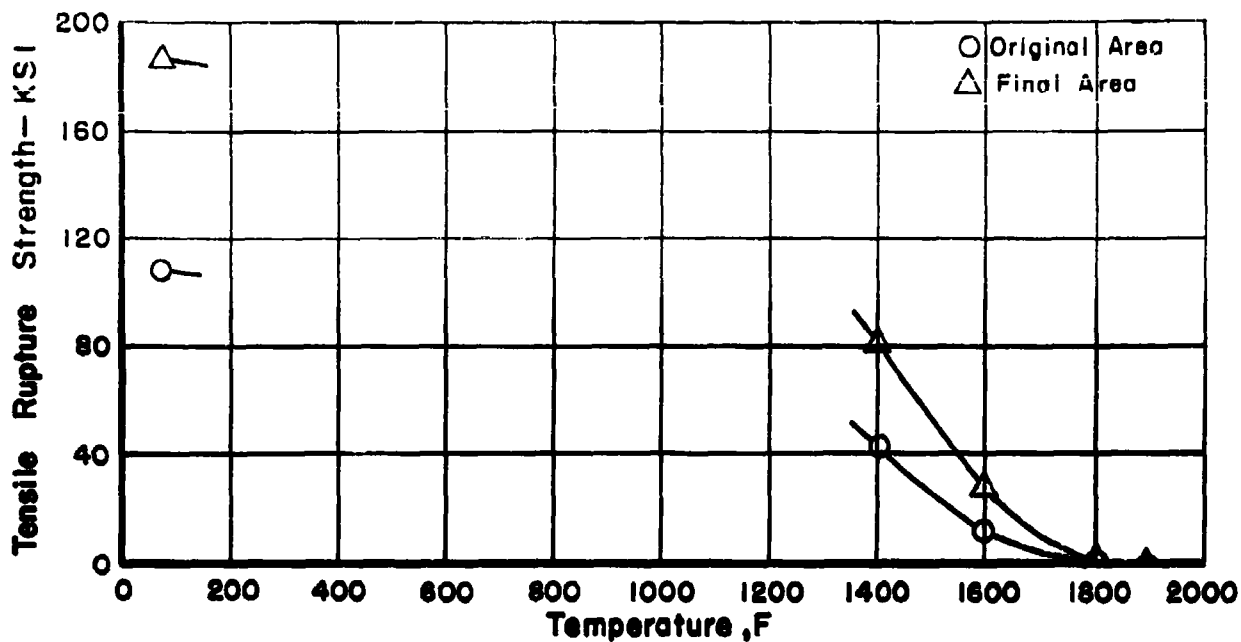


FIGURE 279. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

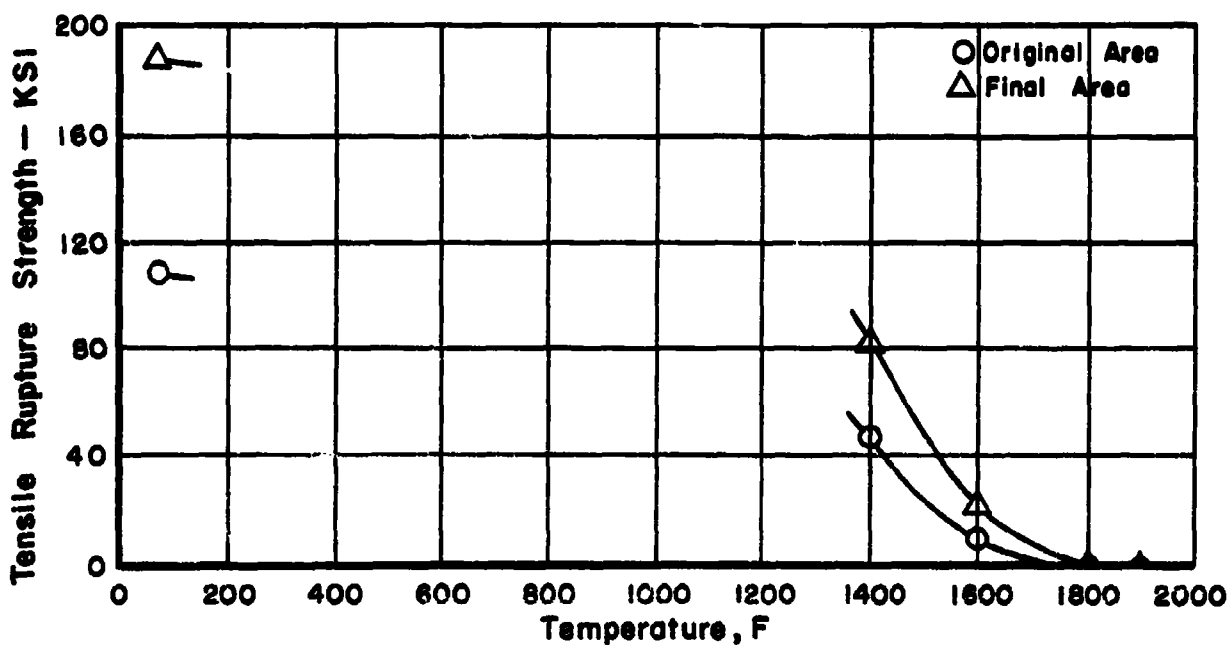


FIGURE 280. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF N-155 EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

APPENDIX V

SUMMARY OF ROOM TEMPERATURE PROPERTIES OF 301 (60% COLD REDUCED) STAINLESS STEEL

Form: 0.050 Inch Sheet

Condition: 60% Cold Reduced

Properties:

Ultimate Tensile Strength	-	F_{tu}	=	272,150 psi
Tensile Yield Strength	-	F_{ty}	=	258,030 psi
Modulus of Elasticity	-	E	=	25.56×10^6 psi
Percent Elongation in 2 inches			=	3.1
Notched Tensile Strength	-	F_{tu}	=	283,530 psi
Compressive Yield Strength	-	F_{cy}	=	206,470 psi
Compressive Modulus of Elasticity	-	E_c	=	26.87×10^6 psi
Ultimate Bearing Strength				
(e/D = 1.5)	-	F_{bru}	=	375,580 psi
(e/D = 2.0)	-	F_{bru}	=	472,020 psi
Bearing Yield Strength				
(e/D = 1.5)	-	F_{bry}	=	326,560 psi
(e/D = 2.0)	-	F_{bry}	=	423,960 psi
Ultimate Shear Strength	-	F_{su}	=	89,100 psi

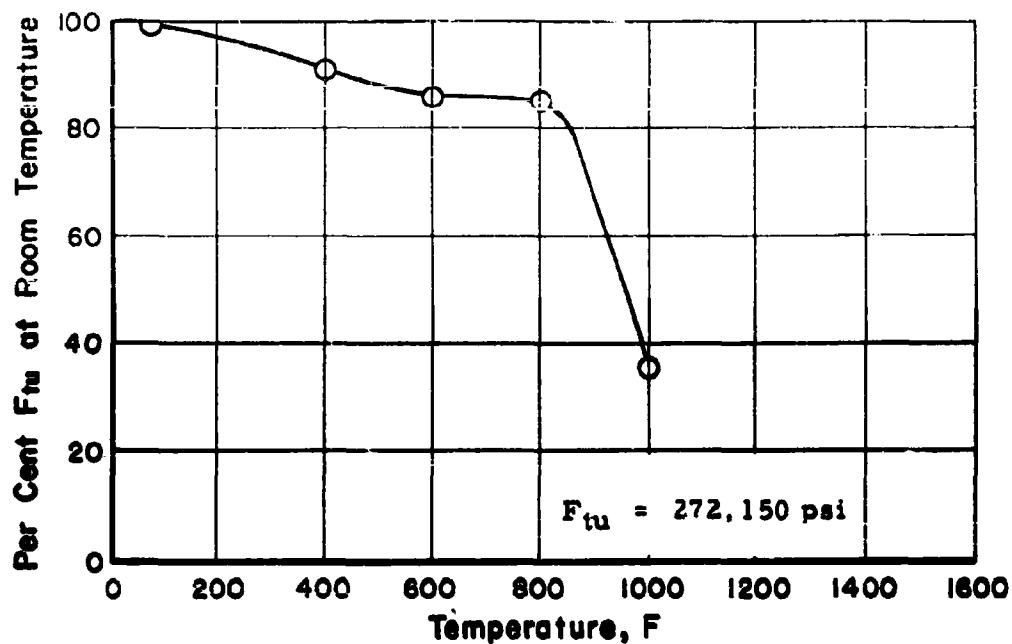


FIGURE 281. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 0.5 HOURS

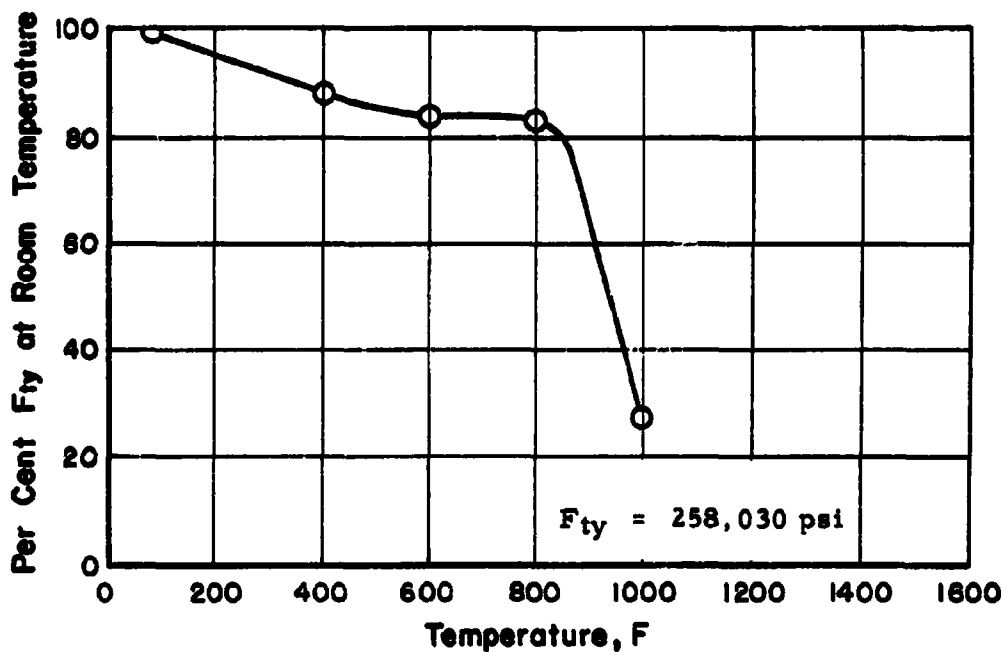


FIGURE 282. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF 301 (60%
COLD REDUCED) STAINLESS STEEL
EXPOSED 0.5 HOURS

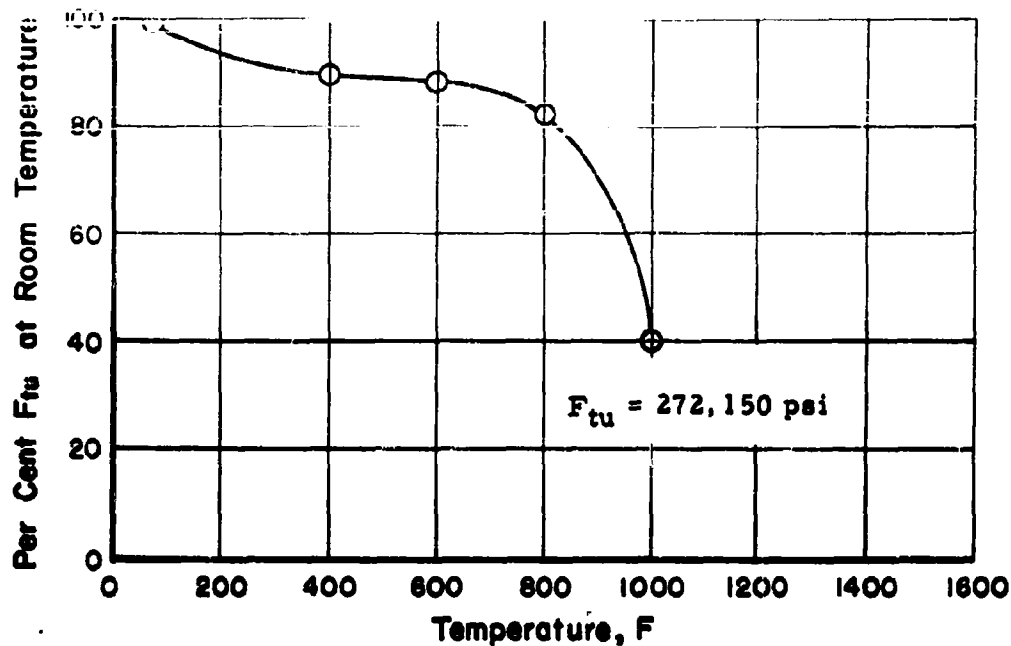


FIGURE 283. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 10 HOURS

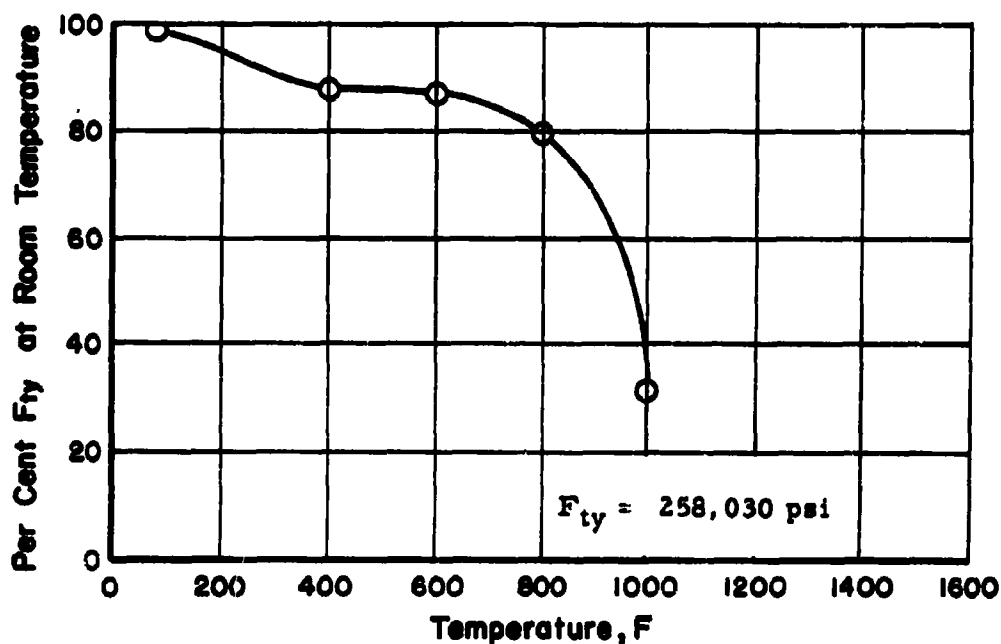


FIGURE 284. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF 301 (60%
COLD REDUCED) STAINLESS STEEL
EXPOSED 10 HOURS

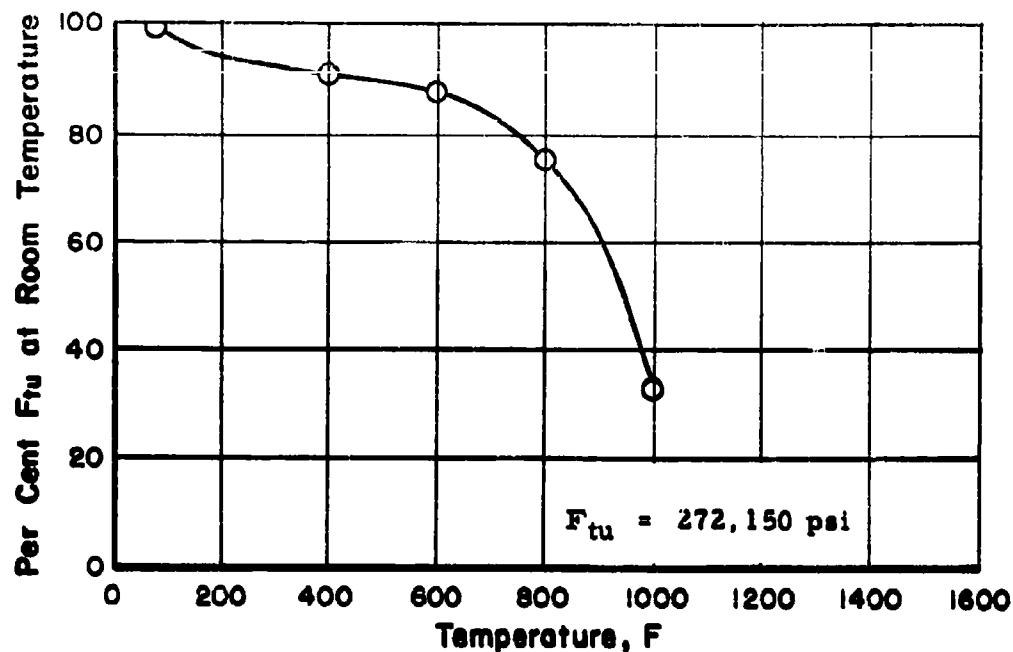


FIGURE 285. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 100 HOURS

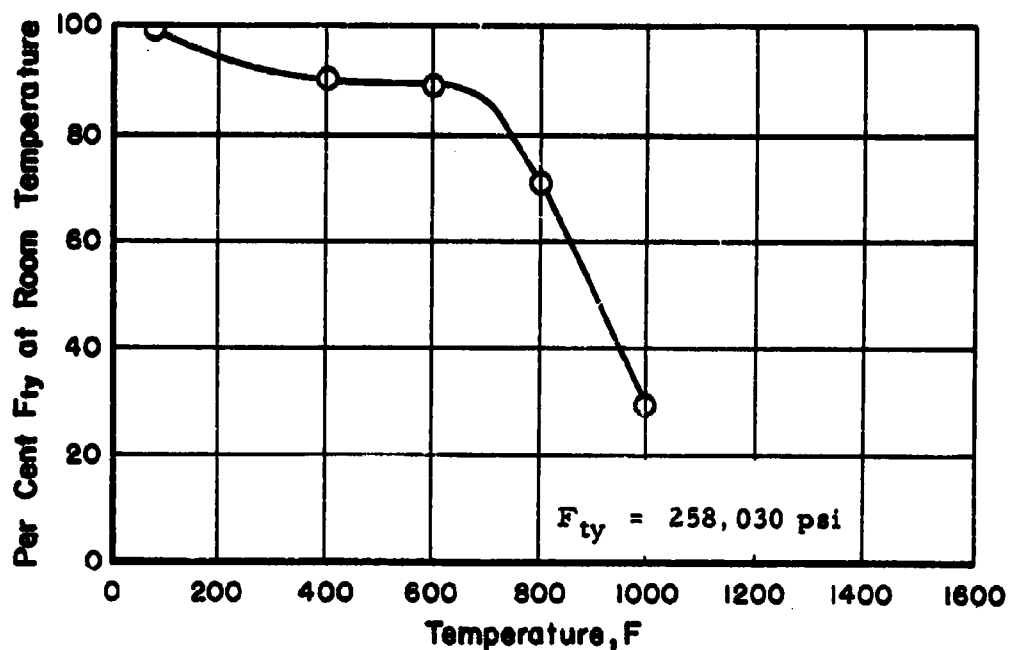


FIGURE 286. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF 301 (60%
COLD REDUCED) STAINLESS STEEL
EXPOSED 100 HOURS

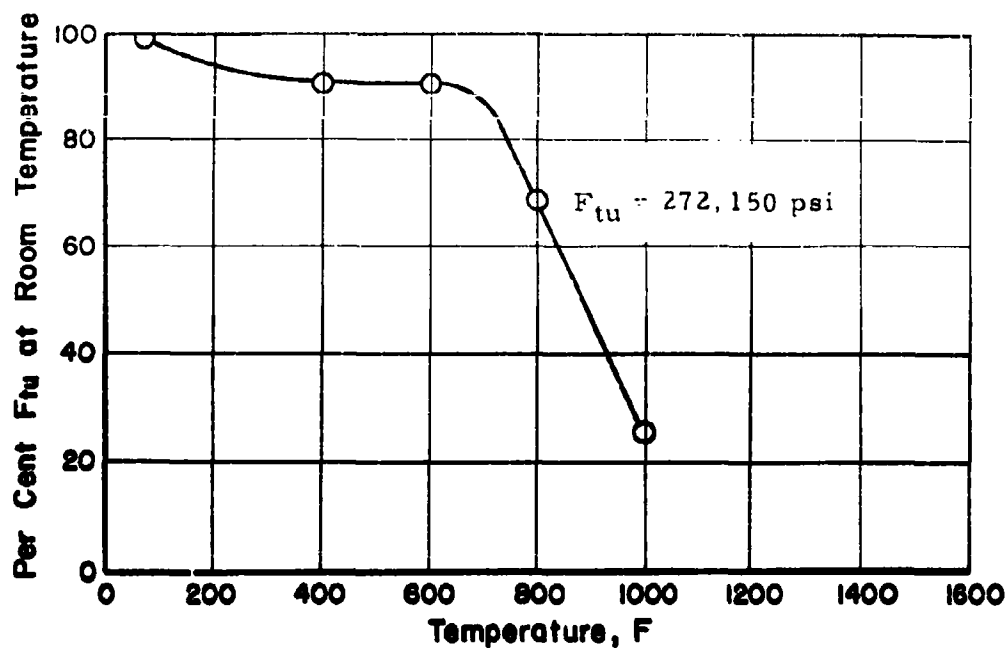


FIGURE 287. EFFECT OF TEMPERATURE ON
ULTIMATE TENSILE STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 1000 HOURS

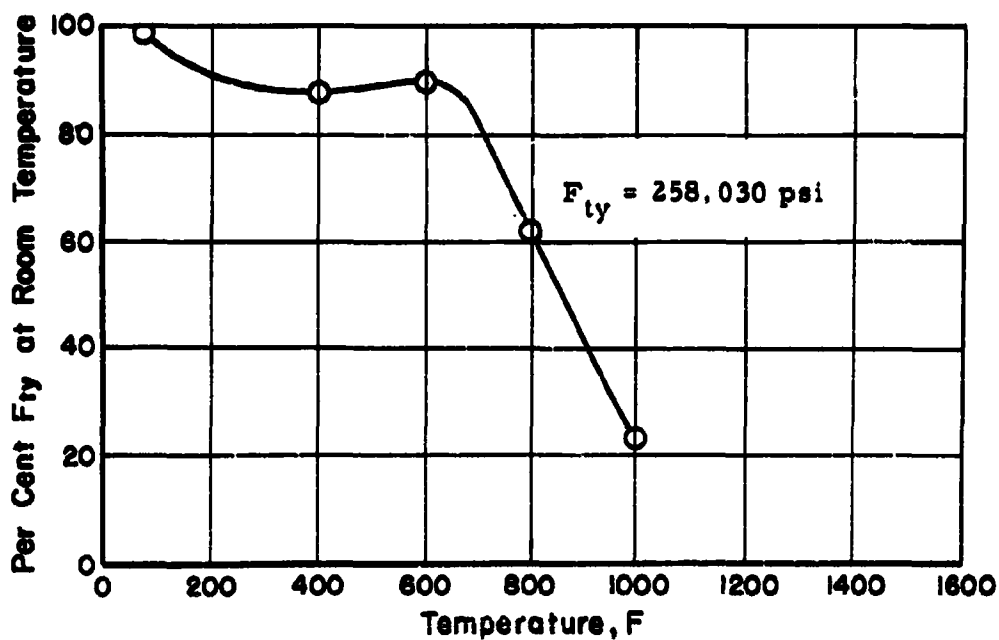


FIGURE 288. EFFECT OF TEMPERATURE ON
TENSILE YIELD STRENGTH OF 301 (60%
COLD REDUCED) STAINLESS STEEL
EXPOSED 1000 HOURS

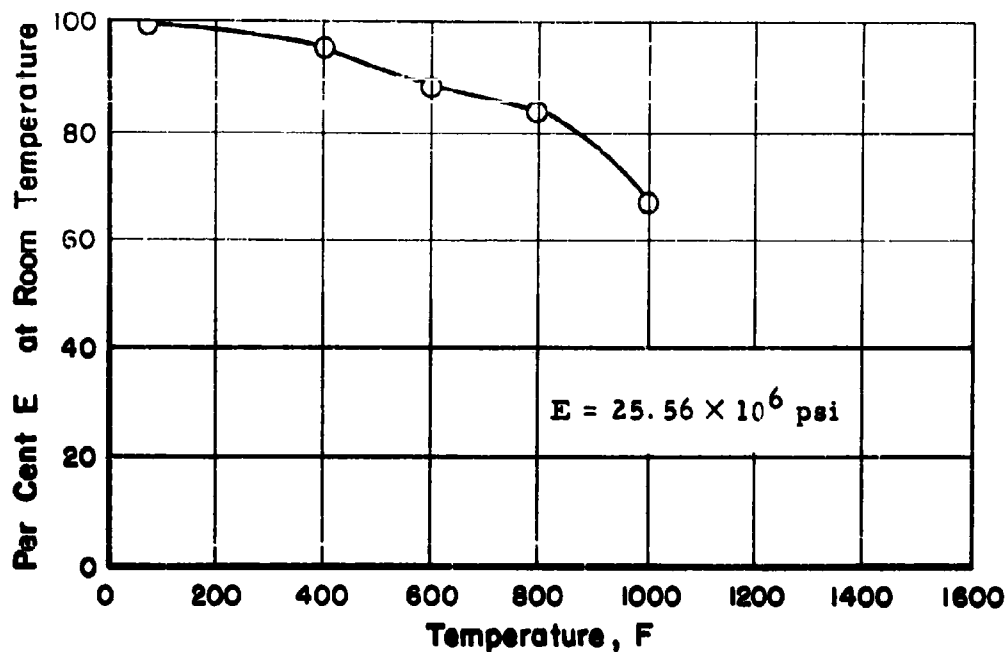


FIGURE 289. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

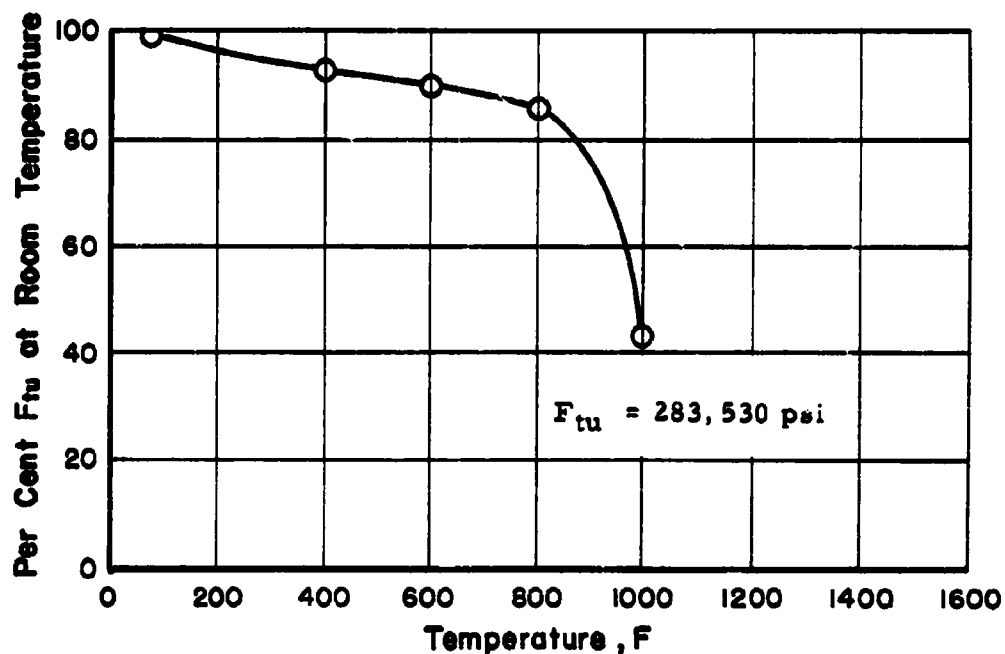


FIGURE 290. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

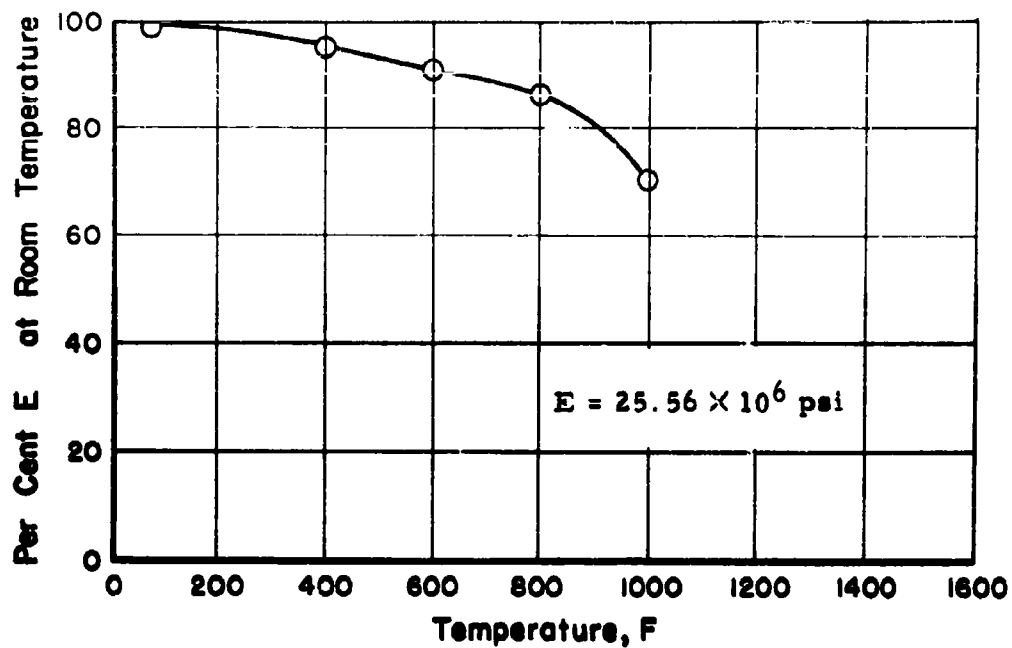


FIGURE 291. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

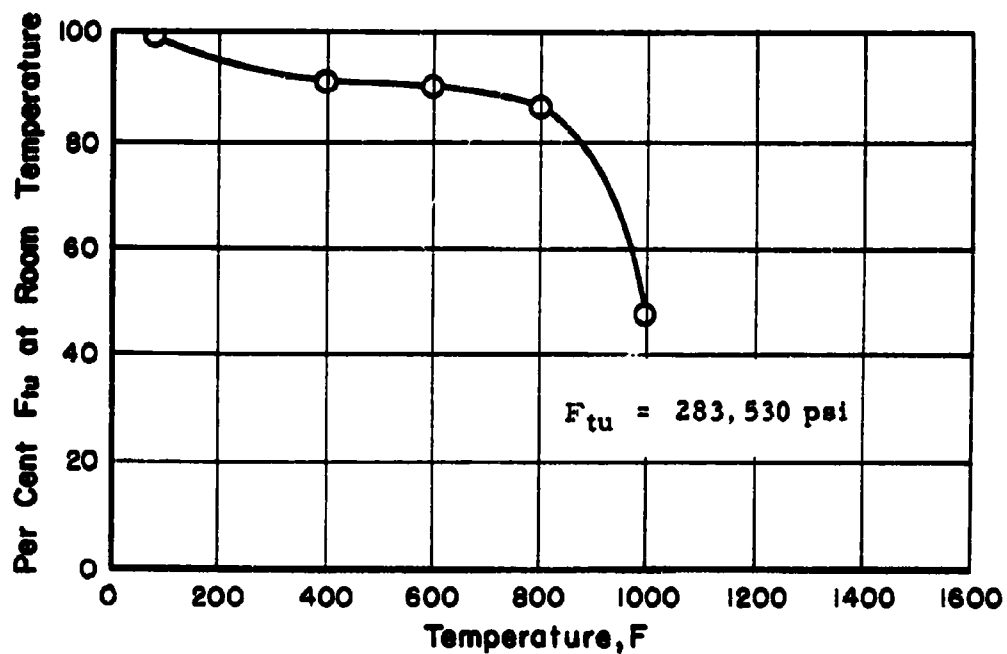


FIGURE 292. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

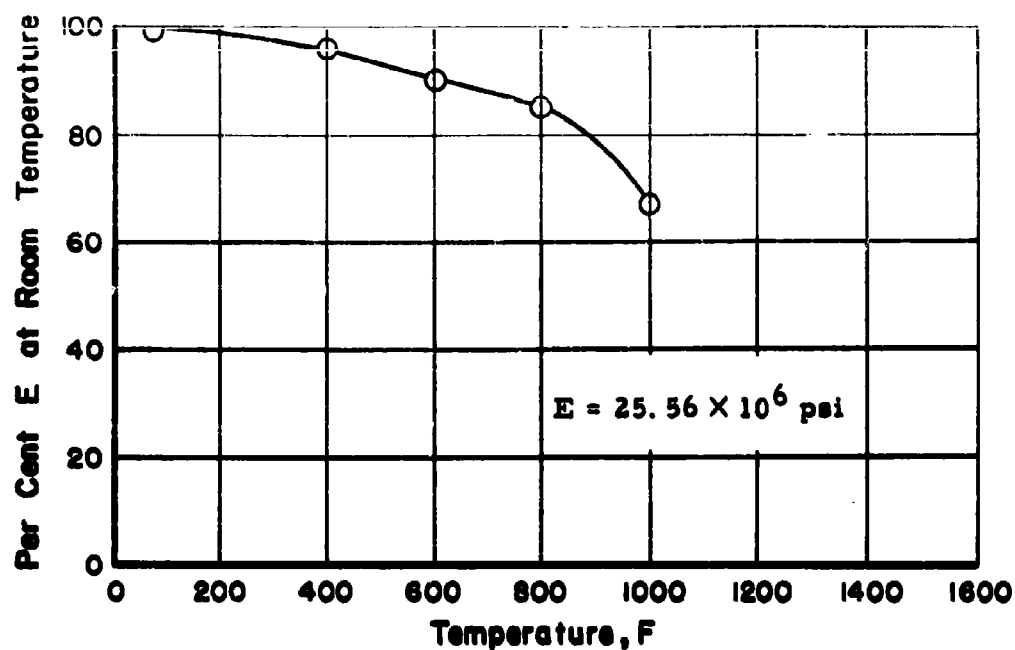


FIGURE 293. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

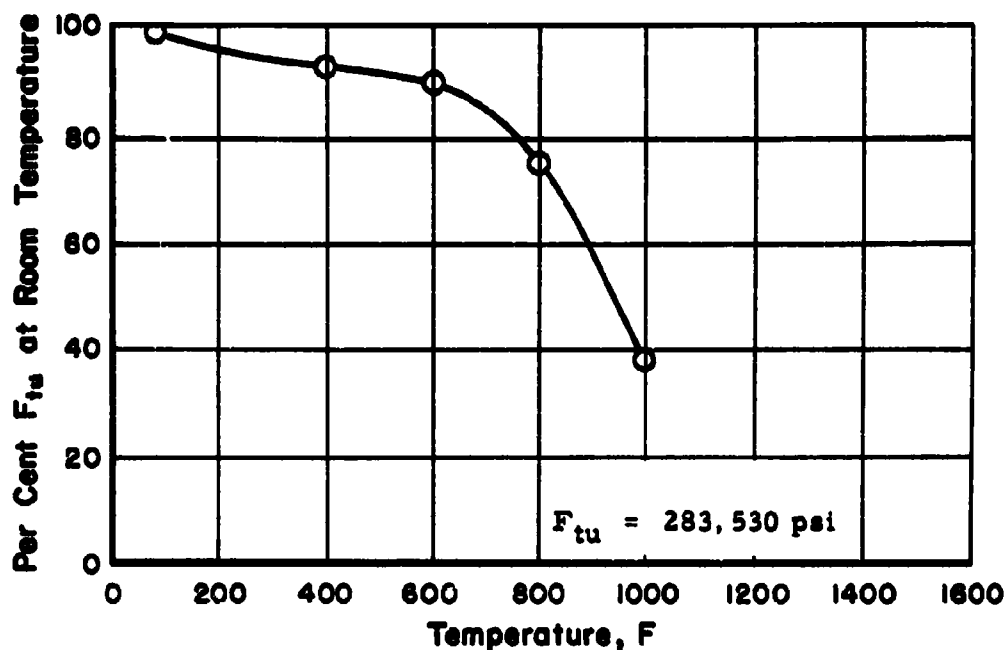


FIGURE 294. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

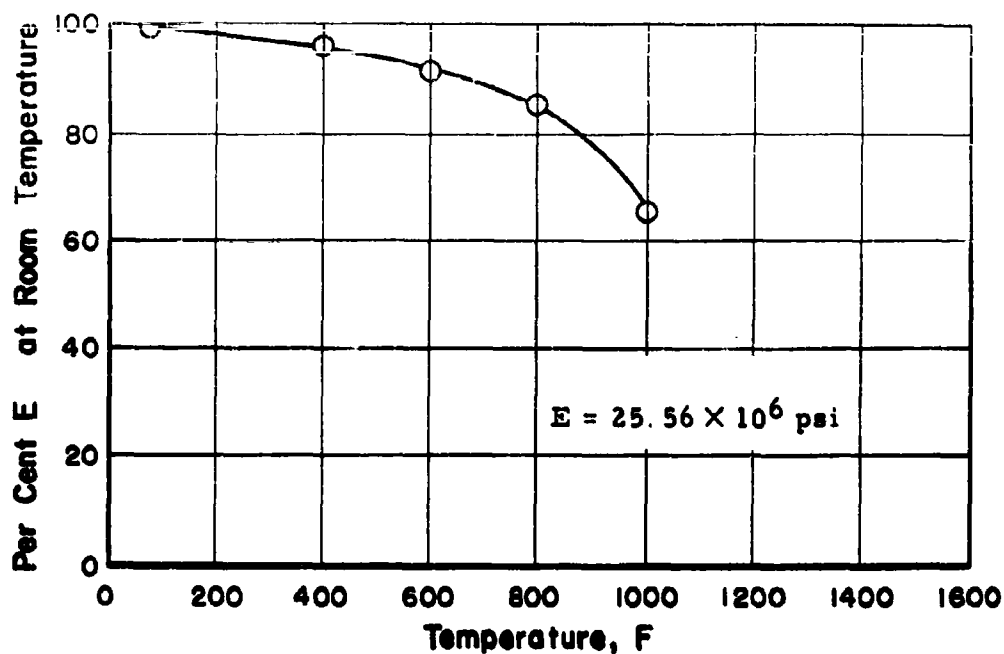


FIGURE 295. EFFECT OF TEMPERATURE ON MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

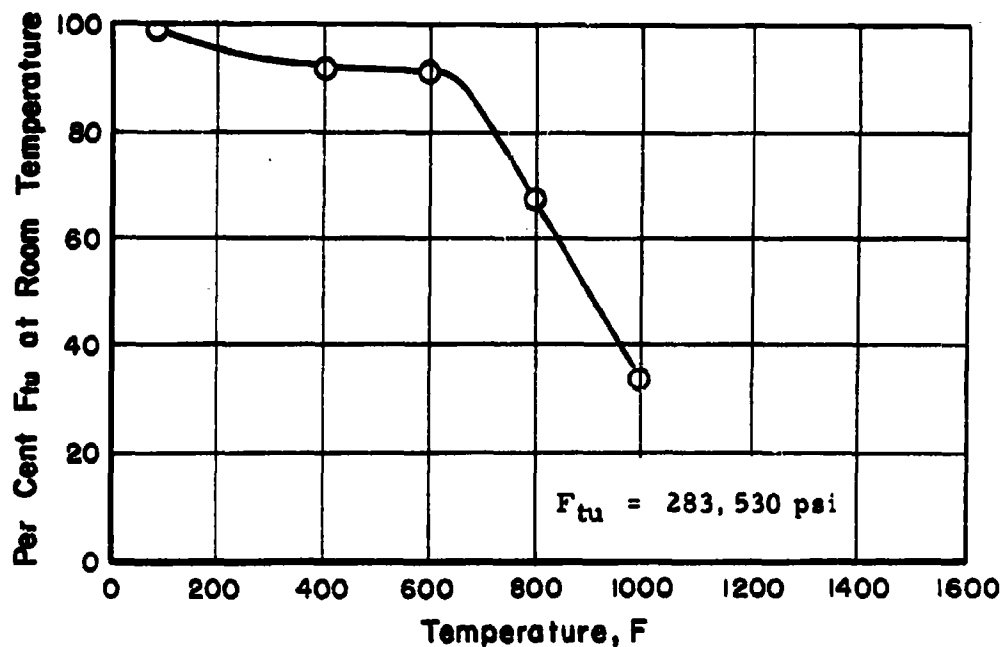


FIGURE 296. EFFECT OF TEMPERATURE ON NOTCHED ULTIMATE TENSILE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

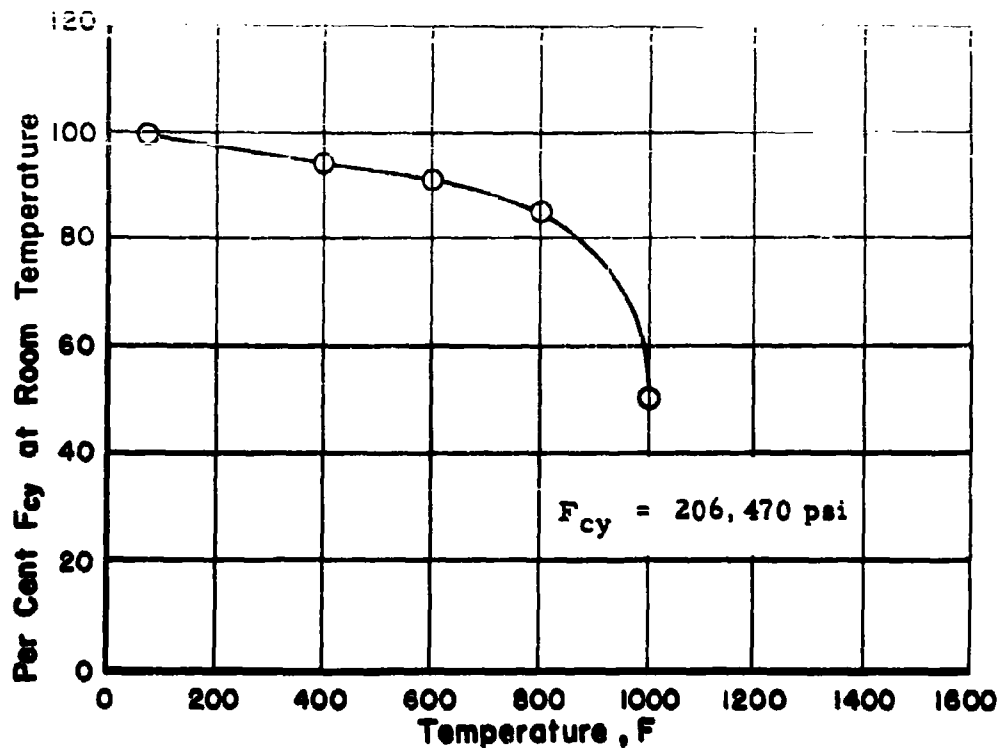


FIGURE 297. EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

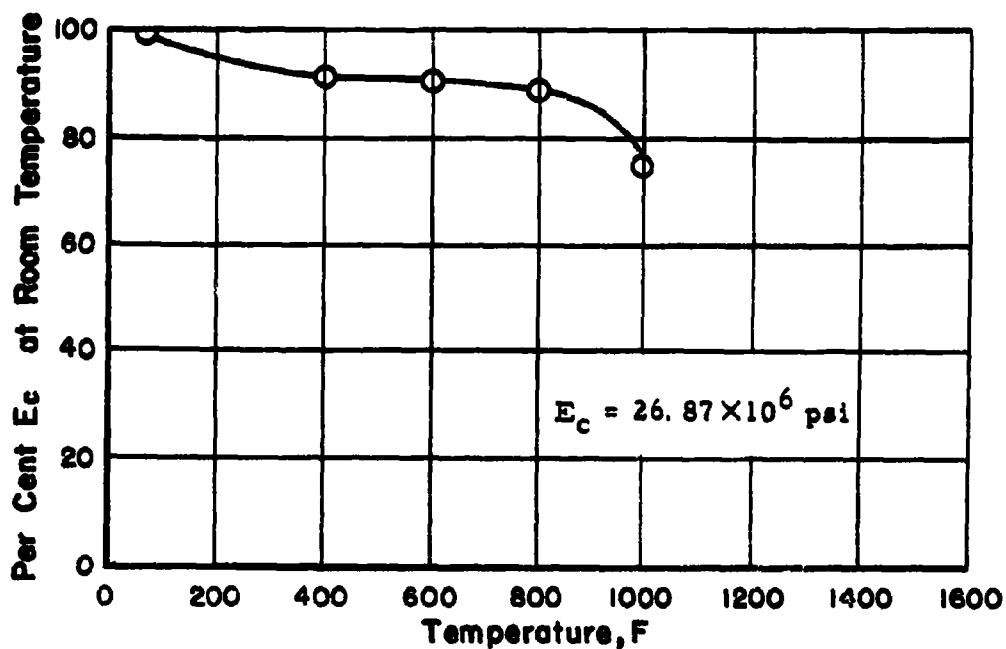


FIGURE 298. EFFECT OF TEMPERATURE ON COMPRESSIVE MODULUS OF ELASTICITY OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

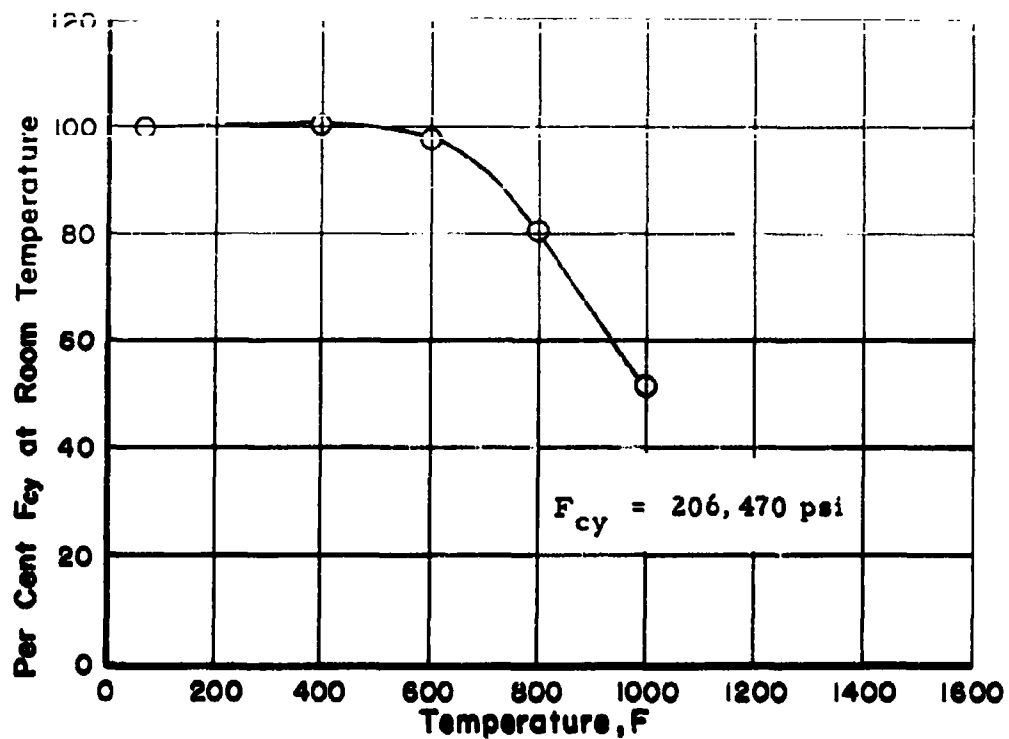


FIGURE 299. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 10 HOURS

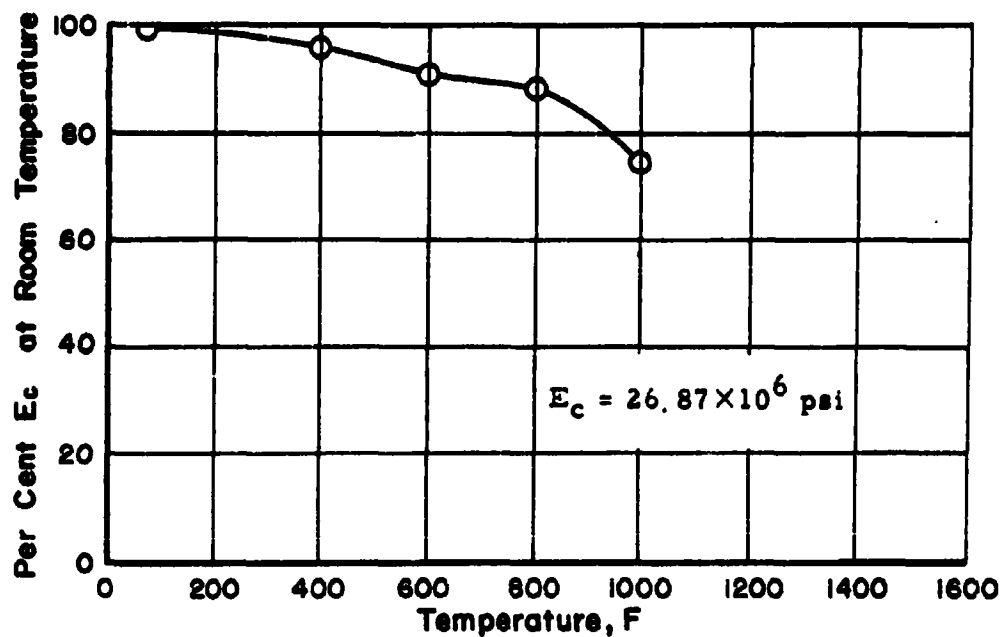


FIGURE 300. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY OF
301 (60% COLD REDUCED) STAINLESS
STEEL EXPOSED 10 HOURS

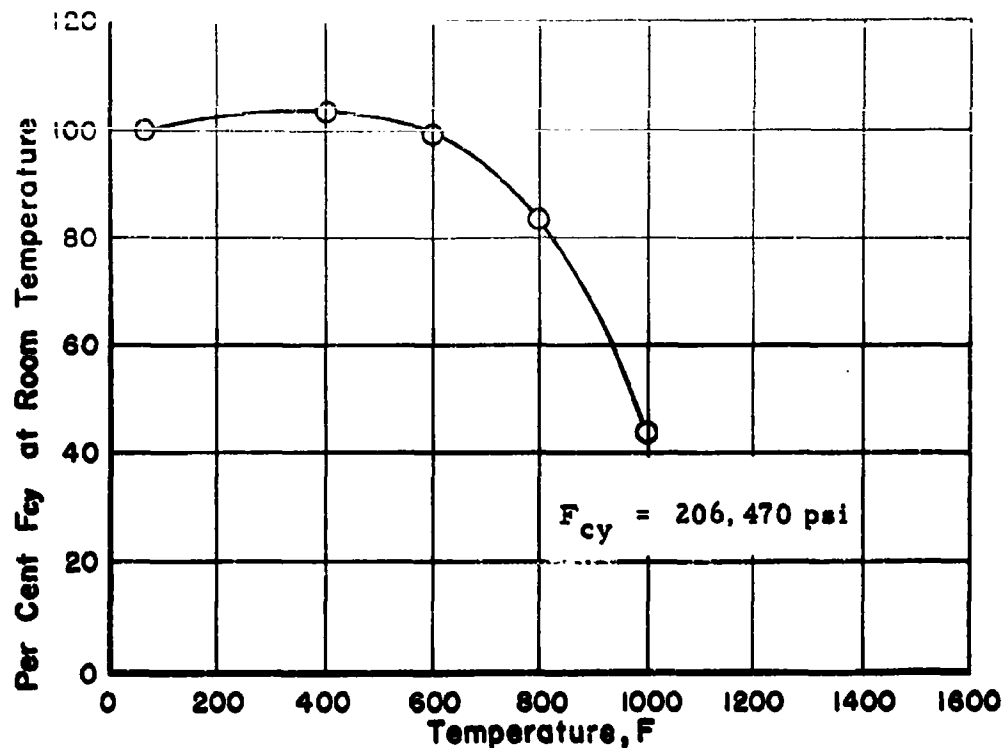


FIGURE 301. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 100 HOURS

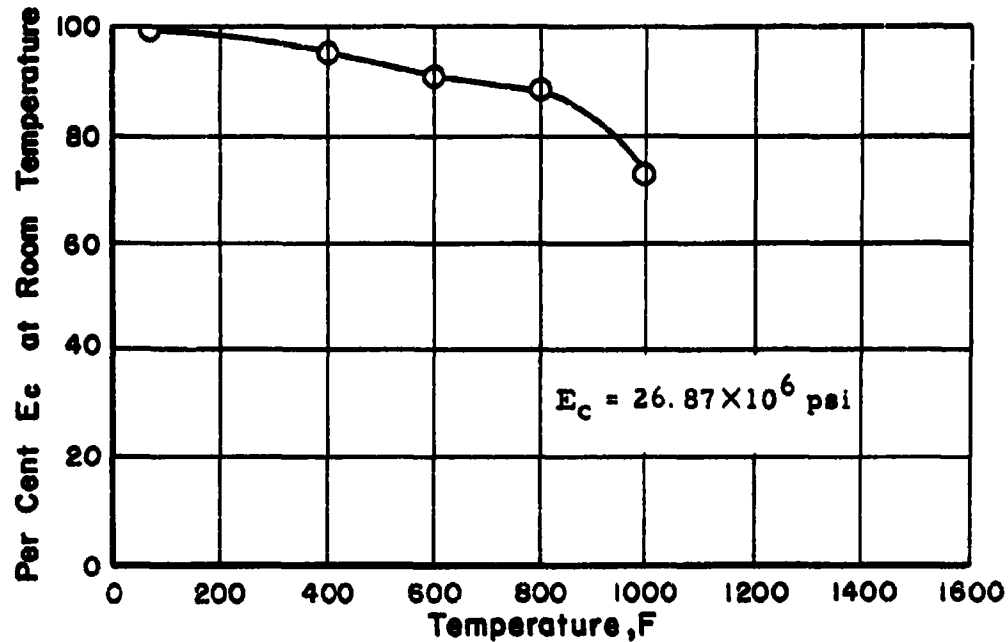


FIGURE 302. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY OF
301 (60% COLD REDUCED) STAINLESS
STEEL EXPOSED 100 HOURS

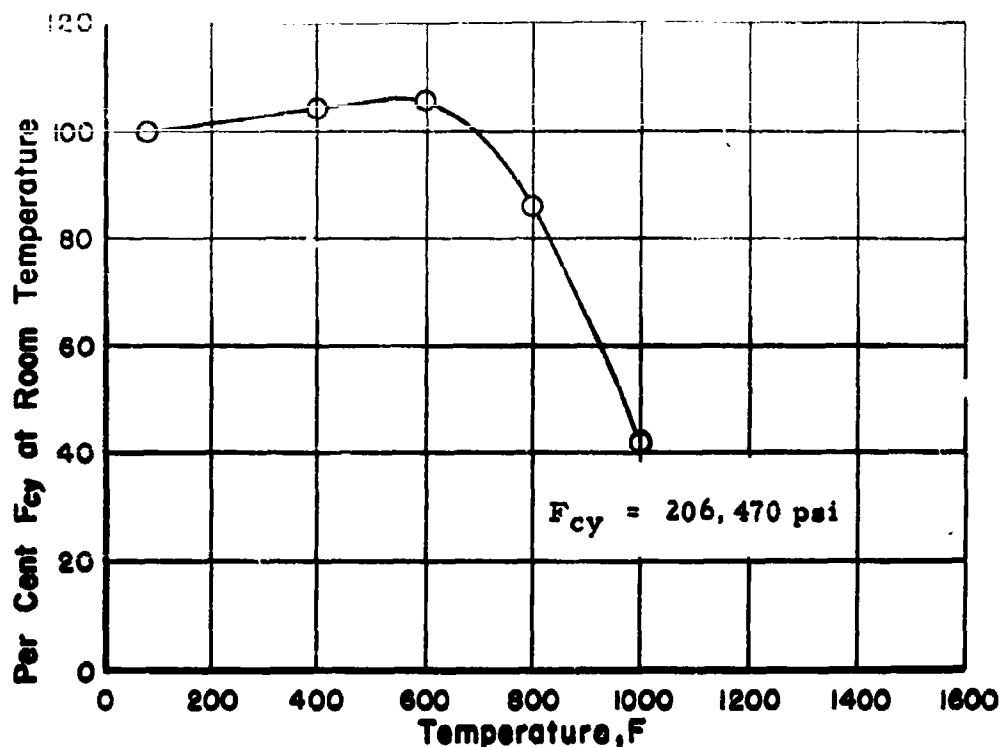


FIGURE 303. EFFECT OF TEMPERATURE ON
COMPRESSIVE YIELD STRENGTH OF 301
(60% COLD REDUCED) STAINLESS
STEEL EXPOSED 1000 HOURS

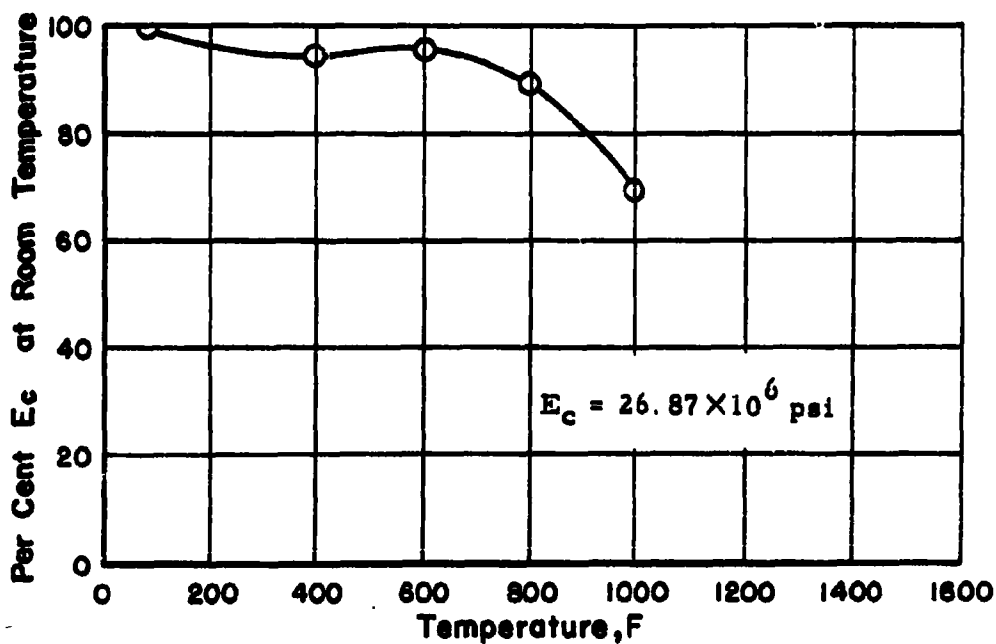


FIGURE 304. EFFECT OF TEMPERATURE ON
COMPRESSIVE MODULUS OF ELASTICITY OF
301 (60% COLD REDUCED) STAINLESS
STEEL EXPOSED 1000 HOURS

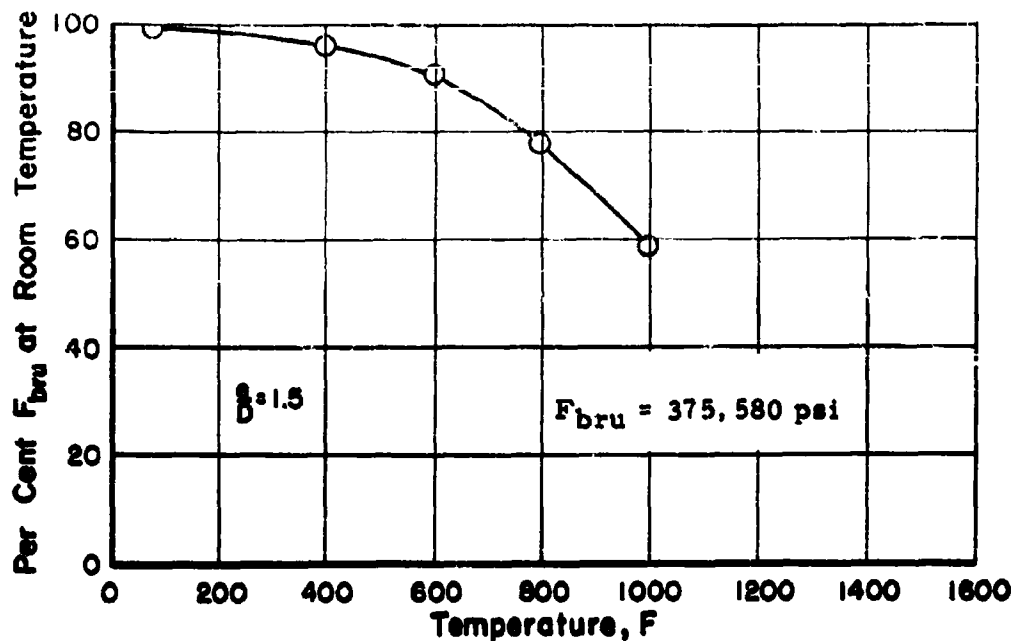


FIGURE 305. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

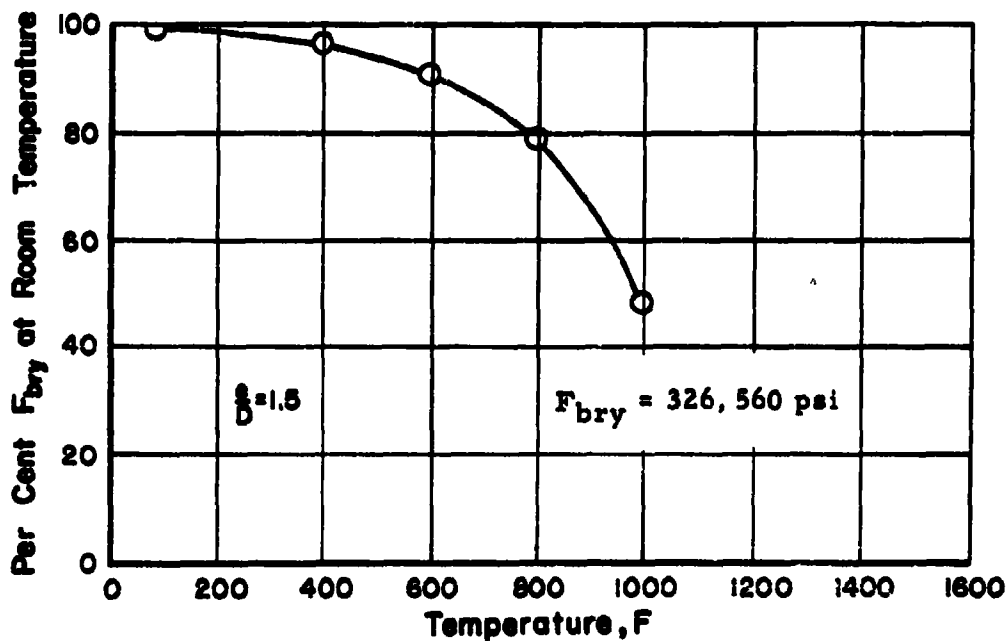


FIGURE 306. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

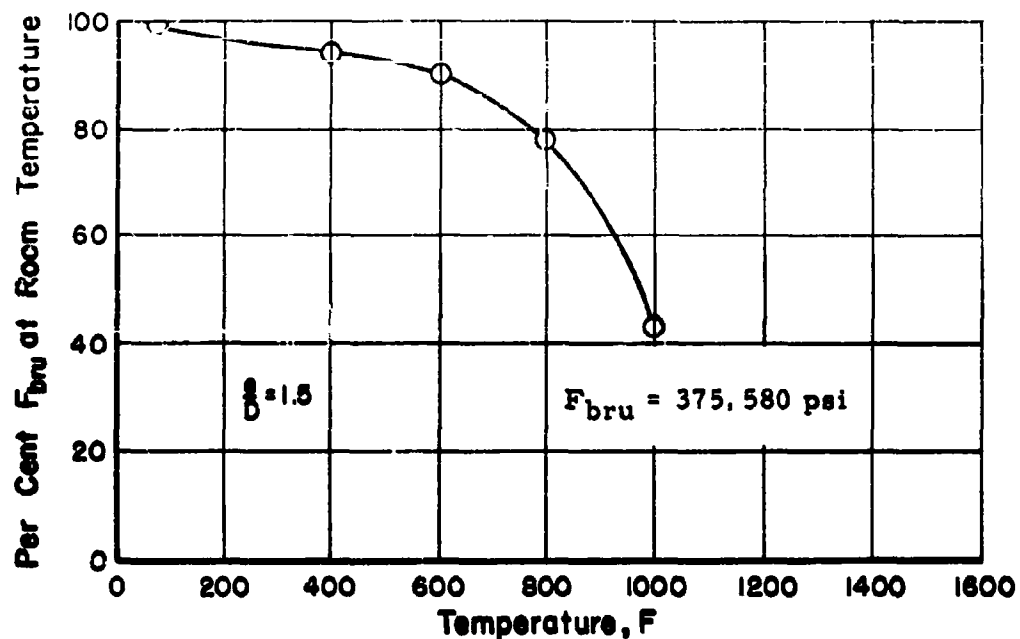


FIGURE 307. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

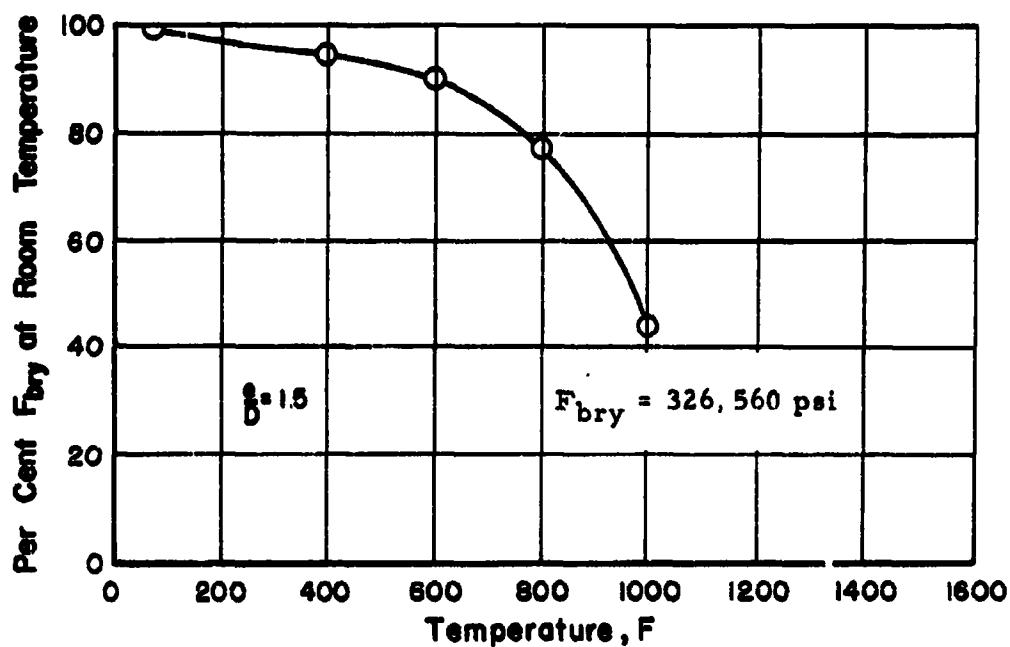


FIGURE 308. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

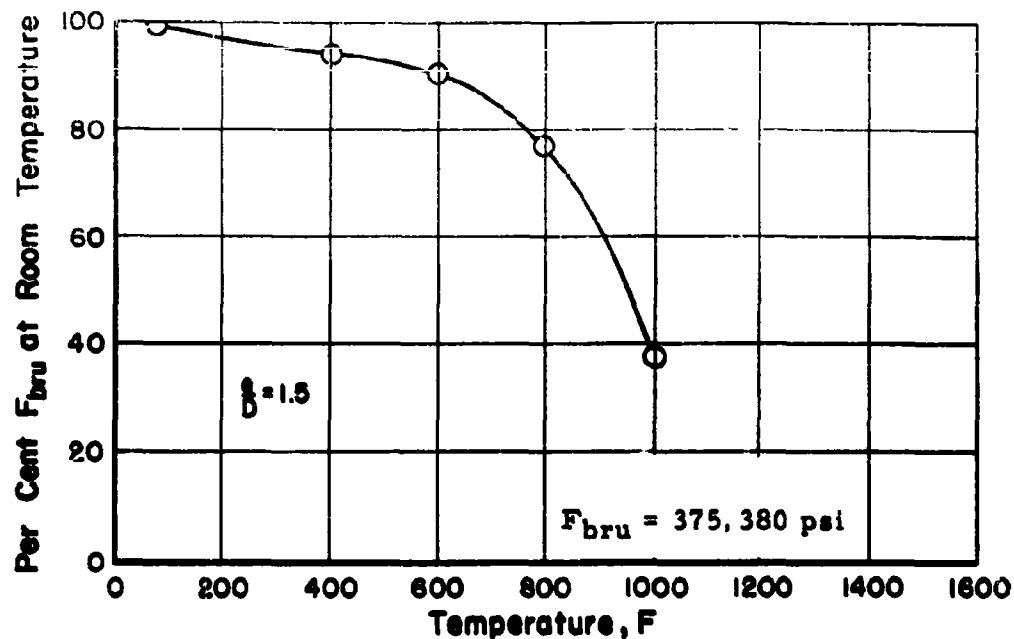


FIGURE 309. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

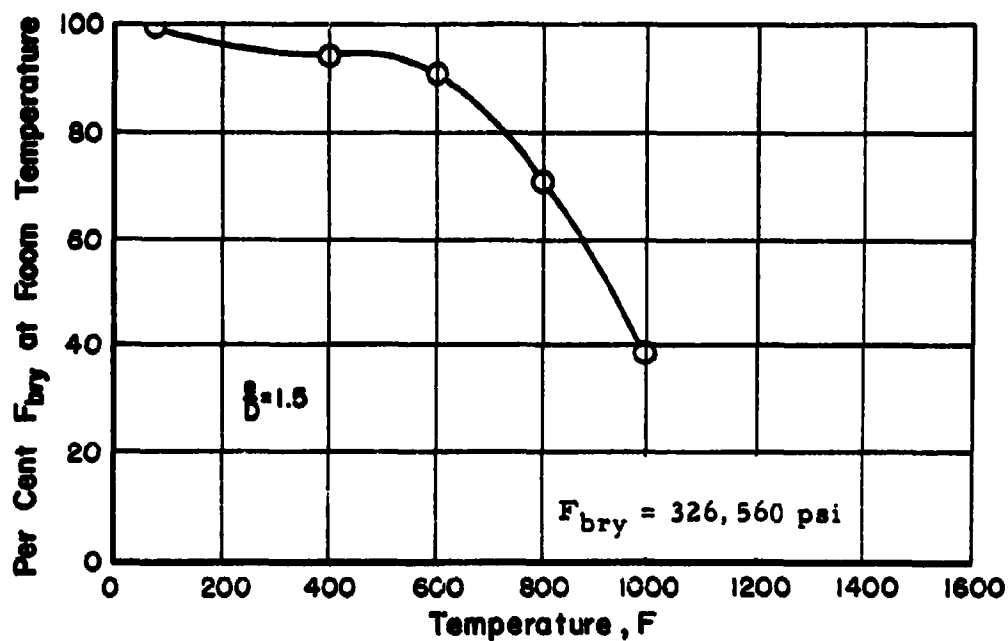


FIGURE 310. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

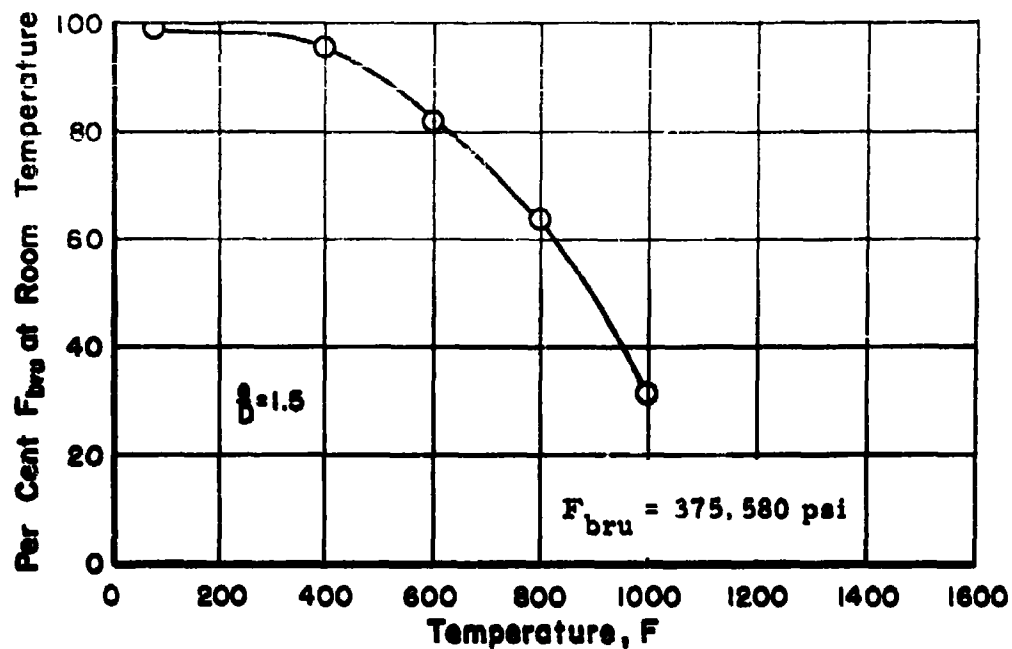


FIGURE 311. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

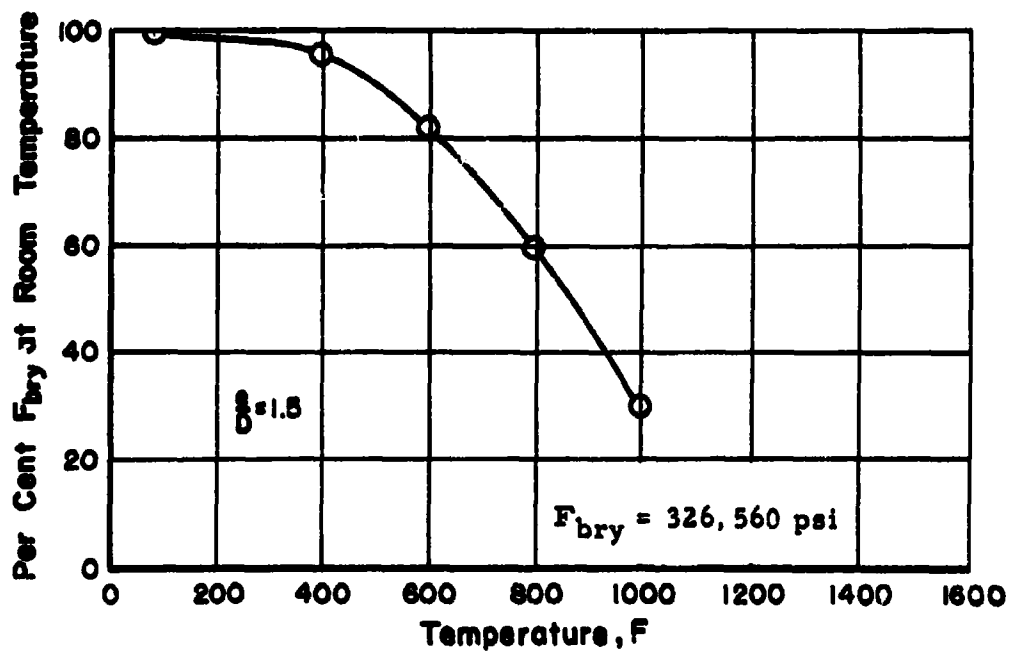


FIGURE 312. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

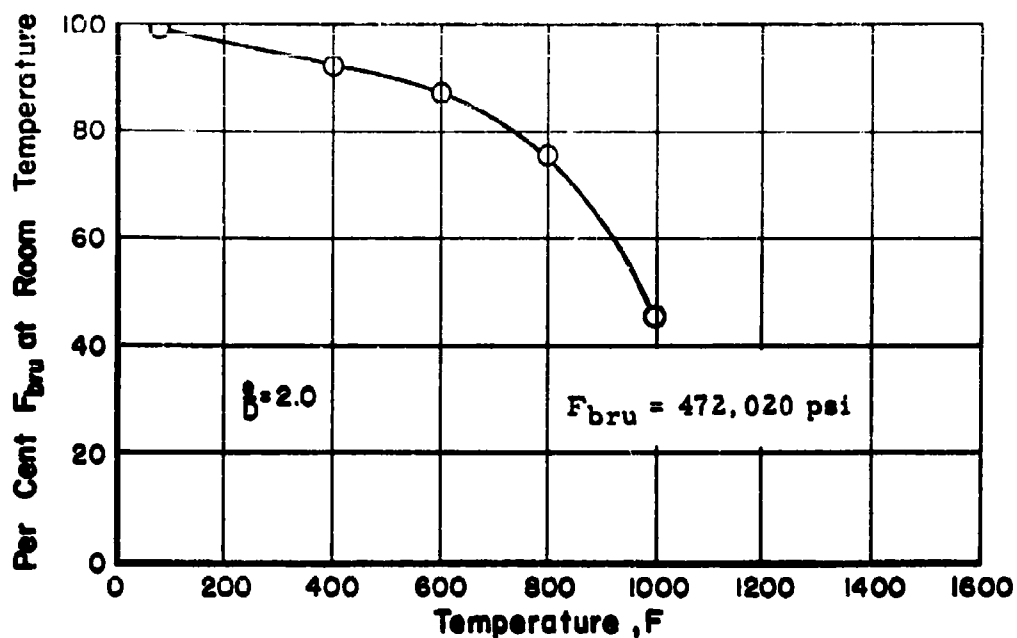


FIGURE 313. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

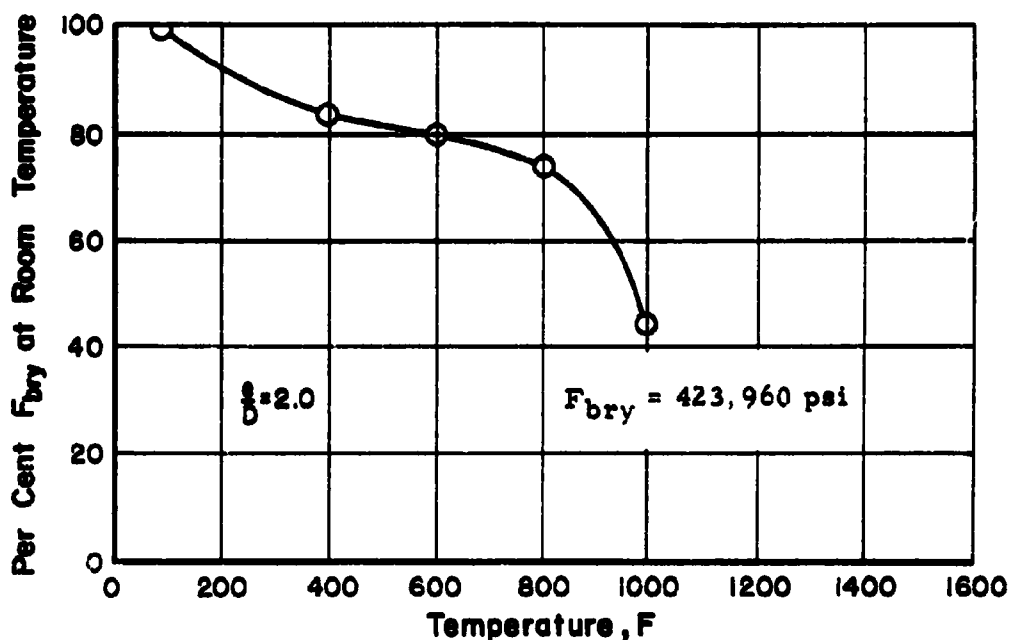


FIGURE 314. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

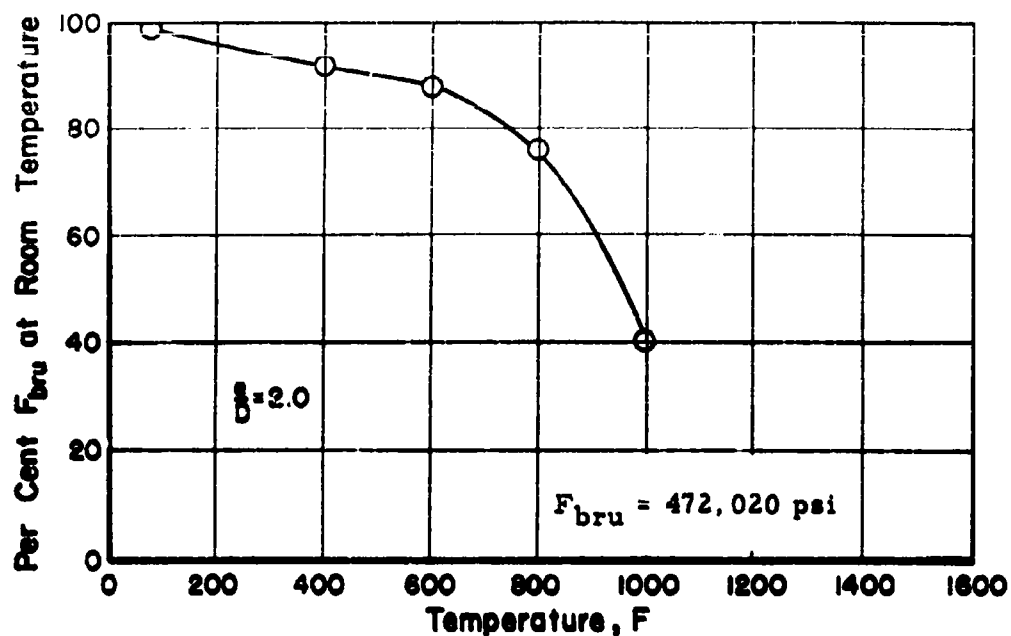


FIGURE 315. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

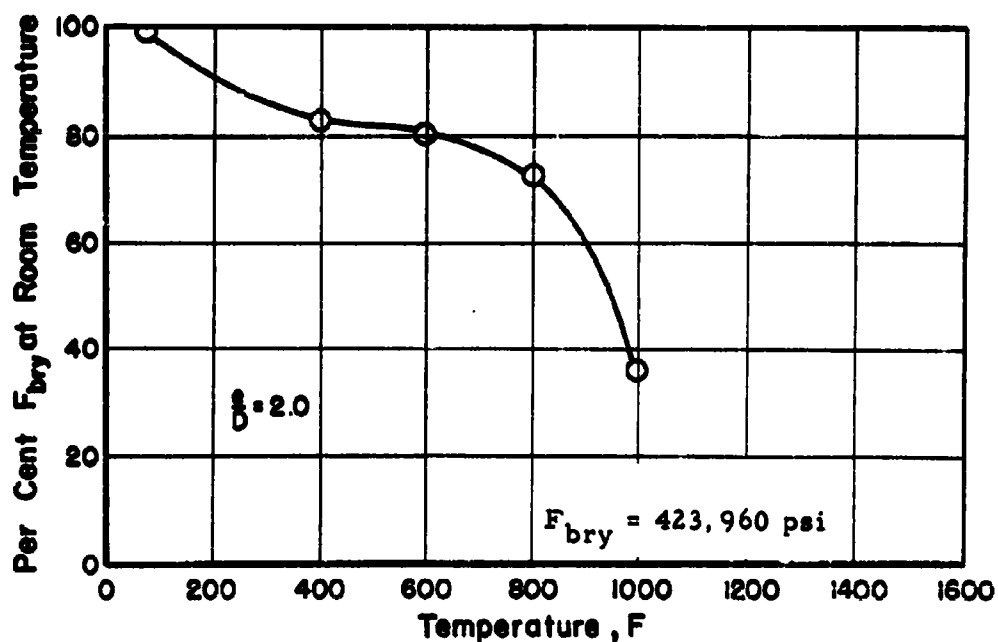


FIGURE 316. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

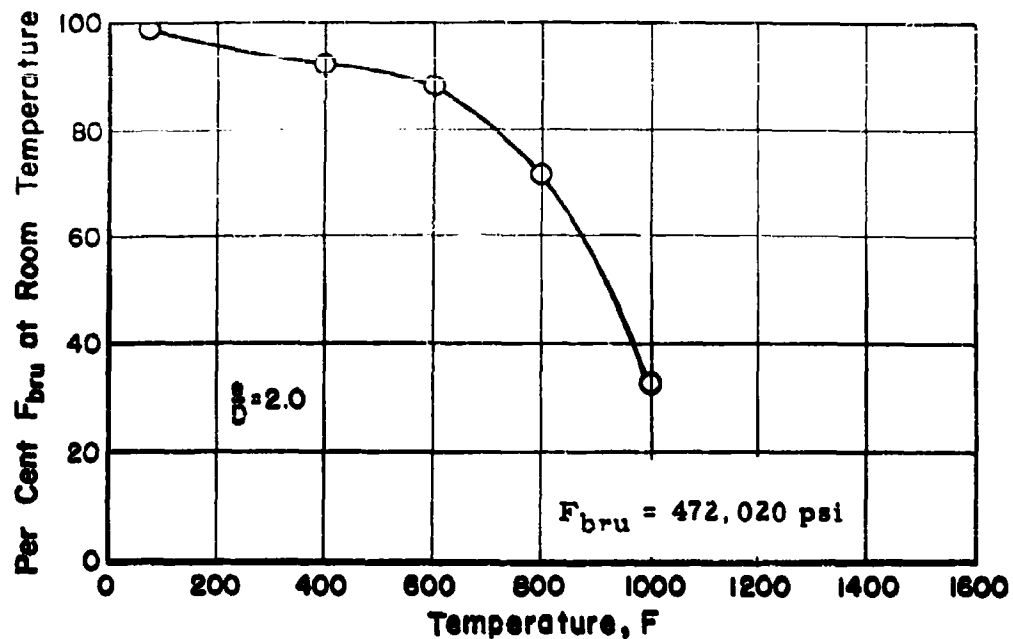


FIGURE 317. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

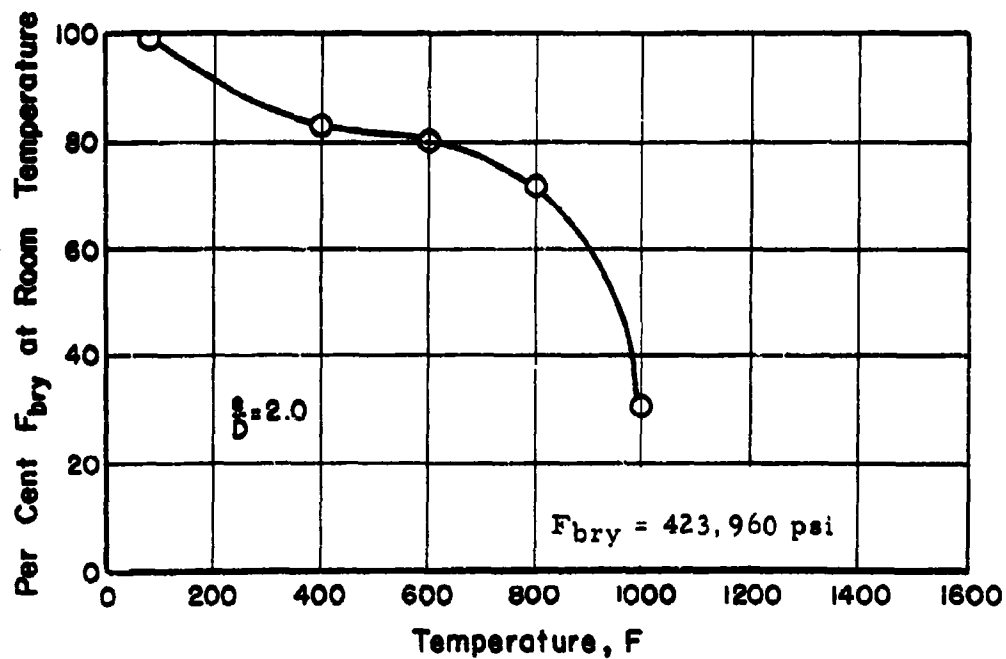


FIGURE 318. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

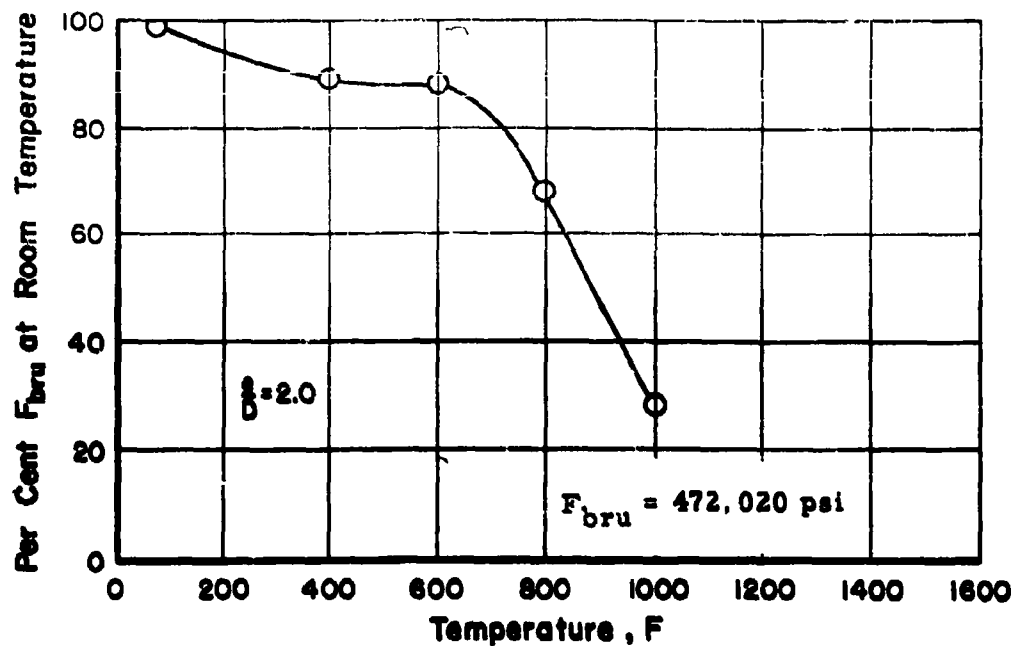


FIGURE 319. EFFECT OF TEMPERATURE ON ULTIMATE BEARING STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

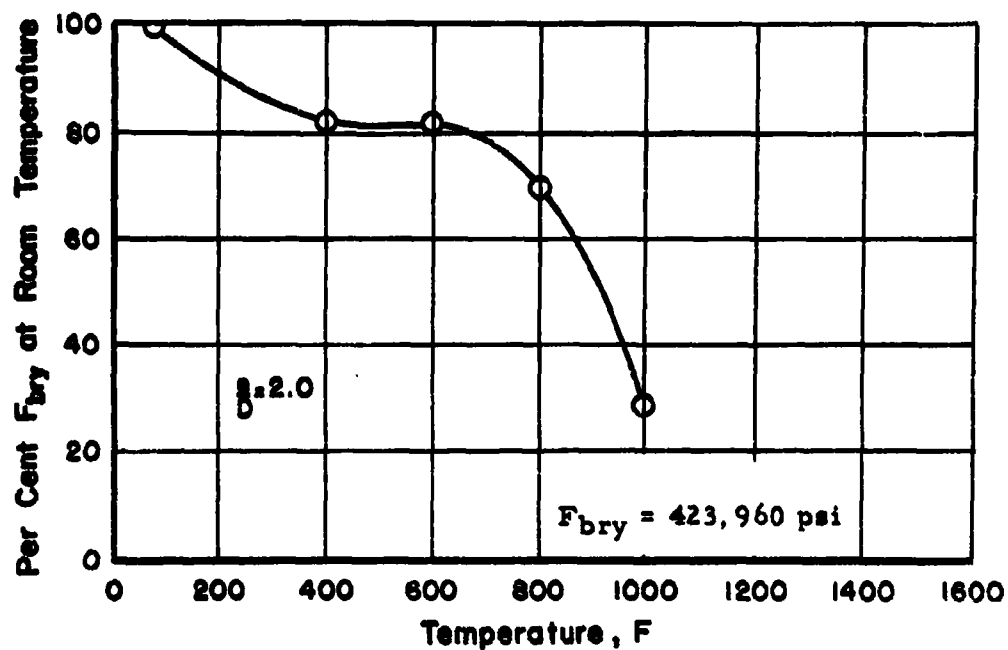


FIGURE 320. EFFECT OF TEMPERATURE ON BEARING YIELD STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

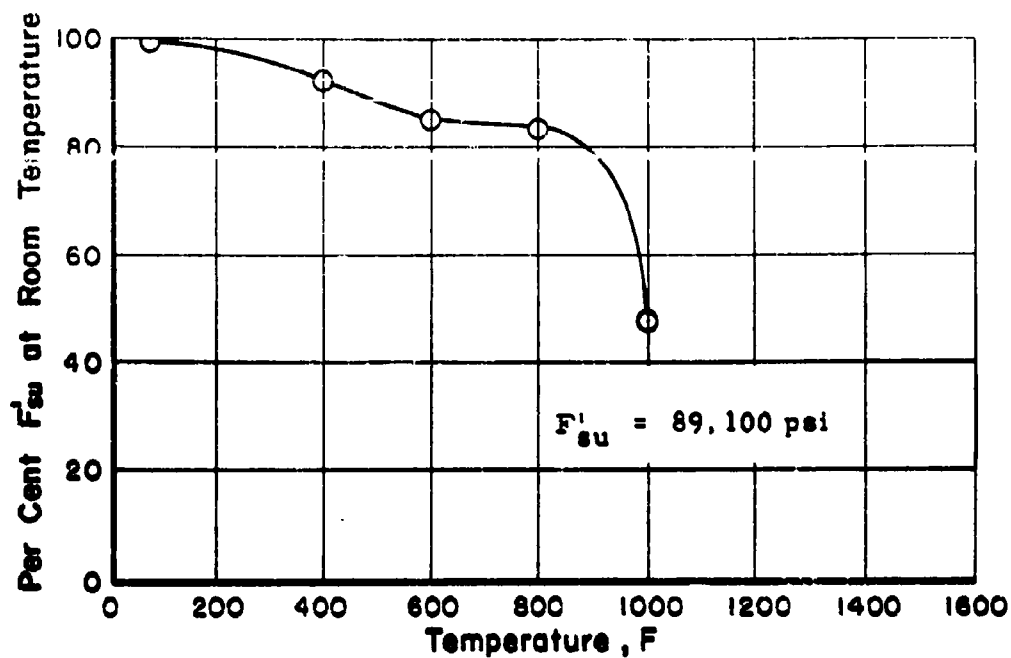


FIGURE 321. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

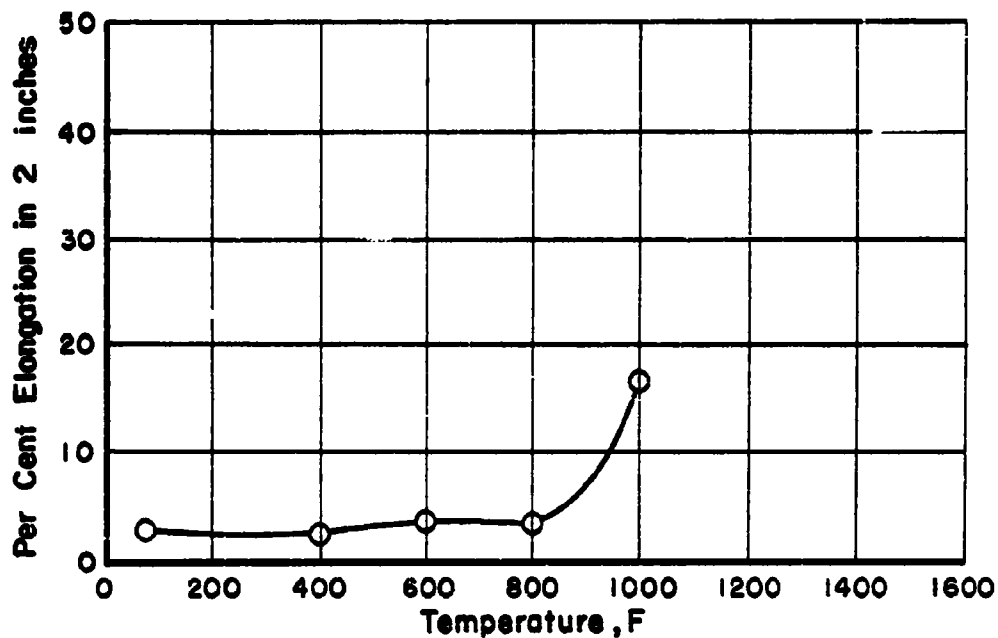


FIGURE 322. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

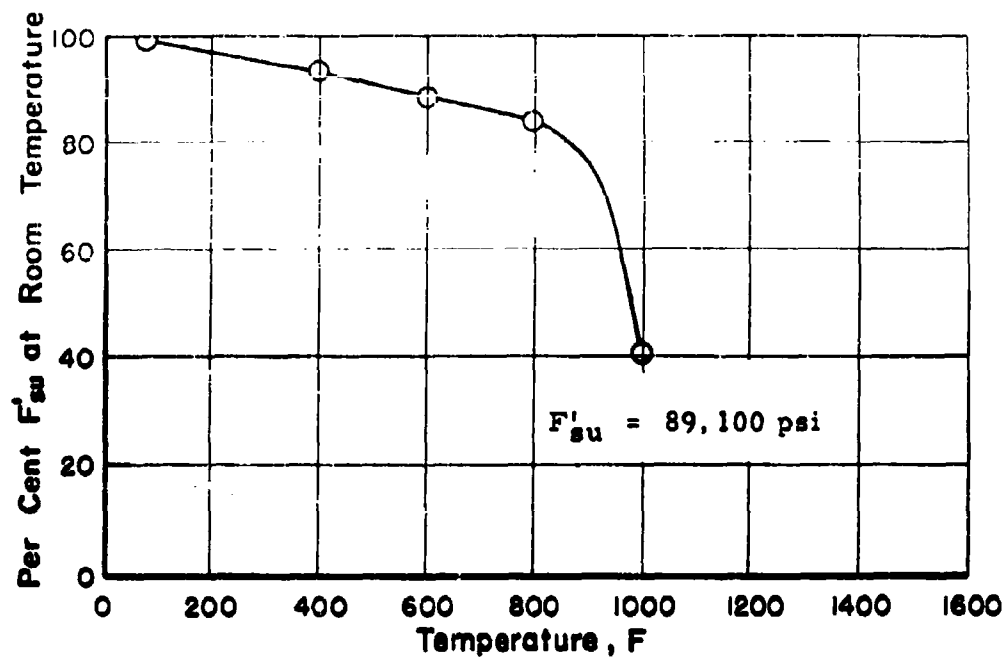


FIGURE 323. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

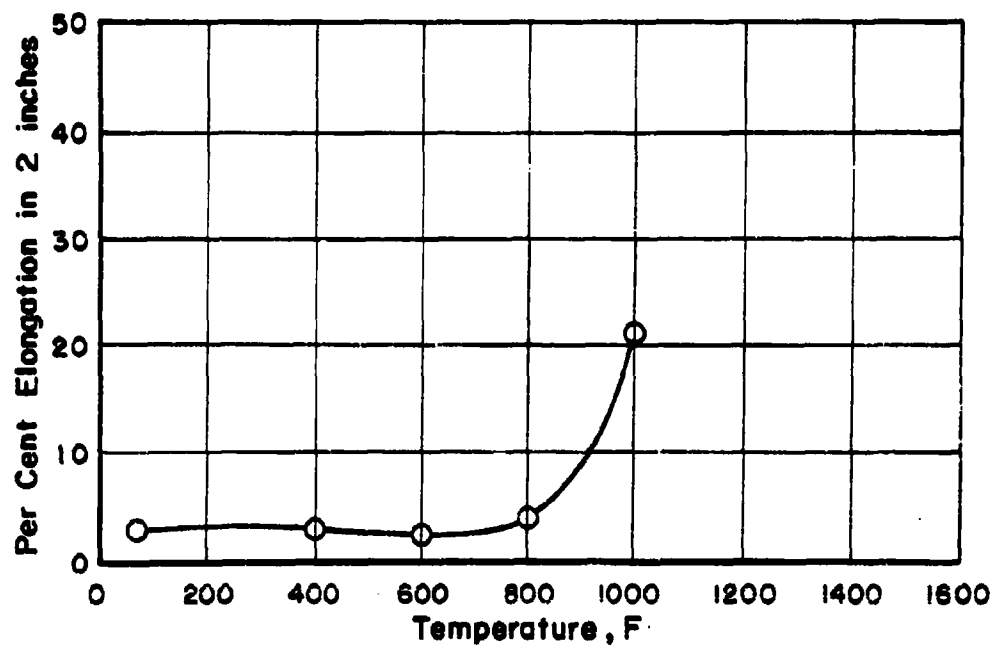


FIGURE 324. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

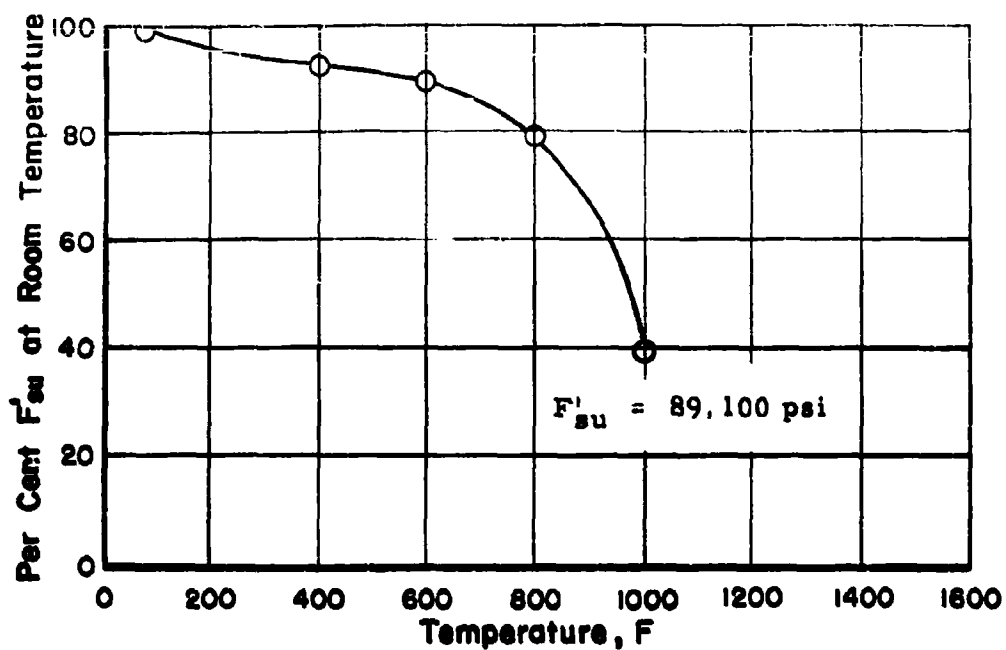


FIGURE 325. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

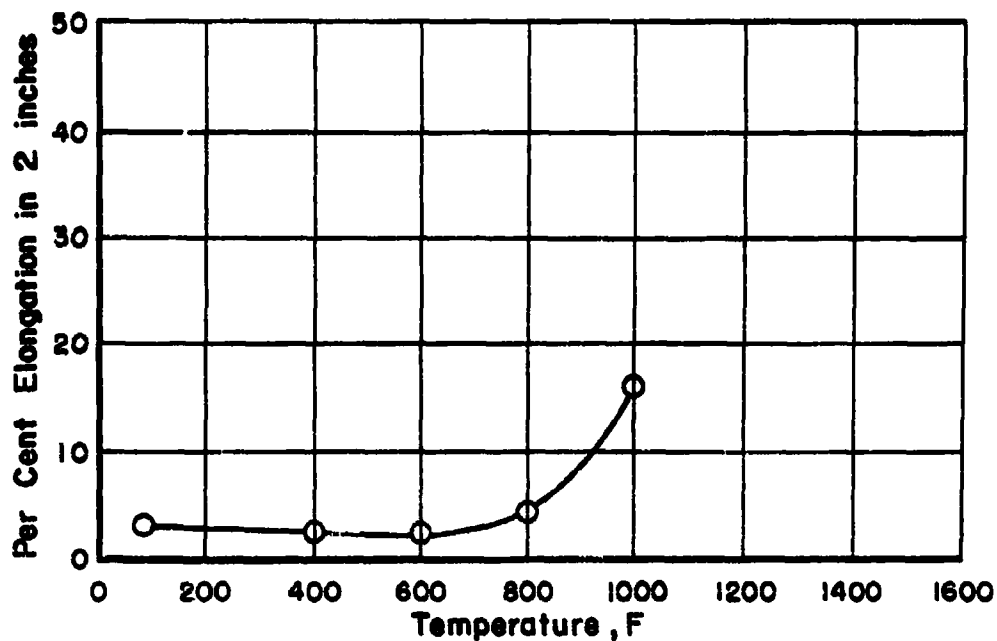


FIGURE 326. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

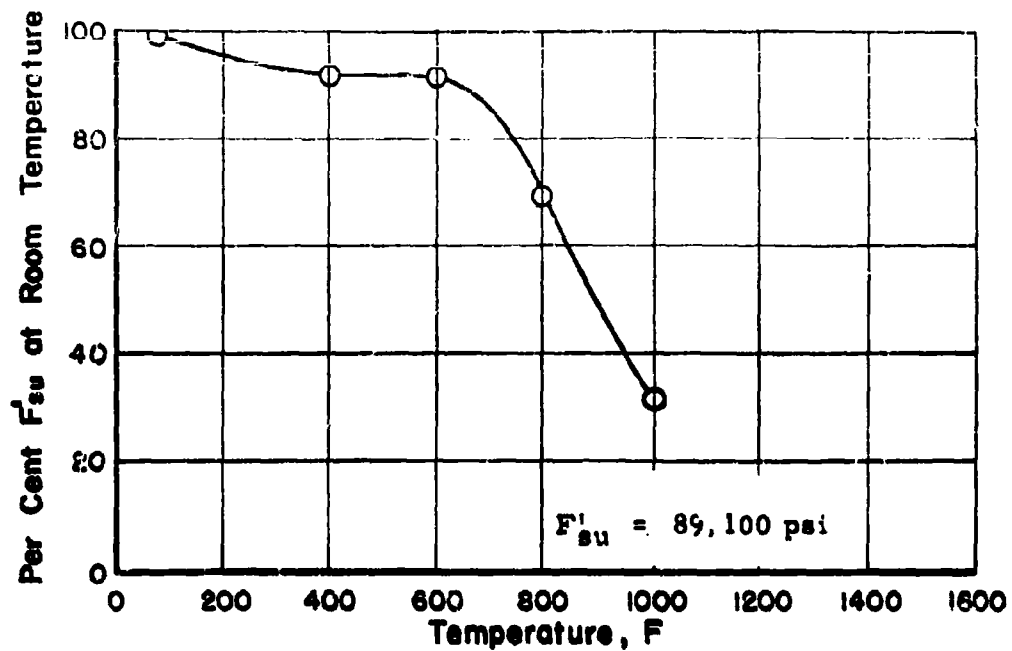


FIGURE 327. EFFECT OF TEMPERATURE ON ULTIMATE SHEAR STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

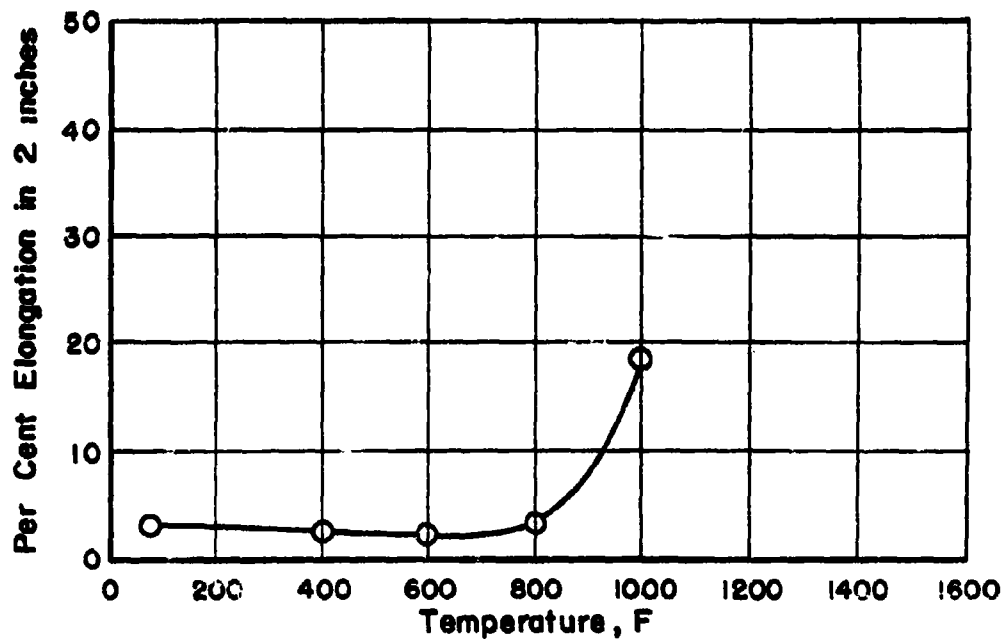


FIGURE 328. EFFECT OF TEMPERATURE ON ELONGATION OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

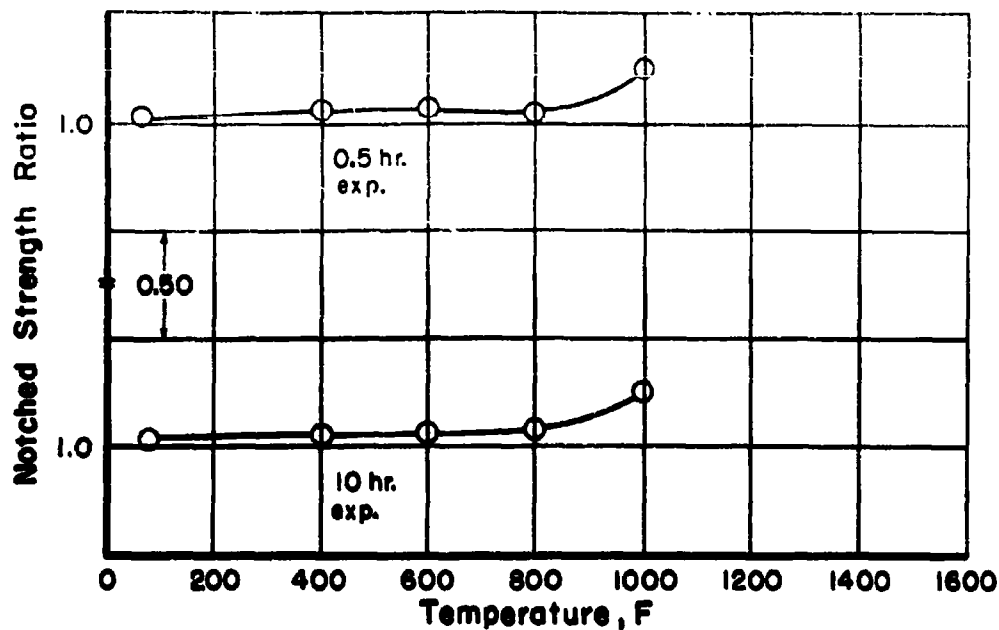


FIGURE 329. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 AND 10 HOURS

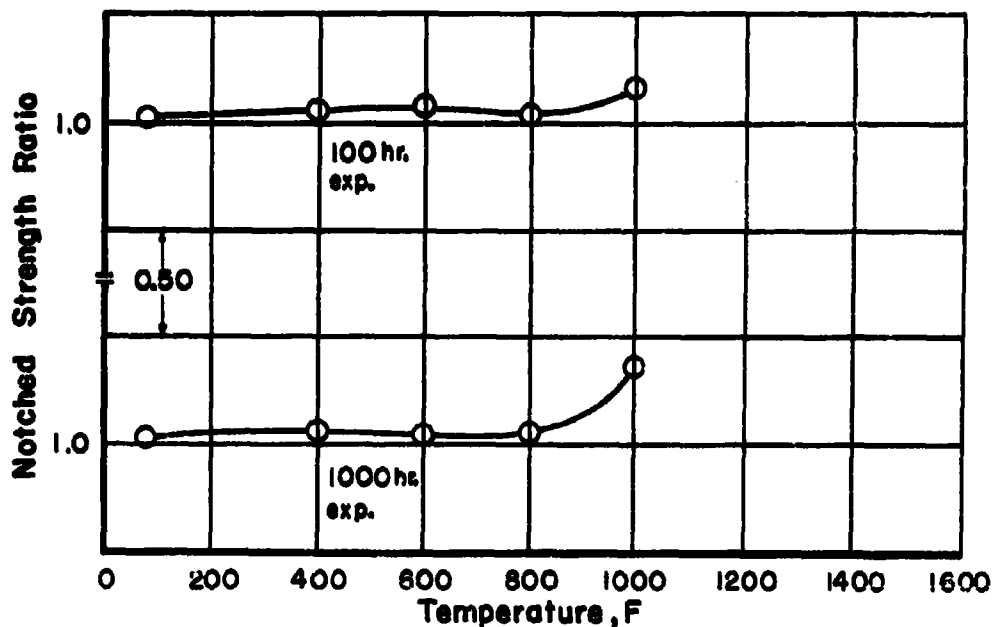


FIGURE 330. EFFECT OF TEMPERATURE ON NOTCHED STRENGTH RATIO OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 AND 1000 HOURS

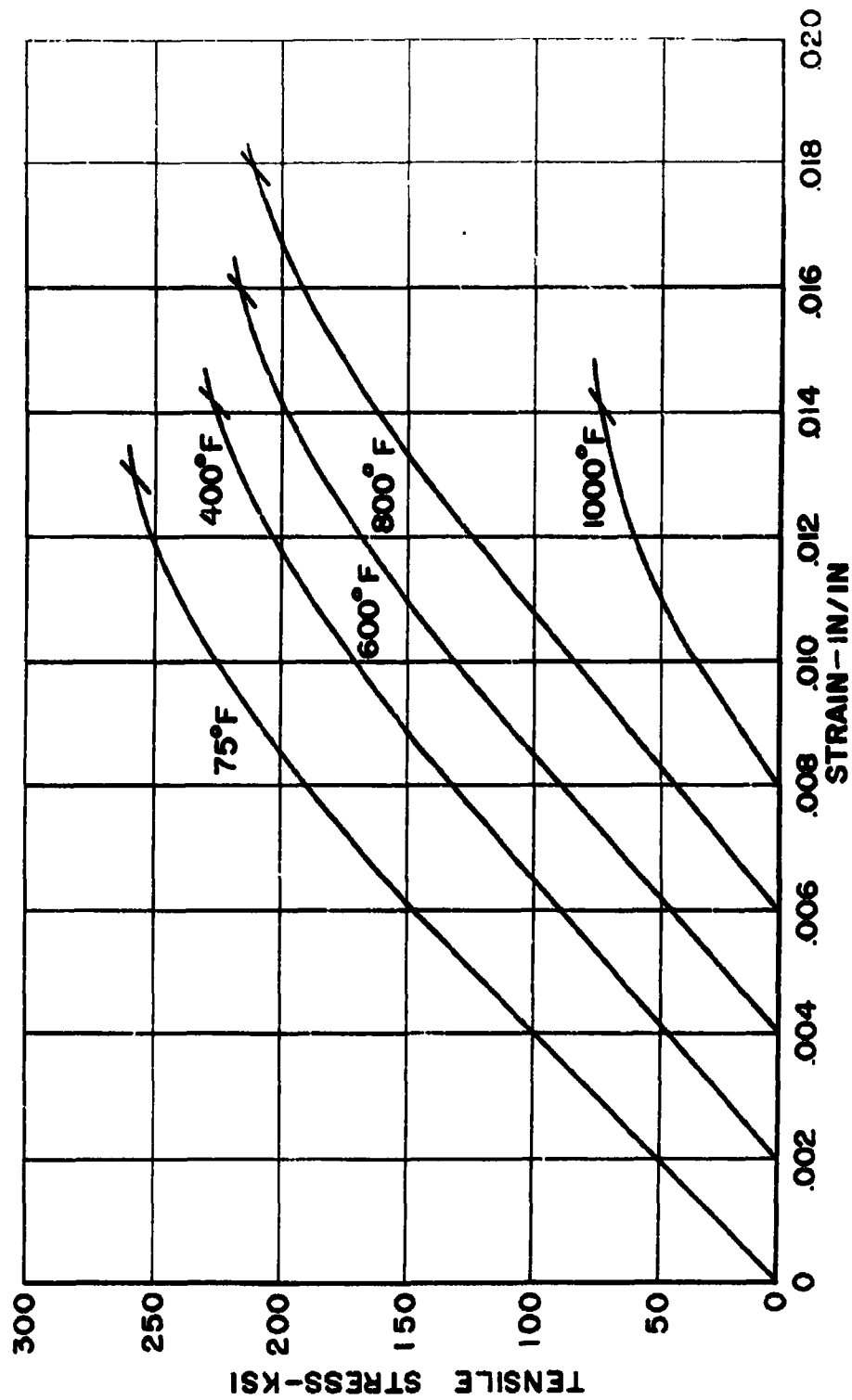


FIGURE 331. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

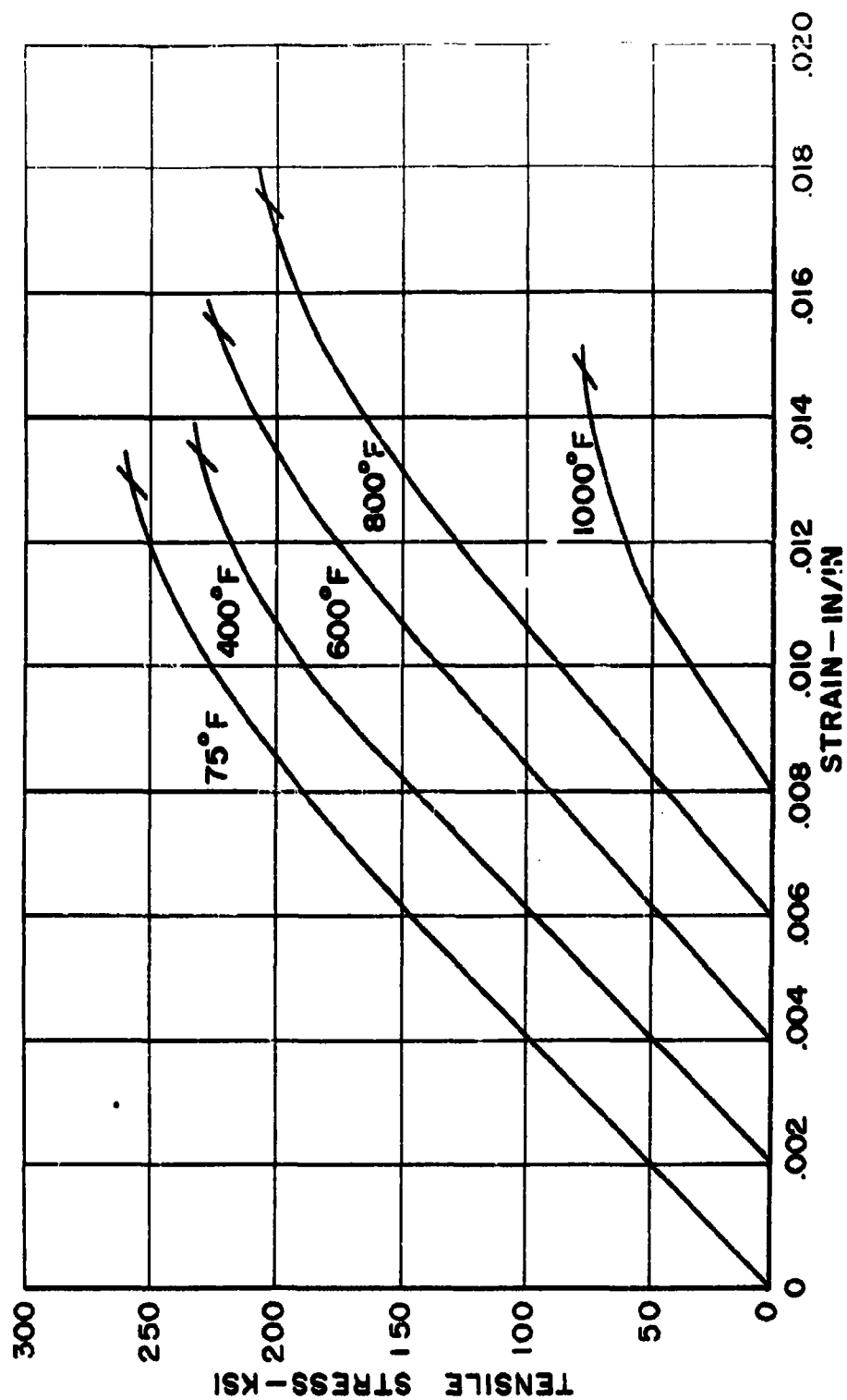


FIGURE 332. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

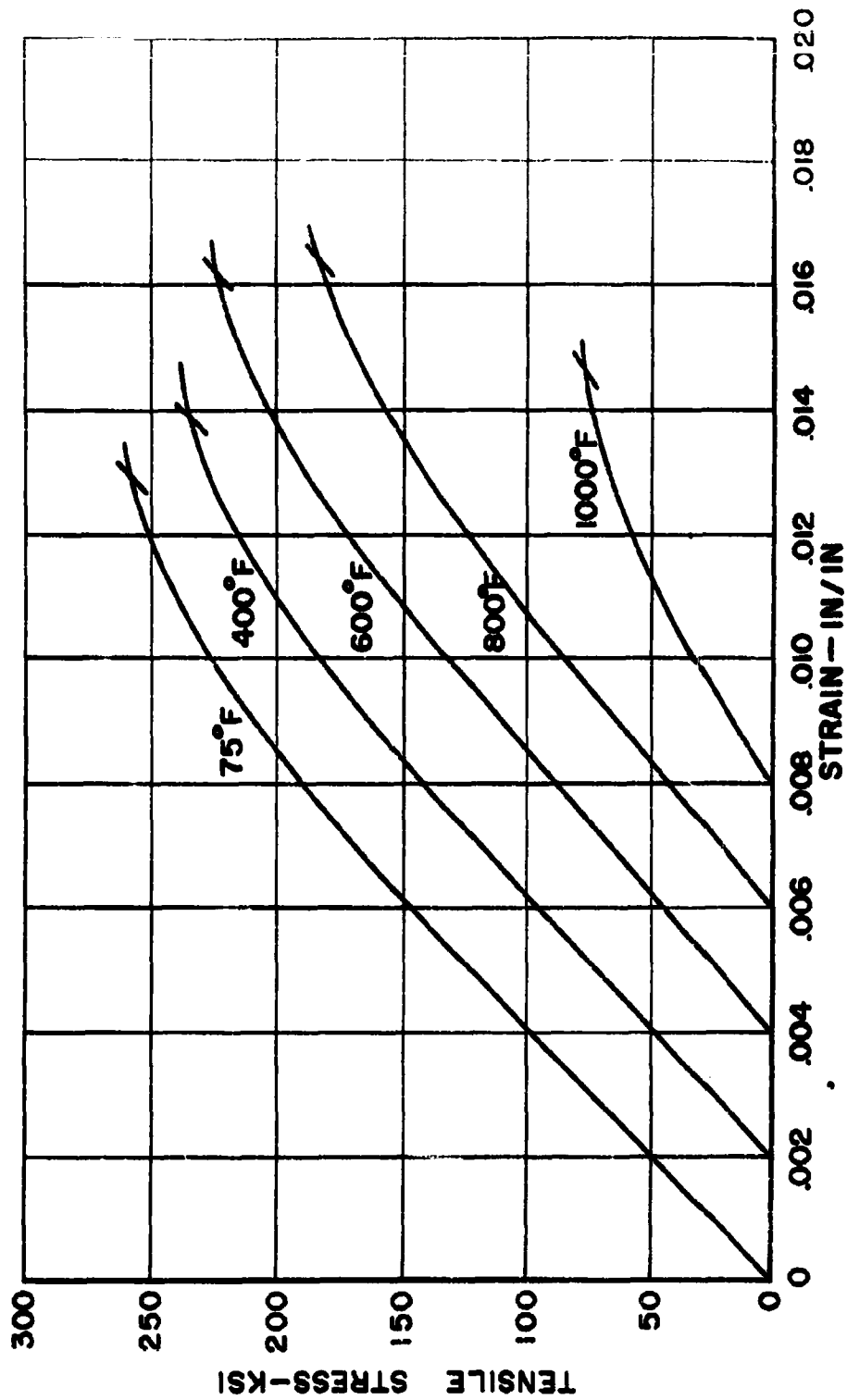


FIGURE 333. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

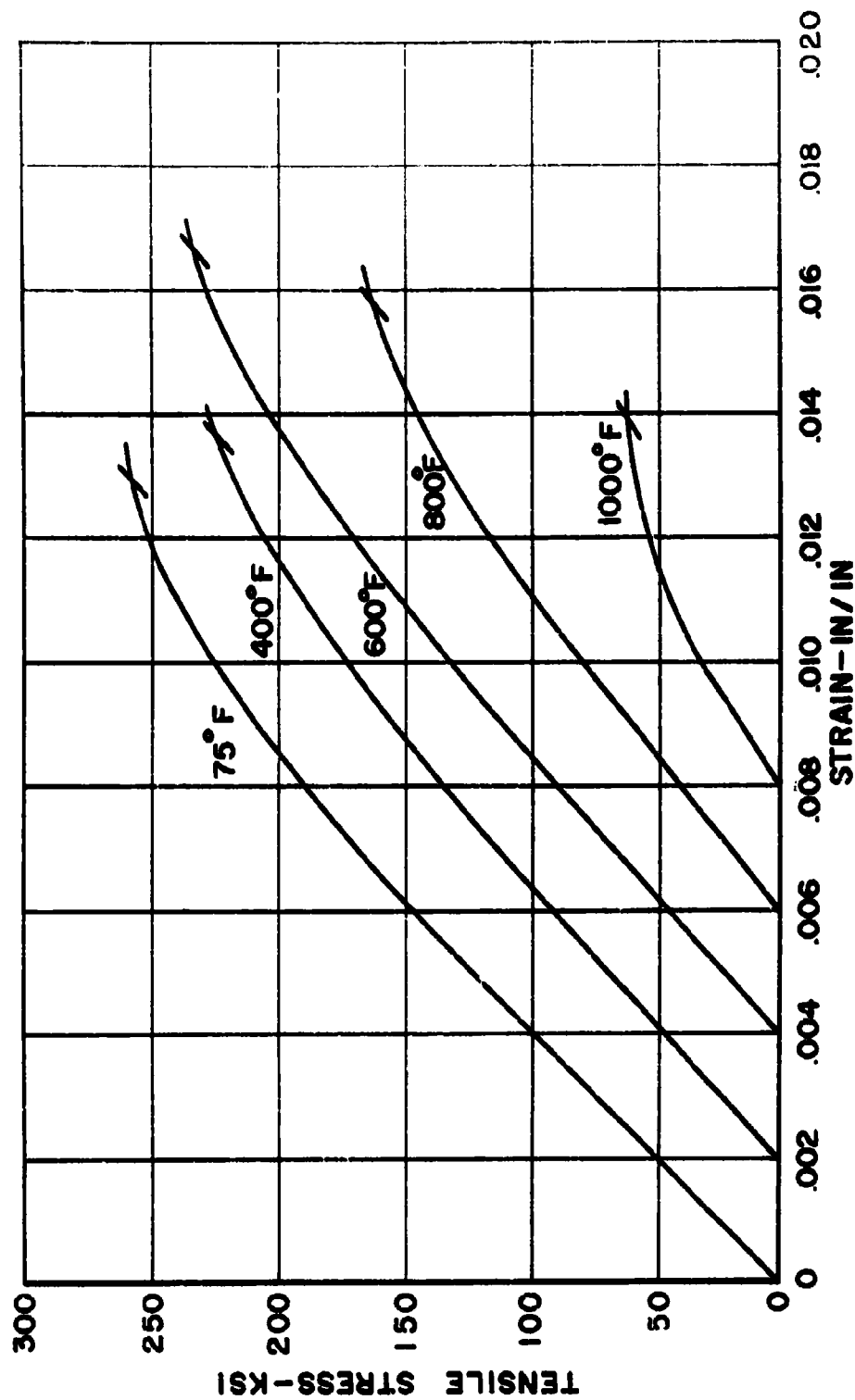


FIGURE 334. TENSILE STRESS-STRAIN CURVES OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

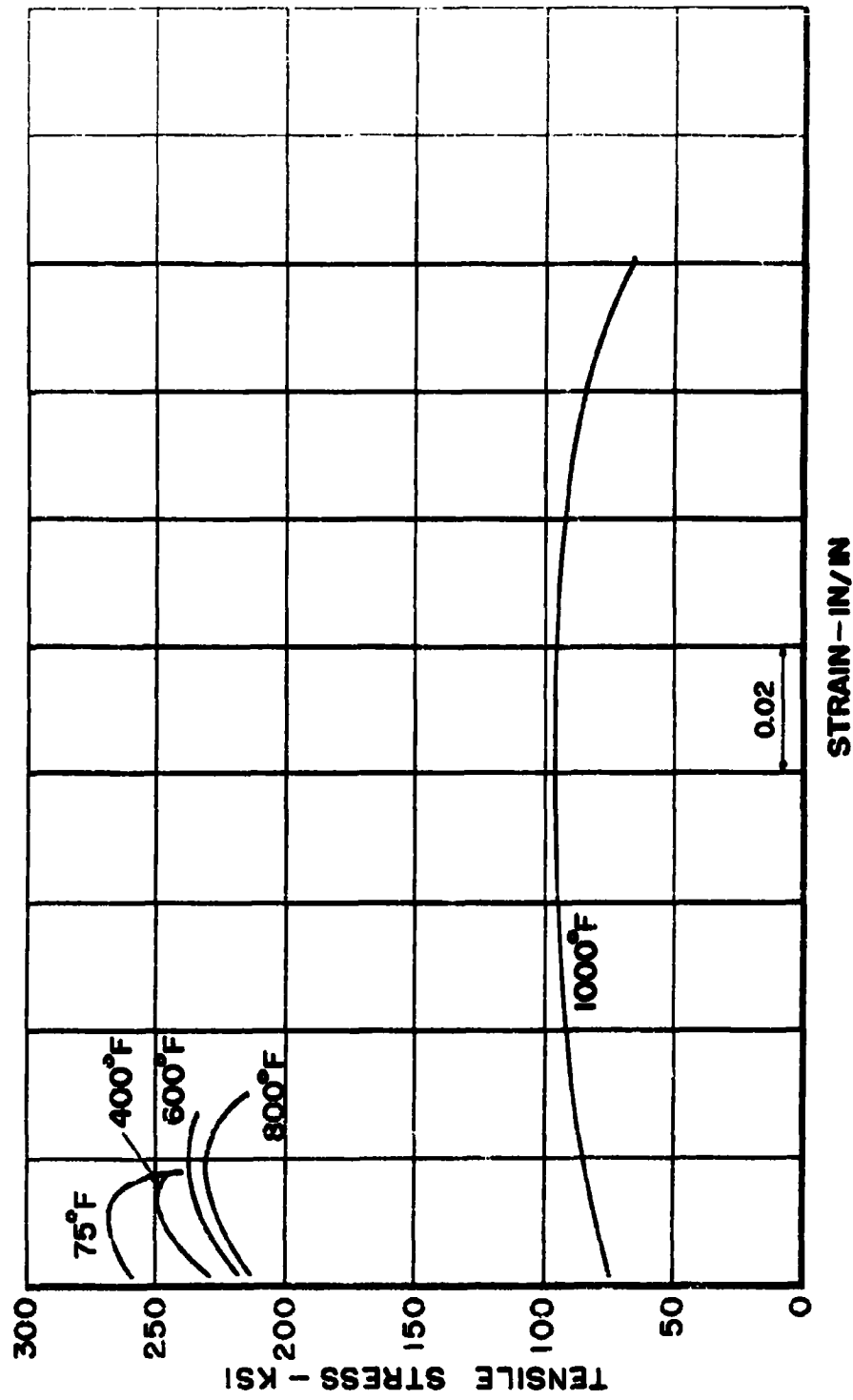


FIGURE 335. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301
(60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS

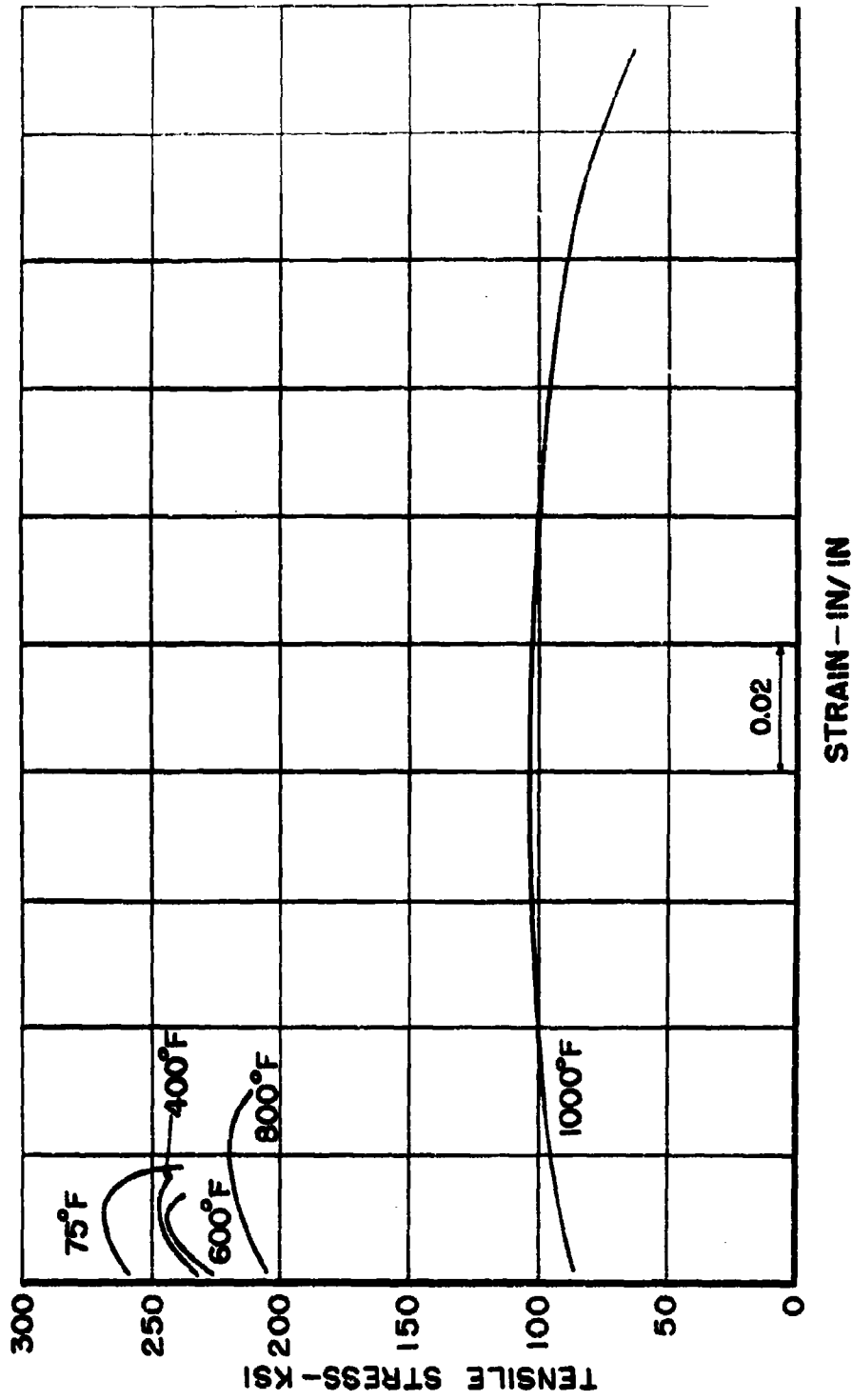


FIGURE 336. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301
(60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS

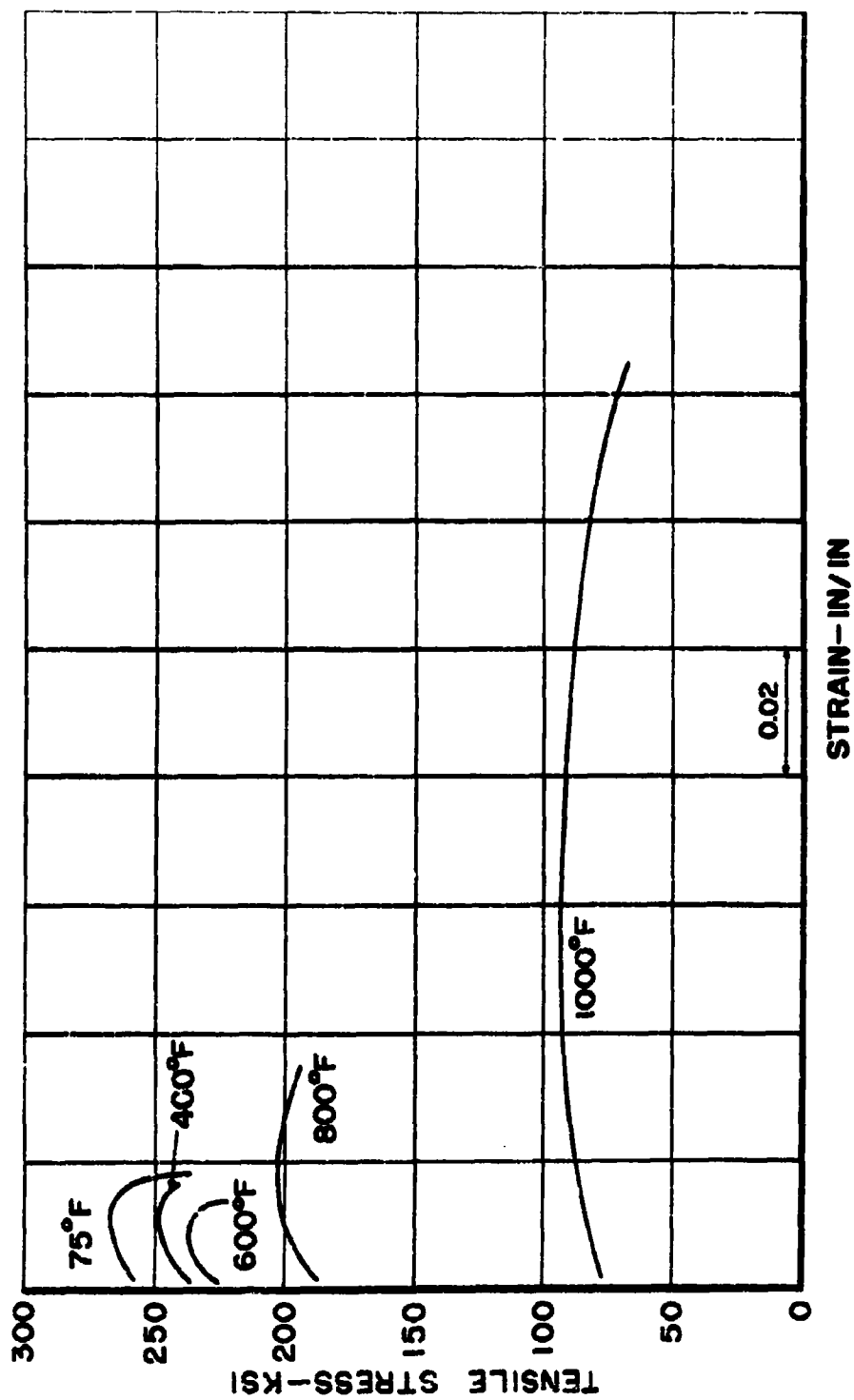


FIGURE 337. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301
(60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS

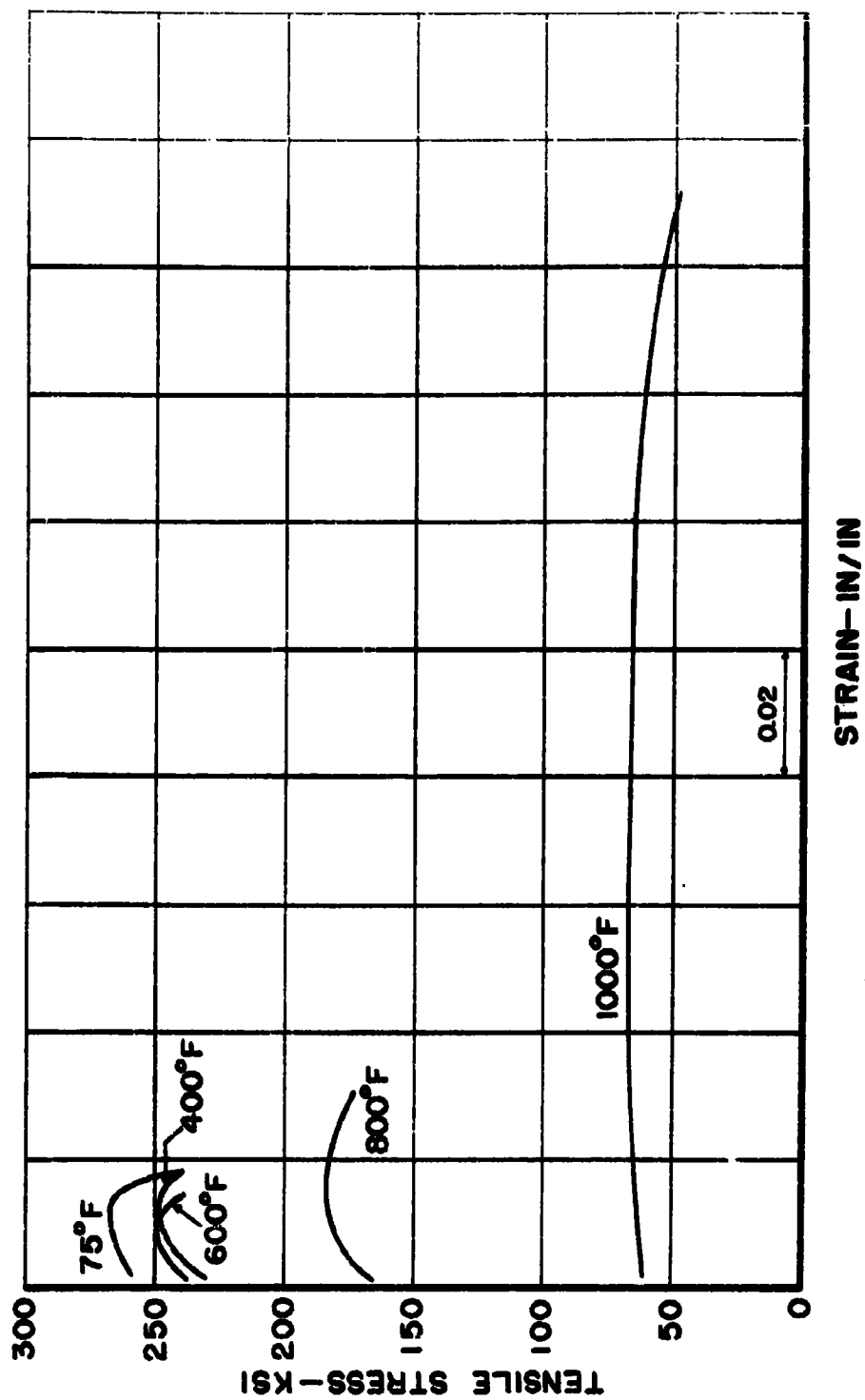


FIGURE 338. TENSILE POSTYIELD STRESS-STRAIN CURVES OF 301
(60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS

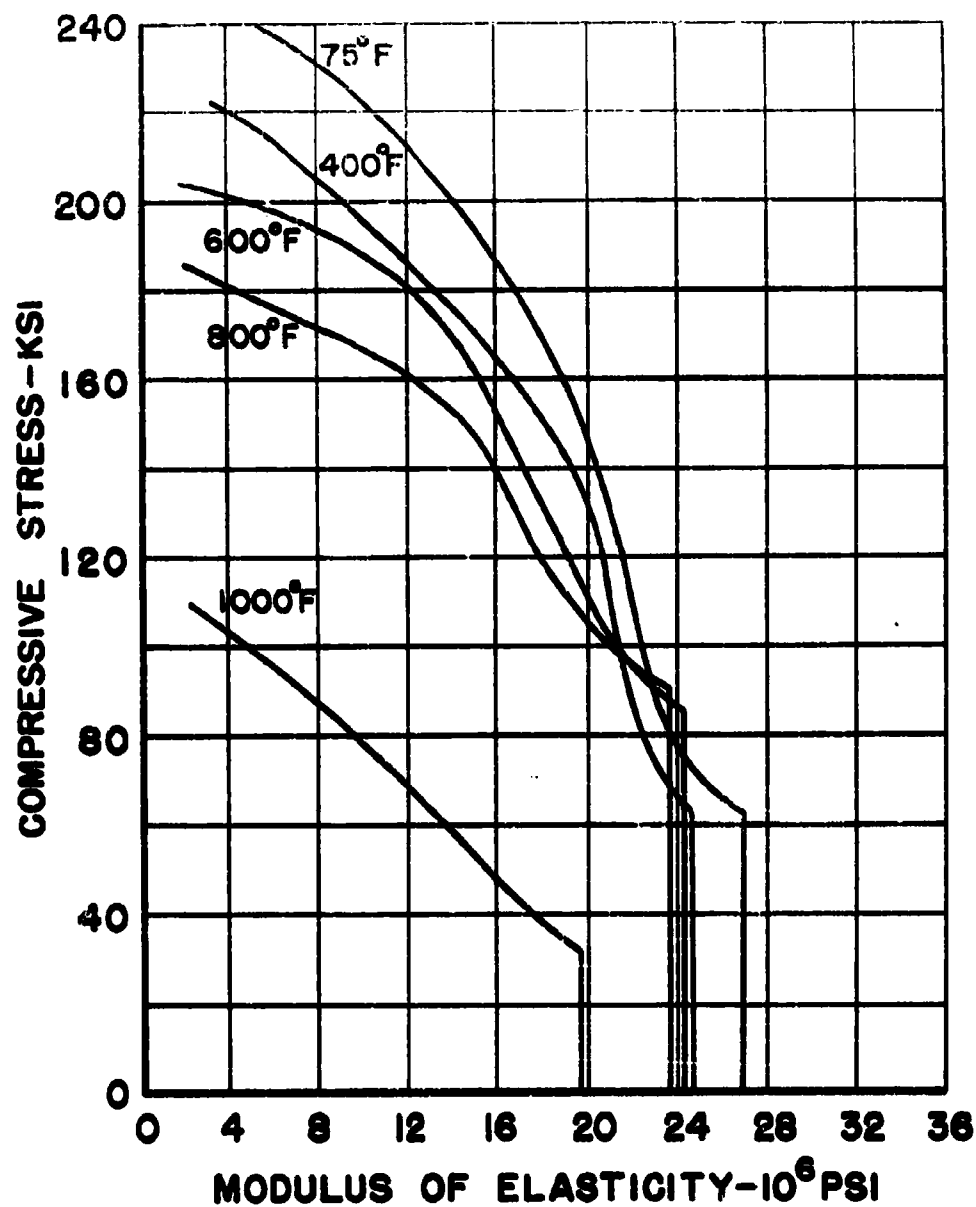


FIGURE 339. COMPRESSIVE TANGENT MODULUS
CURVES OF 301 (60% COLD REDUCED)
STAINLESS STEEL EXPOSED
0.5 HOURS

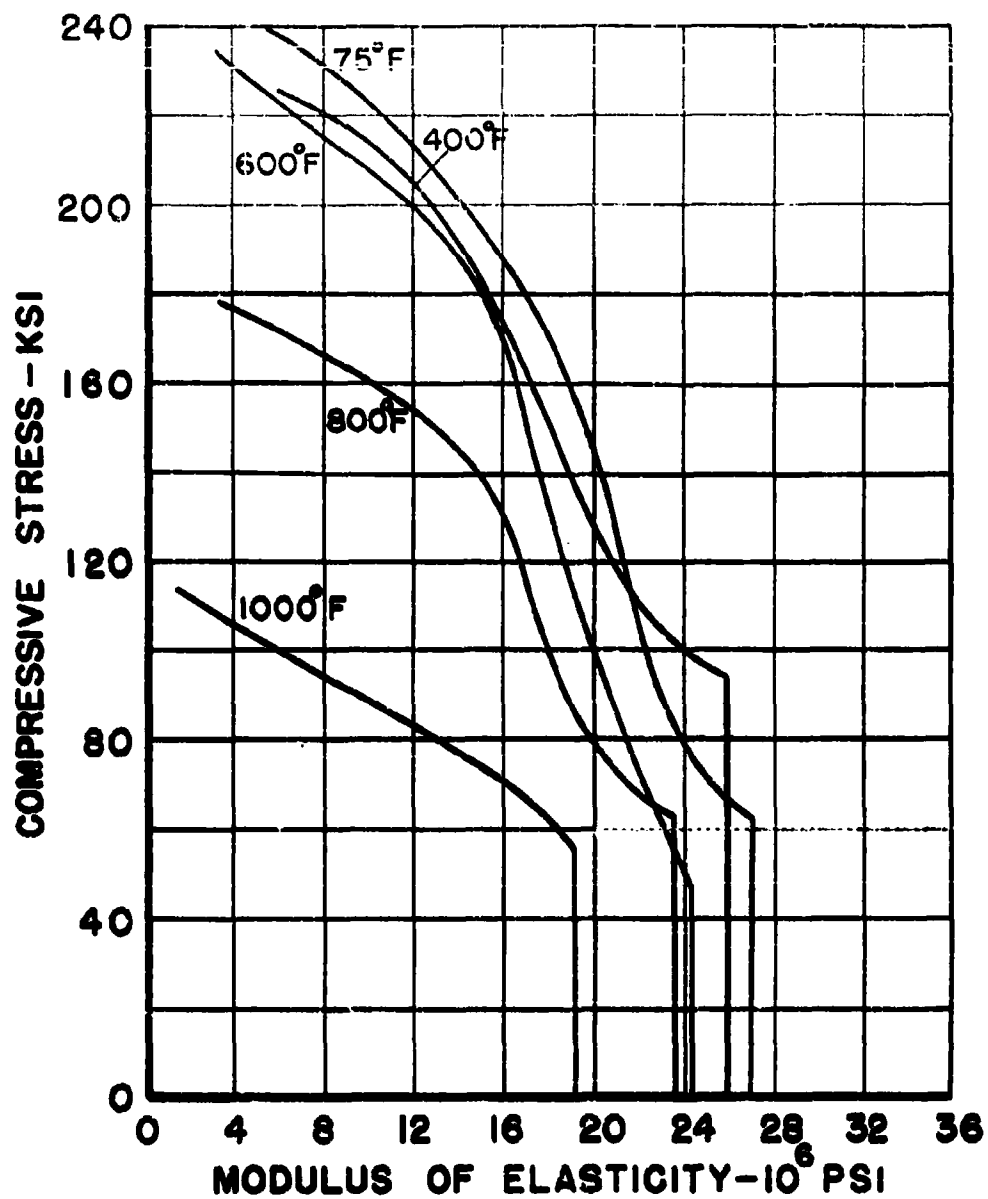


FIGURE 340. COMPRESSIVE TANGENT MODULUS
CURVES OF 301 (60% COLD REDUCED)
STAINLESS STEEL EXPOSED
10 HOURS

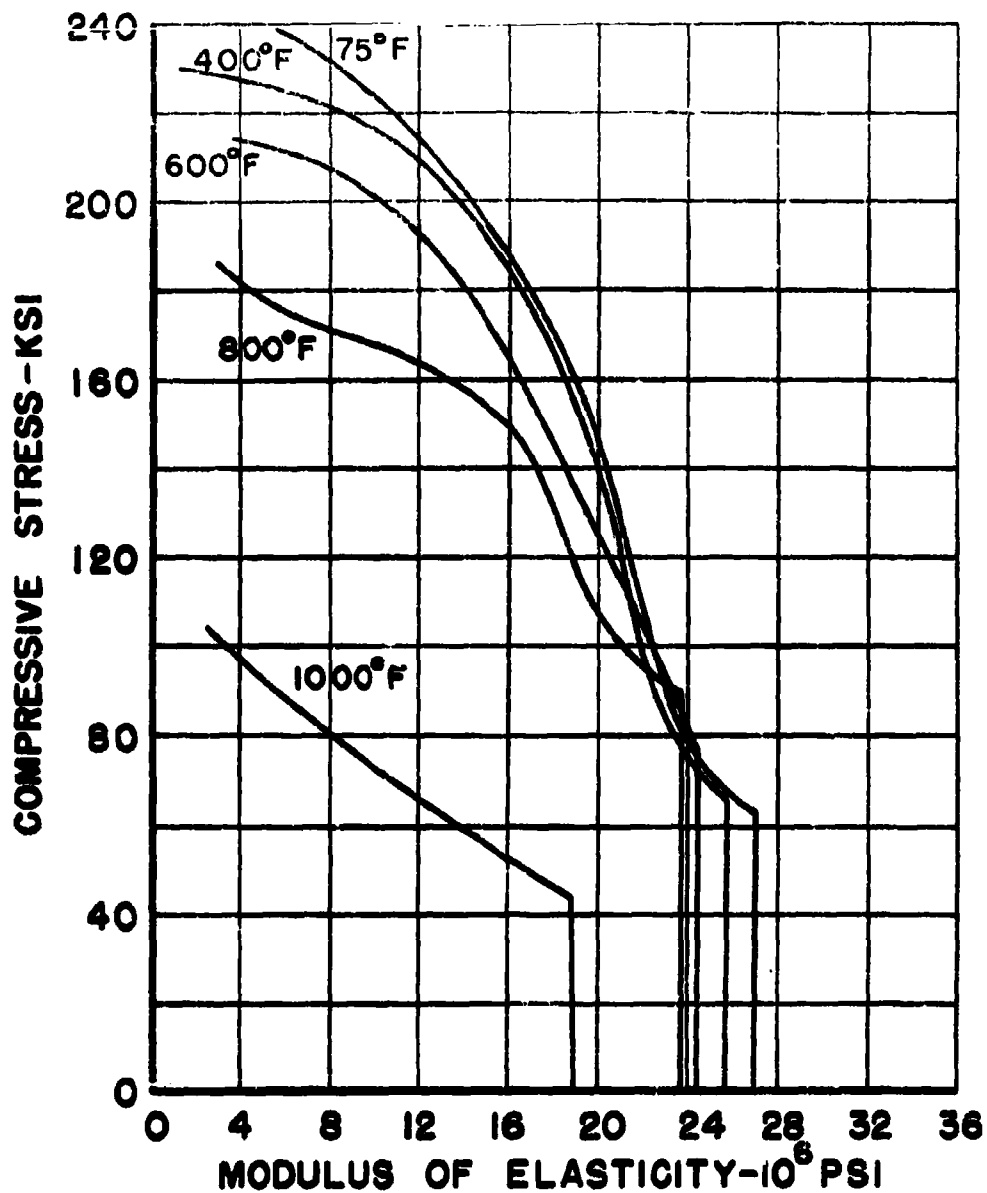


FIGURE 341. COMPRESSIVE TANGENT MODULUS
CURVES OF 301 (60% COLD REDUCED)
STAINLESS STEEL EXPOSED
100 HOURS

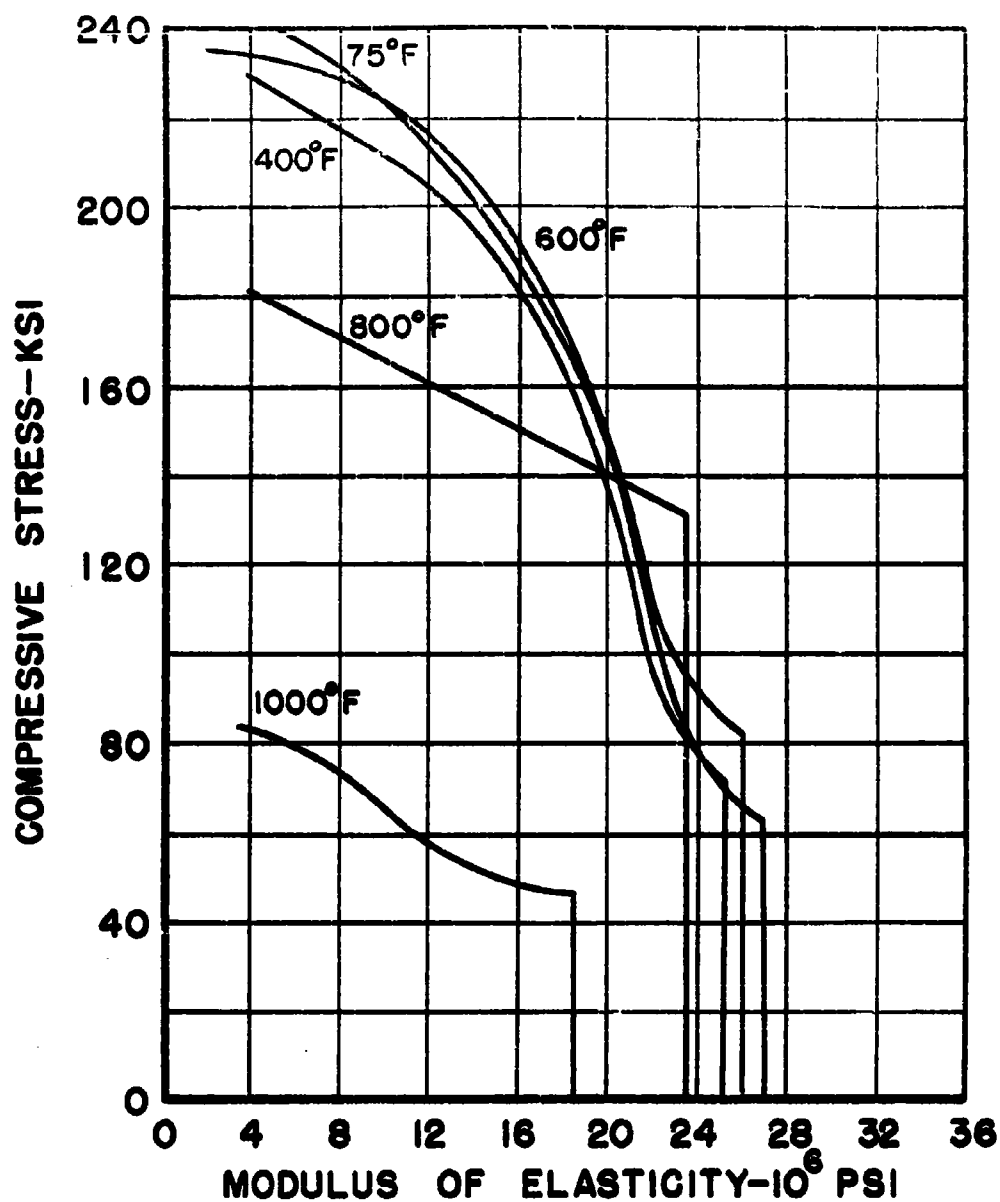


FIGURE 342. COMPRESSIVE TANGENT MODULUS
CURVES OF 301 (60% COLD REDUCED)
STAINLESS STEEL EXPOSED
1000 HOURS

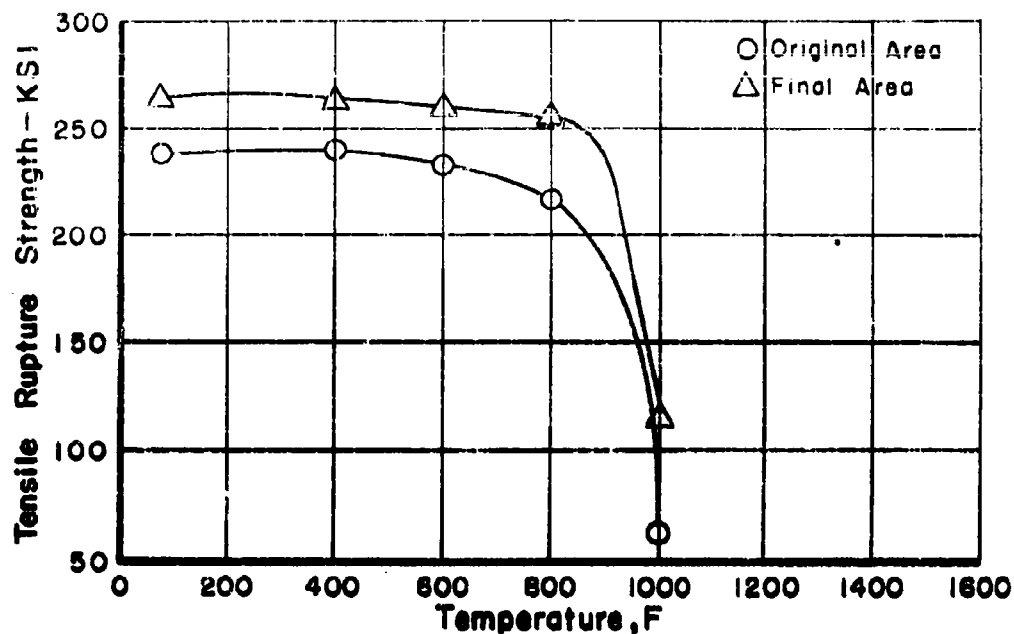


FIGURE 343. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 0.5 HOURS, BASED ON ORIGINAL AND FINAL AREAS

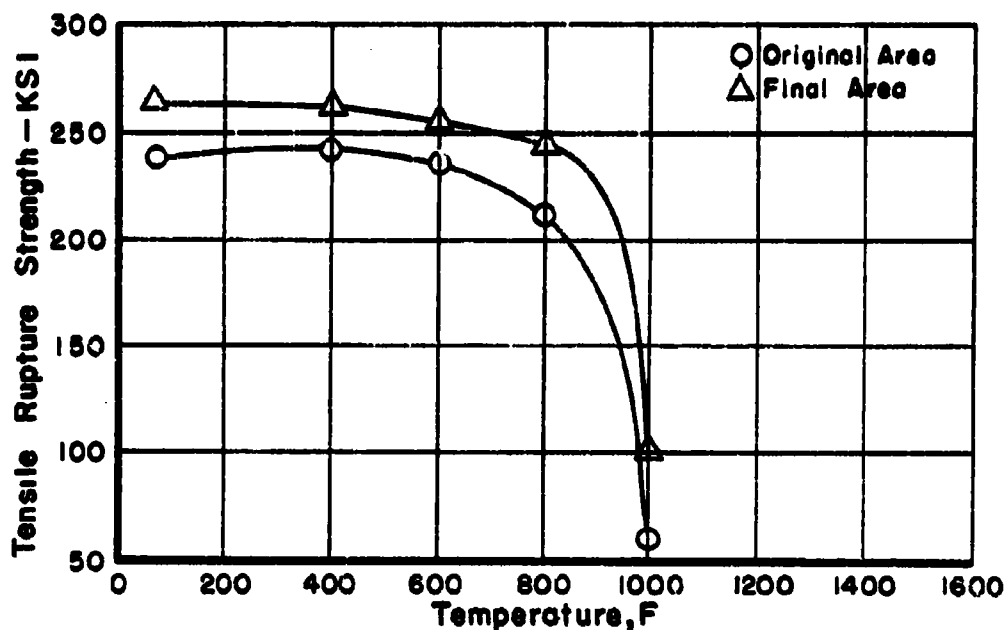


FIGURE 344. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 10 HOURS, BASED ON ORIGINAL AND FINAL AREAS

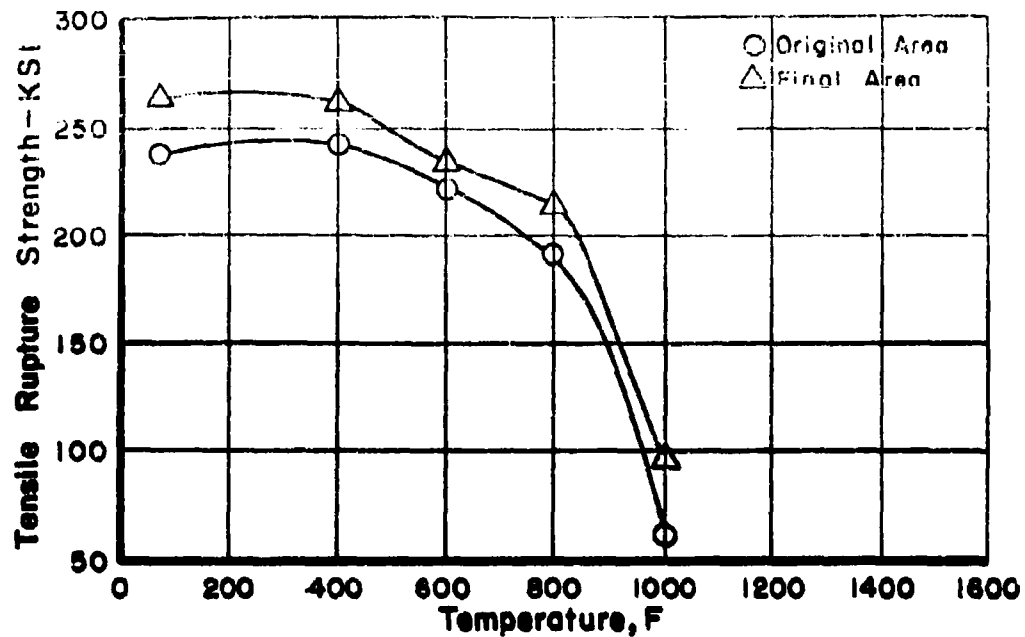


FIGURE 345. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 100 HOURS, BASED ON ORIGINAL AND FINAL AREAS

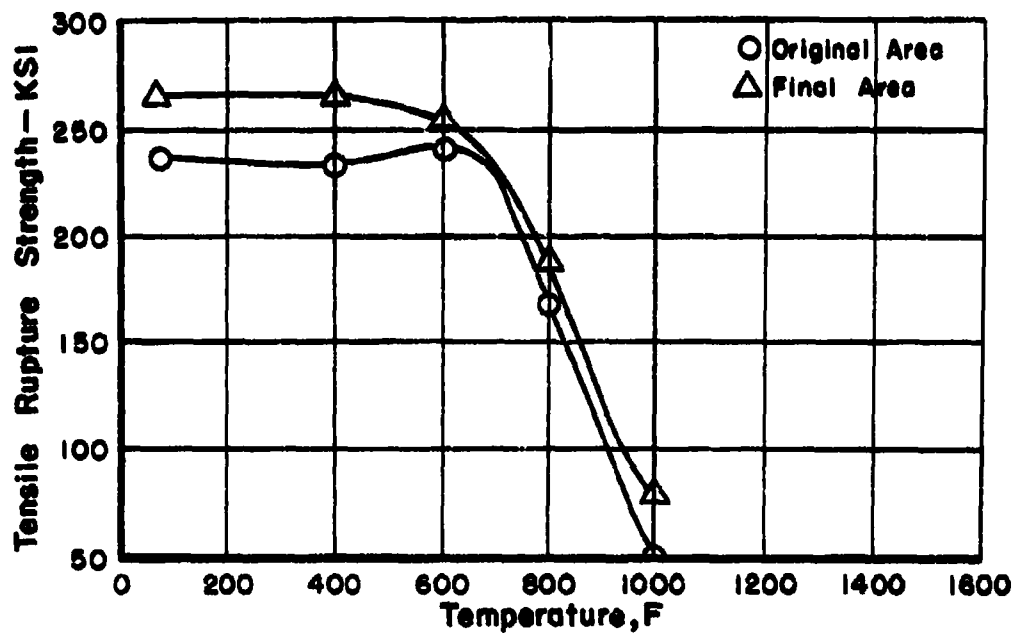


FIGURE 346. EFFECT OF TEMPERATURE ON RUPTURE STRENGTH OF 301 (60% COLD REDUCED) STAINLESS STEEL EXPOSED 1000 HOURS, BASED ON ORIGINAL AND FINAL AREAS

Aeronautical Systems Division, Dir./Materials and Processes, Metals and Ceramics Lab, Wright-Patterson AFB, Ohio.
 Rpt No ASD-TDR-61-529. DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS. Final report, June 62, 398p. Incl illus., tables.

Unclassified Report

This investigation was conducted to determine mechanical properties of several high performance alloys at room and elevated temperatures. The effects of temperature (up to 1900°F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing and shear properties were determined from measured stress-strain information in both the elastic and plastic range. The following five materials were considered in the program:

1. 301 extra hard stainless steel
2. F415-796 (TR 1050)
3. A4 355
4. B404 A1
5. K-155

All material was from 0.050-inch sheet, except the material for the 1/8-inch diameter shear pins, which were fabricated from 1/4-inch plate. Heat treatment was in accordance with existing specifications for the materials, or other procedures approved by ASD to develop the optimum strength properties.

Descriptions of the test specimens, equipment, and procedures used are included. Test results are reported in tables and in curves showing the effects of temperature and time on the various mechanical properties.

- I. High temperature alloys
- II. Mechanical properties
- III. ASD Project 7381.
Task 7381G
Contract AF 33(616)-7056
- IV. Southwestern Research Institute, San Antonio, Texas
- V. M. W. Lewis, A. Division, Jr.
- VI. A4 355
- VII. In ASTM collection

Aeronautical Systems Division, Dir./Materials and Processes, Metals and Ceramics Lab, Wright-Patterson AFB, Ohio.
 Rpt No ASD-TDR-61-529. DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS. Final report, June 62, 398p. Incl illus., tables.

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