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FOREWORD

This report was prepared by the Load Bearing Materials Section, Materials Engineering Branch, Applications Laboratory, Directorate of Materials and Processes and was initiated under Project No. 7381, "Materials Application," Task No. 738103, "Data Collection and Correlation" with Mr. V.F. Lardenoit as project engineer.

Testing was done by Metcut Research Associates under Contract AF33(600)-36430 and by New England Materials Laboratory under Contract AF33(616)-6202. Periods of performance were February, 1958 to March 1960 and February, 1959 to November, 1960, respectively.

The skill and cooperation of both organizations are gratefully acknowledged.

Contrails

ABSTRACT

This program was conducted to determine the creep properties of four martensitic steels in sheet form. Materials tested included Unimach 2 (Thermold J) and Potomac M, both of which are Hot Work Tool Steels, USS 12MoV, a Martensitic Stainless Steel and 17-22A (S), a Low Alloy Martensitic Steel.

Test temperatures were 600°F, 800°F and 900°F for the Unimach 2 (Thermold J) and USS 12 MoV, 800°F, 1000°F and 1050°F for the 17-22A (S) and 600°F, 800°F and 1000°F for the Potomac M. Data includes ultimate tensile strength, tensile yield strength and creep rupture properties. The data are presented in tabular and graphical form depicting creep deformations of 0.05%, 0.10%, 0.30%, 0.50% and 1.0% in times ranging from 10 to 1000 hours. Where available, rupture data is also presented.

This report has been reviewed and approved.

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INTRODUCTION

The design and development of modern aerospace systems which operate at high temperatures has increased the need for reliable creep deformation data. Of particular importance is the need for creep data within the relatively small deformation limits imposed by modern structural design. Included for consideration in such designs are the high strength steels.

The steels included in this program are of the high strength martensitic type. Testing was conducted on four martensitic steels from three different classes as follows:

1. Hot Work Tool Steels
 - a. Unimach 2 (Thermold J)
 - b. Potomac M
2. Martensitic Stainless Steels
 - a. USS 12 MoV
3. Low Alloy Martensitic Steels
 - a. 17-22A (S)

The advantage the hot work tool steels have over the other classes is their much greater resistance to softening at high temperatures. Therefore, of the three classes mentioned above, the hot work tool steels have greater strength than the other martensitic classes. One of the greatest disadvantages associated with the hot work tool steels is their poor resistance to oxidation and corrosion (1) in addition to poor notch strength.

With respect to strength, the martensitic stainless steels are next. Their resistance to oxidation and corrosion is better than that of the hot work tool steels, however they still require coatings for protection. The martensitic stainless steels are also susceptible to hydrogen embrittlement, decarburization, warpage in heat treatment, and have inherent disadvantages in machining and welding as do the hot work tool steels. Another factor associated with this class of steels is that the tempering temperature levels are critical. One of the newer martensitic stainless steels is USS 12 MoV. The newer steels in this class have lower carbon contents, improved ductility and basically are higher tempering modifications of the 420 stainless. (1) The USS 12 MoV retains its high strength up to 900°F. (2)

Of the low alloy martensitic steels, only the bolting steels have high strength at high temperatures. High strengths are attained by the normalizing treatment rather than quenching treatments most commonly used in low-alloy steels. The strength levels attained by this class of steels is lower than the former classes discussed. They have the same disadvantages as the hot work tool steels, but they have a great advantage in their much lower cost. To reach the high strengths at elevated temperatures in the ranges up to 1200°F, these steels must sacrifice room and moderate temperature strengths. (1) The 17-22A (S) steel included in this program was originally developed as a high strength, high temperature bolting material for service up to 1000°F. It needs protection against oxidation above 800°F. (2)

Since small deformation increments are required with the development of modern aerospace systems, emphasis was placed in obtaining creep measurements of less than 1 percent per 1000 hours of creep exposure. All curves are not presented in the figures for reason of clarification; however, all data obtained is tabulated for information purposes.

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PROCEDURE

All testing was conducted under Air Force contract. The Unimach 2 (Thermold J) and 17-22A (S) materials were tested at Metcut Research Associates, Inc. of Cincinnati, Ohio under Contract AF33(600)-36430 under the direction of Dr. William Koster. The Potomac M and USS 12 MoV were tested at New England Materials Laboratory, Inc., Medford, Massachusetts under Contract AF33(616)-6202 under the direction of Mr. B.L. Mulhern.

The materials were procured in the following thicknesses:

1. Unimach 2 (Thermold J) - 0.062 inches
2. 17-22A (S) - 0.064 inches
3. Potomac M - 0.040 inches
4. USS 12 MoV - 0.040 inches.

Chemical analysis of each material is given in table 1. Specimen blanks were sheared so the longitudinal axes of the specimens were parallel to the rolling direction. Specimens were then rough machined, followed by heat treatment and finish machining to the dimensions shown in figures 1, 2 and 3. The technique employed in machining Unimach 2 (Thermold J) and 17-22A (S) was as follows:

1. Rough mill the blanks to 0.040 - 0.050 inches of stock over the 0.5 inch dimension.
2. Heat Treat
3. Finish by "stress-free grinding" as follows:
 - a. Grinding Wheel - Norton 32A46G12VBEP
 - b. Cutting Fluid - Undiluted Stuart Thredkut 99
 - c. Wheel Speed - 2500 ft./min.
 - d. Depth increment - 0.001 inch/pass down to 0.010 inch stock
0.0005 inch/pass for last 0.010 inch

The heat treatments given the materials were:

1. Unimach 2 (Thermold J)
 - a. Solution treat at 1800°F, one-half hour in a neutral atmosphere.
 - b. Cooled to room temperature in a neutral atmosphere.
 - c. Aged at 800°F, 2 hours in a neutral atmosphere.
 - d. Cooled to room temperature in a neutral atmosphere.
 - e. Re-aged.
2. 17-22A (S)
 - a. Copper plated to prevent carburization or decarburization.
 - b. Austenitize at 1750°F, 1 hour, Air cooled in a neutral furnace atmosphere.

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- c. Temper at 1100°F, 6 hours, Air Cooled.
- d. Copper plating removed.
3. Potomac M.
 - a. Preheat at 1300°F.
 - b. Solution at 1900°F.
 - c. Double Temper at 1025°F.
4. USS 12 MoV.
 - a. Austenitize at 1850°F.
 - b. Temper at 950°F.

The materials were subjected to tensile tests at room temperature and the elevated temperatures tabulated below:

- a. Unimach 2 (Thermold J) 600°F, 800°F, 900°F.
- b. 17-22A (S) - 800°F, 1000°F, 1050°F.
- c. Potomac M - 600°F, 800°F, 1000°F.
- d. U.S.S. 12 MoV - 600°F, 800°F, 900°F.

Each material was subjected to five room temperature and 3 elevated temperature tests. Both organizations maintained a strain rate of .005 in/in/min until reaching the yield strength after which the test speed was increased to a head rate of .05 in/min to failure by Metcut while New England Materials Laboratory increased the strain rate of their tests to .05 in/in/min. to failure.

From these data, stress levels were selected to give .05, .10, .30, .50 and 1 percent creep deformation in 10 through 1000 hours at the temperatures specified above. Rupture data was also determined in this range.

Temperatures were read and controlled utilizing Chromel-Alumel thermocouples. Three thermocouples were mounted on each specimen, one in the middle and one each near the gage marks. The middle thermocouple was used as control while the outer thermocouples were used to measure temperature gradient along the specimen. This gradient was maintained at $\pm 2^\circ\text{F}$.

Optical systems were used to measure deformation. Metcut used two platinum extensometers attached to opposite sides of the specimen. Deformation was measured by a creep microscope with a sensitivity of 0.00005 inches. New England Materials Laboratory used notched platinum wires attached at the ends of the specimen gage length. A creep microscope with a sensitivity of 0.0000254 inches was used to measure deformation.

Specimens were soaked at test temperature for a period of at least one-half hour before applying load. Deformation on loading was measured where possible. New England Materials Laboratory used incremental loading techniques on applying load while Metcut Research Associates applied all the load at the same interval. Creep deformation measurements, in both cases, were started immediately after application of the total test load.

RESULTS AND DISCUSSION

The results of the tensile tests are given in tables 2 through 5 and are illustrated in figure 4. As was expected, the two hot work tool steels, Unimach 2 (Thermold J) and Potomac M exhibited the greatest strength with the martensitic stainless steel, USS 12 MoV and the low alloy martensitic steel, 17-22A (S) following in that order.

Creep deformation versus time data for the materials tested are summarized in tables 6 through 9 and figures 5 through 16. As can be seen in figures 7, 10, 13 and 16, the slope of each curve presented increases considerably after 10 to 100 hours (depending on applied stress); indicating that creep behavior becomes critical at the higher test temperatures for each alloy.

Tables 10 and 11 summarize the incremental loading data on the two materials tested at New England Materials Laboratory.

Creep deformation and rupture data and the resulting design curves for each alloy appear in tables 12 through 15 and figures 17 through 22, respectively. In comparing figures 18 and 20, where Unimach 2 (Thermold J) and 17-22A (S) were tested at like temperatures, one can see that the stress required to produce various percentages of deformation is higher for Unimach 2 (Thermold J) in all cases except one, that being at 1000 hours and .05 percent creep deformation. The order of strength levels for the three classes of steels, therefore, appears to still hold true for creep strengths as well as for tensile strengths noted previously. Although the strength to produce the deformations was in most cases higher for the Unimach 2 (Thermold J), it was noted that this value decreased at a faster rate for Unimach 2 (Thermold J) than for 17-22A (S). It therefore appears, that for long time applications the low alloy martensitic steels appear more stable than the hot work tool steels.

The creep deformation and rupture data for the USS 12 MoV and Potomac M steels resulted in a considerable amount of scatter, therefore no design curves are offered for these materials.

Since no other low stress creep data for the four materials tested was readily available at this time, no comparison to previously conducted tests can be offered.

CONCLUSIONS

As was expected, the hot work tool steels exhibited the greatest tensile strengths with the martensitic stainless and low alloy martensitic steels following in that order.

It appears that this same trend occurs in comparing creep properties of these materials.

At the higher test temperatures for each alloy, creep deformation becomes very important while at the lower temperatures, short-time tensile properties become the prime consideration.

It also appears that for long time applications the low alloy martensitic steels are more stable than the hot work tool steels.

Considerable scatter resulted in testing USS 12 MoV and Potomac M. More tests would be necessary before any further conclusions can be drawn with respect to these materials.

BIBLIOGRAPHY

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2. Sachs, G. and Pray, R. Ford III, "Air Weapons Materials Application Handbook, Metals and Alloys," ARDC TR 59-66, December, 1959.

TABLE I
CHEMICAL COMPOSITIONS OF MATERIALS TESTED

| ALLOY | HEAT NO. | SUPPLIER | C | MN | SI | S | P | CR | V | Ni | Mo | Cu |
|-------------------------------|----------|-----------------------|------|------|------|-------|-------|-------|------|------|------|------|
| UNIMACH 2 (THERMOLD J) | D-19207 | UNIVERSAL- CYCLOPS | 0.52 | 0.35 | 1.09 | 0.007 | 0.027 | 5.08 | 0.99 | 1.53 | 1.40 | — |
| 17-22 A(S) | 143612 | CRUCIBLE STEEL | 0.29 | 0.65 | 0.64 | 0.016 | 0.016 | 1.11 | 0.24 | 0.19 | 0.48 | 0.10 |
| POTOMAC M | 28001 | ALLEGHENY- LUDLUM | 0.39 | 0.38 | 0.87 | 0.005 | 0.017 | 5.19 | 0.98 | — | 1.11 | — |
| USS 12 Mo V | X19787 | U.S. STEEL | 0.23 | 0.50 | 0.50 | 0.013 | 0.020 | 12.40 | 0.31 | 0.79 | 0.96 | — |

TABLE 2
SHORT-TIME TENSILE STRENGTH OF UNIMACH 2 (THERMOLD J)
STEEL AT TEST TEMPERATURES

| TEST TEMPERATURE | SPECIMEN NUMBER | ULTIMATE TENSILE STRENGTH (psi) | 0.2% YIELD STRENGTH (psi) | ELONGATION % IN 2" |
|------------------|-----------------|---------------------------------|---------------------------|--------------------|
| ROOM | A 1 | 282,000 | 242,000 | 6.0 |
| | A 2 | 283,000 | 242,000 | 5.0 |
| | A 3 | 285,000 | 248,000 | 7.0 |
| | A 4 | 288,000 | 247,000 | 4.0 |
| | A 5 | 288,000 | 246,000 | 6.0 |
| AVERAGE | | 285,200 | 245,000 | 5.6 |
| 600° F | A 6 | 268,000 | 204,000 | 9.0 |
| | A 7 | 274,000 | 210,000 | 9.0 |
| | A 8 | 271,000 | 202,000 | 7.0 |
| AVERAGE | | 271,000 | 205,333 | 8.33 |
| 800° F | A 9 | 252,000 | 186,000 | 7.0 |
| | A 10 | 251,000 | 181,000 | 8.0 |
| | A 11 | 255,000 | 188,000 | 9.0 |
| AVERAGE | | 252,667 | 185,000 | 8.0 |
| 900° F | A 12 | 239,000 | 182,000 | 9.0 |
| | A 13 | 244,000 | 183,000 | 6.0 |
| | A 14 | 239,000 | 177,000 | 9.0 |
| AVERAGE | | 240,667 | 180,666 | 8.0 |

TABLE 3
SHORT-TIME TENSILE STRENGTH OF 17-22A(S)
STEEL AT TEST TEMPERATURES

| TEST TEMPERATURE | SPECIMEN NUMBER | ULTIMATE TENSILE STRENGTH (psi) | 0.2% YIELD STRENGTH (psi) | ELONGATION % IN 2" |
|------------------|-----------------|---------------------------------|---------------------------|--------------------|
| ROOM | 1 - 1 | 154,000 | 131,000 | 12.5 |
| ROOM | 1 - 2 | 164,000 | 137,000 | 12.0 |
| ROOM | 1 - 3 | 170,000 | 149,000 | 8.5 |
| ROOM | 1 - 4 | 165,000 | 125,000 | 11.0 |
| ROOM | 1 - 5 | 170,000 | 145,000 | 11.5 |
| AVERAGE | | 164,600 | 137,400 | 11.1 |
| 800° F | 1 - 6 | 132,000 | 106,000 | 12.0 |
| 800° F | 1 - 7 | 130,000 | 109,000 | 12.0 |
| 800° F | 1 - 8 | 121,000 | 94,500 | 12.3 |
| AVERAGE | | 127,666 | 103,166 | 12.1 |
| 1000° F | 1 - 9 | 110,000 | 99,500 | 13.5 |
| 1000° F | 1 - 10 | 103,000 | 90,500 | 13.0 |
| 1000° F | 1 - 11 | 108,000 | 89,000 | 14.0 |
| AVERAGE | | 107,000 | 93,000 | 13.5 |
| 1050° F | 1 - 12 | 94,000 | 81,500 | 15.0 |
| 1050° F | 1 - 13 | 97,000 | 84,000 | 11.0 |
| 1050° F | 1 - 14 | 97,000 | 86,000 | 16.0 |
| AVERAGE | | 96,000 | 83,833 | 14.0 |

TABLE 4
SHORT - TIME TENSILE STRENGTH OF POTOMAC M
STEEL AT TEST TEMPERATURES

| TEST TEMPERATURE | SPECIMEN NUMBER | ULTIMATE TENSILE STRENGTH (psi) | 0.2% YIELD STRENGTH (psi) | ELONGATION % IN 2" |
|------------------|-----------------|---------------------------------|---------------------------|--------------------|
| ROOM | 1 | 298,000 | 218,000 | 7.8 |
| | 2 | 282,000 | 213,000 | 7.7 |
| | 3 | 281,000 | 206,000 | 7.6 |
| | 4 | 273,000 | 207,000 | 7.1 |
| | 5 | 305,000 | 226,000 | 7.1 |
| AVERAGE | | 287,800 | 214,000 | 7.46 |
| 600° F | 6 | 258,000 | 197,000 | 5.5 |
| | 7 | 260,000 | 196,000 | 5.9 |
| | 8 | 251,000 | 198,500 | 5.7 |
| AVERAGE | | 256,333 | 197,166 | 5.7 |
| 800° F | 9 | 244,000 | 184,000 | 6.3 |
| | 10 | 229,000 | 170,000 | 5.8 |
| | 11 | 244,000 | 177,000 | 5.7 |
| AVERAGE | | 239,000 | 177,000 | 5.93 |
| 1000° F | 12 | 202,000 | 149,000 | 7.0 |
| | 13 | 203,000 | 150,000 | 6.0 |
| | 14 | 223,000 | 178,000 | 6.0 |
| AVERAGE | | 209,333 | 159,000 | 6.33 |

TABLE 5
SHORT-TIME TENSILE STRENGTH OF USS 12 Mo V
STEEL AT TEST TEMPERATURES

| TEST TEMPERATURE | SPECIMEN NUMBER | ULTIMATE TENSILE STRENGTH (psi) | 0.2 % YIELD STRENGTH (psi) | ELONGATION % IN 2" |
|------------------|-----------------|---------------------------------|----------------------------|--------------------|
| ROOM | 1 | 268,500 | 160,000 | 10.1 |
| | 2 | 264,000 | 155,500 | 9.2 |
| | 3 | 265,000 | 161,000 | 10.3 |
| | 4 | 263,000 | 156,000 | 8.5 |
| | 5 | 268,000 | 162,500 | 10.3 |
| AVERAGE | | 265,700 | 159,000 | 9.68 |
| 600° F | 6 | 227,000 | 171,000 | 5.7 |
| | 7 | 230,000 | 179,000 | 6.2 |
| | 8 | 245,000 | 179,500 | 6.2 |
| AVERAGE | | 234,000 | 176,500 | 6.03 |
| 800° F | 9 | 219,000 | 159,000 | 6.1 |
| | 10 | 226,500 | 168,000 | 7.6 |
| | 11 | 221,000 | 160,000 | 7.6 |
| AVERAGE | | 222,166 | 162,333 | 7.1 |
| 1000° F | 12 | 211,000 | 149,500 | 7.0 |
| | 13 | 217,000 | 157,500 | 7.4 |
| | 14 | 196,500 | 147,000 | 7.3 |
| AVERAGE | | 208,166 | 151,333 | 7.23 |

TABLE 6
DEFORMATION-TIME DATA FOR UNIMACH 2 (THERMOLD J) STEEL

600° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|--|--------------------------|--|--------------------------|--|--------------------------|
| SPEC. NO. A - 99 STRESS = 135,000 LIFE = — | | SPEC. NO. A - 62 STRESS = 220,000 LIFE = — | | 46 0.300 80 0.310 110 0.330 155 0.340 220 0.350 325 0.365 520 0.385 710 0.425 780 0.430 930 0.450 1000 0.460 1275 0.500 | |
| 5 | 0.030 | 0.1 | 0.050 | SPEC. NO. A-58 STRESS = 255,000 LIFE = — | |
| 10 | 0.040 | 1.1 | 0.100 | 5 | 0.260 |
| 19 | 0.050 | 5 | 0.110 | 12.5 | 0.300 |
| 50 | 0.055 | 7.5 | 0.130 | 15 | 0.310 |
| 100 | 0.060 | 20 | 0.140 | 40 | 0.370 |
| 145 | 0.055 | 40 | 0.150 | 60 | 0.410 |
| 200 | 0.065 | 110 | 0.175 | 85 | 0.420 |
| 300 | 0.070 | 150 | 0.180 | 150 | 0.455 |
| 410 | 0.070 | 265 | 0.195 | 200 | 0.475 |
| 500 | 0.065 | 360 | 0.200 | 250 | 0.495 |
| 750 | 0.072 | 475 | 0.205 | 278 | 0.500 |
| 850 | 0.090 | 600 | 0.207 | 310 | 0.510 |
| 1000 | 0.095 | 650 | 0.210 | SPEC. NO. A-32 STRESS = 260,000 LIFE = — | |
| 1035 | 0.100 | 680 | 0.210 | 0.4 | 0.300 |
| SPEC. NO. A-79 STRESS = 190,000 LIFE = — | | SPEC. NO. A-30 STRESS = 240,000 LIFE = — | | 2 | 0.370 |
| 1.2 | 0.050 | 0.2 | 0.100 | 15 | 0.460 |
| 10 | 0.065 | 30 | 0.230 | 33 | 0.500 |
| 20 | 0.080 | 100 | 0.280 | 40 | 0.502 |
| 40 | 0.090 | 150 | 0.295 | 100 | 0.550 |
| 50 | 0.095 | 195 | 0.300 | 200 | 0.583 |
| 66.8 | 0.100 | 215 | 0.302 | 305 | 0.605 |
| 75 | 0.105 | 250 | 0.305 | 500 | 0.630 |
| 100 | 0.110 | 350 | 0.320 | 565 | 0.625 |
| 160 | 0.118 | 440 | 0.330 | 690 | 0.630 |
| 200 | 0.120 | 540 | 0.340 | 810 | 0.638 |
| 245 | 0.120 | 675 | 0.350 | 905 | 0.638 |
| 330 | 0.122 | 750 | 0.365 | SPEC. NO. A-19 STRESS = 250,000 LIFE = — | |
| 405 | 0.130 | 775 | 0.350 | 0.1 | 0.100 |
| 450 | 0.132 | 970 | 0.365 | 10 | 0.240 |
| 600 | 0.140 | | | 30 | 0.280 |
| 700 | 0.150 | | | | |
| 870 | 0.155 | | | | |
| 1015 | 0.160 | | | | |

TABLE 6 (CONTINUED)

| 600° F | | 800° F | | | |
|---|-----------------------|---|-----------------------|---|-----------------------|
| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
| SPEC. NO. A-101 STRESS = 265,000 LIFE = — | | SPEC. NO. A-74 STRESS = 70,000 LIFE = — | | 55 0.185 105 0.197 165 0.205 240 0.210 430 0.220 650 0.235 820 0.250 955 0.250 1020 0.260 | |
| 2.5 0.500 25 0.580 35 0.590 75 0.635 95 0.655 125 0.680 160 0.695 220 0.720 300 0.725 350 0.750 525 0.770 625 0.785 745 0.805 | | 35 0.010 105 0.025 195 0.040 235 0.050 250 0.055 350 0.060 515 0.070 635 0.075 705 0.075 760 0.075 805 0.070 865 0.090 950 0.090 988 0.100 1020 0.105 | | SPEC. NO. A-59 STRESS = 150,000 LIFE = 217.4 | |
| SPEC. NO. A-100 STRESS = 268,000 LIFE = — | | SPEC. NO. A-109 STRESS = 115,000 LIFE = — | | 0.5 0.050 2.5 0.100 5 0.130 10 0.170 25 0.200 115 0.260 140 0.270 215 0.275 | |
| 2 0.500 30 0.755 85 0.830 150 0.870 | | 2.3 0.050 15 0.070 34 0.100 45 0.110 70 0.130 95 0.135 155 0.150 200 0.160 315 0.155 450 0.165 500 0.170 575 0.170 680 0.170 | | SPEC. NO. A-63 STRESS = 160,000 LIFE = — | |
| SPEC. NO. A-80 STRESS = 130,000 LIFE = — | | SPEC. NO. A-80 STRESS = 130,000 LIFE = — | | 0.1 0.050 0.5 0.100 20 0.205 50 0.275 60 0.300 80 0.305 140 0.330 240 0.370 350 0.390 445 0.410 505 0.400 625 0.440 700 0.430 800 0.440 900 0.470 1005 0.490 | |
| | | 1 0.050 3.5 0.100 20 0.135 | | | |

TABLE 6 (CONTINUED)

| 800° F | | 900° F | | 900° F | |
|--|--------------------------|---|--------------------------|--|--------------------------|
| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
| SPEC. NO. A-96 STRESS = 185,000 LIFE = 204.1 | | SPEC. NO. A-67 STRESS = 15,000 LIFE = — | | SPEC. NO. A-41 STRESS = 60,000 LIFE = — | |
| 12 | 0.300 | 60 | 0.025 | 12 | 0.050 |
| 30 | 0.340 | 145 | 0.040 | 35 | 0.060 |
| 55 | 0.410 | 190 | 0.035 | 55 | 0.080 |
| 120 | 0.500 | 220 | 0.050 | 72 | 0.100 |
| 170 | 0.520 | 330 | 0.055 | 80 | 0.105 |
| SPEC. NO. A-24 STRESS = 200,000 LIFE = 135.8 | | 420 | 0.075 | 110 | 0.115 |
| 4 | 0.300 | 485 | 0.070 | 165 | 0.140 |
| 15 | 0.420 | 580 | 0.070 | 220 | 0.170 |
| 20 | 0.480 | 610 | 0.080 | 310 | 0.205 |
| 23 | 0.500 | 685 | 0.085 | 400 | 0.250 |
| 55 | 0.510 | 770 | 0.085 | 480 | 0.280 |
| 110 | 0.630 | 810 | 0.100 | 487 | 0.300 |
| 120 | 0.640 | 825 | 0.110 | 570 | 0.320 |
| 130 | 0.645 | 870 | 0.105 | 720 | 0.400 |
| SPEC. NO. A-34 STRESS = 230,000 LIFE = 60.3 | | 940 | 0.125 | 825 | 0.455 |
| 0.7 | 0.300 | 980 | 0.130 | 883 | 0.500 |
| 1.7 | 0.500 | SPEC. NO. A-87 STRESS = 40,000 LIFE = — | | 975 | 0.540 |
| 8 | 0.750 | 30 | 0.050 | SPEC. NO. A-49 STRESS = 115,000 LIFE = 296.5 | |
| 10 | 0.820 | 70 | 0.060 | 3.1 | 0.050 |
| 21 | 1.000 | 110 | 0.075 | 12.2 | 0.100 |
| | | 210 | 0.090 | 20 | 0.105 |
| | | 243 | 0.100 | 55 | 0.180 |
| | | 345 | 0.120 | 109 | 0.300 |
| | | 395 | 0.120 | 125 | 0.310 |
| | | 455 | 0.145 | 140 | 0.330 |
| | | 535 | 0.140 | 165 | 0.370 |
| | | 605 | 0.170 | 200 | 0.440 |
| | | 795 | 0.195 | 216 | 0.500 |
| | | 1015 | 0.300 | 245 | 0.540 |
| | | | | 265 | 0.575 |

TABLE 6 (CONTINUED)

900° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|--|--------------------------|--|--------------------------|
| SPEC. NO. A-68 STRESS = 120,000 LIFE = — | | SPEC. NO. A-103 STRESS = 180,000 LIFE = 68.8 | |
| 0.3 | 0.050 | 0.1 | 0.050 |
| 1.5 | 0.100 | 0.2 | 0.100 |
| 10 | 0.150 | 2 | 0.300 |
| 30 | 0.215 | 5 | 0.430 |
| 55 | 0.280 | 6 | 0.450 |
| 63 | 0.300 | 8.5 | 0.500 |
| 110 | 0.370 | 15 | 0.675 |
| 165 | 0.460 | 45 | 1.000 |
| 187 | 0.500 | | |
| 245 | 0.565 | | |
| 270 | 0.610 | | |
| 330 | 0.735 | | |
| 365 | 0.820 | | |
| 408 | 1.000 | | |
| SPEC. NO. A-97 STRESS = 150,000 LIFE = 183.5 | | | |
| 0.3 | 0.050 | | |
| 1.0 | 0.100 | | |
| 10 | 0.215 | | |
| 14 | 0.300 | | |
| 30 | 0.345 | | |
| 40 | 0.400 | | |
| 56.5 | 0.500 | | |
| 65 | 0.510 | | |
| 80 | 0.570 | | |
| 90 | 0.625 | | |
| 140 | 0.870 | | |
| 149 | 1.000 | | |

TABLE 7
DEFORMATION-TIME DATA FOR 17-22 A(S) STEEL

800° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|--|-----------------------|--|-----------------------|--|-----------------------|
| SPEC NO. 1-62 STRESS = 72,500 LIFE = — | | SPEC NO. 1-90 STRESS = 95,000 LIFE = — | | SPEC NO. 1-96 STRESS = 118,000 LIFE = — | |
| 1 10 | 0.010 | 1.1 | 0.050 | 485 | 0.500 |
| 2 60 | 0.020 | 5 | 0.070 | 590 | 0.515 |
| 4 30 | 0.030 | 13 | 0.100 | 730 | 0.535 |
| 6 20 | 0.040 | 25 | 0.110 | 910 | 0.560 |
| 8 00 | 0.050 | 50 | 0.120 | 1000 | 0.575 |
| 9 60 | 0.060 | 100 | 0.150 | SPEC NO. 1-96 STRESS = 118,000 LIFE = — | |
| SPEC NO. 1-139 STRESS = 80,000 LIFE = — | | 170 | 0.170 | 0.1 | 0.050 |
| 7 5 | 0.025 | 315 | 0.185 | 0.2 | 0.100 |
| 9 5 | 0.030 | 470 | 0.205 | 5 | 0.300 |
| 240 | 0.050 | 650 | 0.215 | 20 | 0.460 |
| 430 | 0.070 | 790 | 0.220 | 24 | 0.500 |
| SPEC NO. 1-87 STRESS = 82,000 LIFE = 862.1 | | 975 | 0.235 | 35 | 0.550 |
| 10 | 0.030 | 1040 | 0.240 | 65 | 0.640 |
| 40 | 0.050 | SPEC NO. 1-132 STRESS = 107,500 LIFE = — | | 100 | 0.700 |
| 50 | 0.055 | 0.1 | 0.050 | 175 | 0.780 |
| 100 | 0.070 | 0.9 | 0.100 | 300 | 0.850 |
| 160 | 0.073 | 10 | 0.200 | 390 | 0.890 |
| 260 | 0.080 | 50 | 0.270 | 777 | 1.000 |
| 390 | 0.085 | 105 | 0.300 | SPEC NO. 1-105 STRESS = 120,000 LIFE = — | |
| 500 | 0.095 | 245 | 0.350 | 0.1 | 0.100 |
| 660 | 0.100 | 400 | 0.375 | 0.8 | 0.300 |
| 730 | 0.105 | 500 | 0.390 | 4.2 | 0.500 |
| 830 | 0.105 | 600 | 0.400 | 10 | 0.640 |
| 855 | 0.110 | 780 | 0.420 | 15 | 0.710 |
| SPEC NO. 1-146 STRESS = 88,000 LIFE = — | | 960 | 0.440 | 50 | 1.000 |
| 3 | 0.050 | SPEC NO. 1-136 STRESS = 111,000 LIFE = — | | | |
| 20 | 0.085 | 0.3 | 0.050 | | |
| 55 | 0.100 | 1.5 | 0.100 | | |
| 100 | 0.115 | 20 | 0.285 | | |
| 160 | 0.130 | 25 | 0.300 | | |
| | | 60 | 0.360 | | |
| | | 115 | 0.410 | | |
| | | 200 | 0.450 | | |
| | | 300 | 0.470 | | |
| | | 360 | 0.480 | | |
| | | 410 | 0.495 | | |

TABLE 7 (CONTINUED)
DEFORMATION-TIME DATA FOR 17-22 A (S) STEEL

1000° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---|-----------------------|---|-----------------------|--|-----------------------|
| SPEC NO. 1-89 STRESS = 10,000 LIFE = — | | 150 | 0.140 | SPEC NO. 1-86 STRESS = 60,000 LIFE = — | |
| 100 | 0.020 | 275 | 0.185 | 0.2 | 0.050 |
| 300 | 0.025 | 370 | 0.220 | 1.3 | 0.100 |
| 500 | 0.030 | 700 | 0.295 | 10 | 0.210 |
| 610 | 0.035 | 750 | 0.300 | 33 | 0.300 |
| 800 | 0.040 | 850 | 0.320 | 60 | 0.370 |
| 1000 | 0.045 | 985 | 0.365 | 80 | 0.425 |
| 1120 | 0.050 | 1790 | 0.500 | 94 | 0.500 |
| SPEC NO. 1-118 STRESS = 20,000 LIFE = — | | SPEC NO. 1-119 STRESS = 40,000 LIFE = — | | 120 | 0.540 |
| 60 | 0.030 | 10 | 0.050 | 160 | 0.665 |
| 130 | 0.050 | 31 | 0.100 | 190 | 0.750 |
| 200 | 0.060 | 45 | 0.115 | 286 | 1.000 |
| 320 | 0.080 | 95 | 0.165 | SPEC NO. 1-111 STRESS = 70,000 LIFE = — | |
| 410 | 0.090 | 160 | 0.200 | 0.1 | 0.050 |
| 520 | 0.100 | 220 | 0.240 | 0.5 | 0.100 |
| SPEC NO. 1-110 STRESS = 30,000 LIFE = — | | 280 | 0.275 | 5 | 0.230 |
| 23 | 0.050 | 360 | 0.300 | 10 | 0.300 |
| 50 | 0.070 | 410 | 0.325 | 20 | 0.390 |
| 150 | 0.100 | 490 | 0.360 | 29 | 0.500 |
| 250 | 0.120 | 585 | 0.410 | 40 | 0.555 |
| 350 | 0.140 | 710 | 0.470 | 50 | 0.690 |
| 460 | 0.160 | 755 | 0.490 | 88 | 1.000 |
| 540 | 0.170 | 775 | 0.500 | SPEC NO. 1-130 STRESS = 82,000 LIFE = — | |
| 700 | 0.190 | 890 | 0.550 | 0.2 | 0.100 |
| 870 | 0.210 | 1000 | 0.600 | 1.4 | 0.300 |
| 1090 | 0.230 | SPEC NO. 1-100 STRESS = 45,500 LIFE = — | | 4.1 | 0.500 |
| SPEC NO. 1-82 STRESS = 32,500 LIFE = — | | 2 | 0.050 | 10 | 0.795 |
| 14 | 0.050 | 6 | 0.100 | 13 | 1.000 |
| 50 | 0.095 | 55 | 0.210 | SPEC NO. 1-114 STRESS = 85,000 LIFE = 47 | |
| 57 | 0.100 | 145 | 0.300 | 0.1 | 0.100 |
| | | 270 | 0.410 | 0.9 | 0.300 |
| | | 370 | 0.500 | 2.8 | 0.500 |
| | | 415 | 0.535 | 10 | 1.000 |
| | | 555 | 0.655 | | |
| | | 680 | 0.765 | | |
| | | 775 | 0.860 | | |
| | | 935 | 1.000 | | |

TABLE 7 (CONTINUED)
DEFORMATION-TIME DATA FOR 17-22 A (S) STEEL

1050° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | | |
|---|--------------------------|---|--------------------------|---|--------------------------|---|-----|
| SPEC NO. 1-48 STRESS = 2,000 LIFE = — | | SPEC NO. 1-94 STRESS = 25,000 LIFE = — | | SPEC NO. 1-153 STRESS = 55,000 LIFE = — | | | |
| 100 | 0.010 | 5 | 0.050 | 0.2 | 0.050 | | |
| 200 | 0.012 | 17 | 0.100 | 0.8 | 0.100 | | |
| 350 | 0.015 | 50 | 0.140 | 10 | 0.300 | | |
| 500 | 0.020 | 125 | 0.200 | 22 | 0.500 | | |
| 750 | 0.022 | 210 | 0.250 | 35 | 0.700 | | |
| 850 | 0.025 | 330 | 0.300 | 45 | 0.890 | | |
| 1000 | 0.030 | 470 | 0.350 | 55 | 1.000 | | |
| 1090 | 0.033 | 600 | 0.400 | SPEC NO. 1-68 STRESS = 65,000 LIFE = 17.9 | | | |
| 1570 | 0.050 | 725 | 0.450 | 0.3 | 0.3 | | |
| SPEC NO. 1-113 STRESS = 9,000 LIFE = — | | 885 | 0.500 | | | 1 | 0.5 |
| SPEC NO. 1-116 STRESS = 32,000 LIFE = — | | 1000 | 0.540 | | | | |
| 100 | 0.030 | 2 | 0.050 | | | | |
| 260 | 0.050 | 11 | 0.100 | | | | |
| 280 | 0.055 | 153 | 0.300 | | | | |
| 500 | 0.060 | 285 | 0.400 | | | | |
| 700 | 0.070 | 425 | 0.500 | | | | |
| 820 | 0.080 | 560 | 0.600 | | | | |
| 980 | 0.090 | 710 | 0.700 | | | | |
| 1095 | 0.095 | 1065 | 1.000 | | | | |
| 1130 | 0.100 | SPEC NO. 1-109 STRESS = 45,000 LIFE = — | | | | | |
| SPEC NO. 1-135 STRESS = 20,000 LIFE = — | | 0.5 | 0.050 | | | | |
| 19 | 0.050 | 2 | 0.100 | | | | |
| 55 | 0.070 | 26 | 0.300 | | | | |
| 123 | 0.100 | 62 | 0.500 | | | | |
| 145 | 0.105 | 100 | 0.700 | | | | |
| 215 | 0.120 | 140 | 0.890 | | | | |
| 285 | 0.150 | 158 | 1.000 | | | | |
| 410 | 0.180 | | | | | | |
| 500 | 0.185 | | | | | | |
| 640 | 0.195 | | | | | | |
| 750 | 0.210 | | | | | | |
| 870 | 0.230 | | | | | | |
| 995 | 0.245 | | | | | | |

TABLE 8
DEFORMATION-TIME DATA FOR POTOMAC M STEEL

600° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---|--------------------------|---|--------------------------|---|--------------------------|
| SPEC. NO. 3 STRESS = 150,000 LIFE = — | | SPEC. NO. 5 STRESS = 215,000 LIFE = — | | SPEC. NO. 7 STRESS = 230,000 LIFE = — | |
| 18.1 | 0.041 | 0.3 | 0.501 | 280.2 | 0.821 |
| 42.2 | 0.050 | 1.1 | 0.520 | 340.8 | 0.819 |
| 114.7 | 0.060 | 2.8 | 0.561 | 400.8 | 0.824 |
| 163.0 | 0.063 | 4.5 | 0.560 | 497.6 | 0.840 |
| 186.1 | 0.064 | 5.7 | 0.568 | 570.4 | 0.841 |
| 258.2 | 0.065 | 7.3 | 0.573 | 618.8 | 0.849 |
| 425.8 | 0.069 | 9.7 | 0.581 | SPEC. NO. 8 STRESS = 235,000 LIFE = — | |
| 508.4 | 0.069 | 18.3 | 0.565 | 0.2 | 0.319 |
| 907.2 | 0.070 | 32.6 | 0.565 | 1.4 | 0.353 |
| SPEC. NO. 4 STRESS = 200,000 LIFE = — | | 42.6 | 0.578 | 2.8 | 0.366 |
| 0.7 | 0.332 | 56.0 | 0.598 | 4.4 | 0.372 |
| 1.2 | 0.346 | 79.8 | 0.607 | 5.3 | 0.378 |
| 2.2 | 0.347 | 117.4 | 0.600 | 7.1 | 0.392 |
| 3.7 | 0.365 | 147.8 | 0.623 | 18.3 | 0.384 |
| 5.0 | 0.359 | 176.7 | 0.638 | 46.5 | 0.380 |
| 6.0 | 0.360 | 224.4 | 0.632 | 118.9 | 0.407 |
| 6.9 | 0.363 | 271.9 | 0.650 | 175.5 | 0.425 |
| 9.0 | 0.389 | 381.4 | 0.645 | 261.3 | 0.432 |
| 31.9 | 0.360 | 442.3 | 0.653 | 333.4 | 0.433 |
| 93.5 | 0.398 | 573.9 | 0.653 | 452.7 | 0.438 |
| 129.6 | 0.407 | 645.5 | 0.661 | 477.2 | 0.430 |
| 152.4 | 0.416 | 811.9 | 0.673 | 488.6 | 0.449 |
| 177.6 | 0.406 | 1063.0 | 0.701 | 610.3 | 0.438 |
| 198.9 | 0.419 | SPEC. NO. 6 STRESS = 225,000 LIFE = — | | SPEC. NO. 8 STRESS = 235,000 LIFE = — | |
| 224.6 | 0.412 | 0.4 | 0.654 | 0.4 | 0.815 |
| 261.3 | 0.429 | 1.4 | 0.714 | 2.7 | 0.847 |
| 287.9 | 0.403 | 2.4 | 0.715 | 5.5 | 0.875 |
| 392.7 | 0.411 | 4.0 | 0.716 | 6.7 | 0.888 |
| 450.8 | 0.419 | 6.4 | 0.734 | 31.1 | 0.904 |
| 559.8 | 0.407 | 16.8 | 0.752 | 41.1 | 0.922 |
| 644.5 | 0.407 | 31.0 | 0.777 | 54.9 | 0.928 |
| 701.9 | 0.432 | 41.6 | 0.771 | 65.3 | 0.947 |
| 909.7 | 0.429 | 65.2 | 0.774 | 74.4 | 0.958 |
| 993.2 | 0.455 | 89.4 | 0.797 | 84.5 | 0.965 |
| 1030.3 | 0.443 | 138.0 | 0.794 | 109.1 | 0.968 |
| | | 184.6 | 0.793 | 156.0 | 0.975 |
| | | 209.6 | 0.807 | 204.1 | 0.993 |
| | | 233.6 | 0.806 | 265.5 | 0.990 |
| | | | | 334.4 | 1.022 |

TABLE 8 (CONTINUED)

800° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---|--------------------------|--|--------------------------|--|--------------------------|
| SPEC. NO. 10 STRESS = 55,000 LIFE = — | | SPEC. NO. 13 STRESS = 100,000 LIFE = — | | SPEC. NO. 18 STRESS = 170,000 LIFE = 240.1 | |
| 2.7 | 0.031 | 1.4 | 0.012 | 0.2 | 0.171 |
| 66.0 | 0.050 | 2.9 | 0.035 | 0.5 | 0.185 |
| 80.1 | 0.056 | 3.8 | 0.040 | 0.9 | 0.192 |
| 90.4 | 0.055 | 4.9 | 0.045 | 1.8 | 0.211 |
| 353.3 | 0.074 | 6.1 | 0.049 | 2.4 | 0.221 |
| 431.3 | 0.077 | 6.9 | 0.055 | 7.4 | 0.251 |
| 473.3 | 0.079 | 16.9 | 0.077 | 18.8 | 0.254 |
| 665.7 | 0.086 | 21.2 | 0.082 | 29.5 | 0.285 |
| 819.8 | 0.096 | 30.8 | 0.081 | 44.5 | 0.304 |
| 905.9 | 0.097 | 52.2 | 0.084 | 75.2 | 0.305 |
| 1002.5 | 0.105 | 78.9 | 0.094 | 104.0 | 0.317 |
| | | 90.4 | 0.108 | 127.2 | 0.331 |
| | | 115.8 | 0.126 | 151.7 | 0.342 |
| | | | | 175.7 | 0.344 |
| | | | | 199.1 | 0.342 |
| | | | | 214.5 | 0.354 |
| SPEC. NO. 11 STRESS = 65,000 LIFE = — | | SPEC. NO. 16 STRESS = 160,000 LIFE = 496.3 | | SPEC. NO. 19 STRESS = 180,000 LIFE = 141.5 | |
| 18.3 | 0.017 | 0.4 | 0.146 | 0.9 | 0.277 |
| 88.0 | 0.024 | 0.8 | 0.140 | 4.6 | 0.339 |
| 120.0 | 0.025 | 2.2 | 0.166 | 6.0 | 0.347 |
| 161.7 | 0.027 | 3.7 | 0.185 | 16.9 | 0.358 |
| 233.8 | 0.029 | 13.8 | 0.194 | 24.0 | 0.397 |
| 380.1 | 0.037 | 24.3 | 0.212 | 30.7 | 0.400 |
| 523.2 | 0.042 | 48.9 | 0.222 | 41.5 | 0.400 |
| 619.2 | 0.047 | 64.0 | 0.217 | 52.9 | 0.410 |
| 812.0 | 0.049 | 74.8 | 0.237 | 65.1 | 0.409 |
| 955.7 | 0.064 | 86.0 | 0.267 | 79.2 | 0.418 |
| | | 100.1 | 0.257 | 89.2 | 0.430 |
| | | 111.5 | 0.246 | 114.7 | 0.434 |
| | | 135.7 | 0.265 | 137.6 | 0.440 |
| | | 158.6 | 0.248 | | |
| | | 170.1 | 0.262 | | |
| | | 181.8 | 0.243 | | |
| | | 195.9 | 0.267 | | |
| | | 205.9 | 0.253 | | |
| | | 230.8 | 0.252 | | |
| | | 244.0 | 0.277 | | |
| | | 267.9 | 0.281 | | |
| | | 327.1 | 0.271 | | |
| | | 397.9 | 0.284 | | |
| | | 435.4 | 0.287 | | |
| | | 471.4 | 0.294 | | |
| | | 487.0 | 0.302 | | |
| SPEC. NO. 12 STRESS = 76,000 LIFE = — | | | | | |
| 0.5 | 0.071 | | | | |
| 8.3 | 0.099 | | | | |
| 18.0 | 0.103 | | | | |
| 42.4 | 0.119 | | | | |
| 102.6 | 0.128 | | | | |
| 175.9 | 0.127 | | | | |
| 198.6 | 0.139 | | | | |
| 257.4 | 0.150 | | | | |
| 345.3 | 0.148 | | | | |

TABLE 8 (CONTINUED)

800° F

| TIME (HOURS) | DEFORMATION (% IN 2") |
|------------------|--------------------------|
| SPEC NO. 20 | |
| STRESS = 200,000 | |
| LIFE = 138.7 | |
| 1.0 | 0.354 |
| 2.1 | 0.375 |
| 4.1 | 0.412 |
| 5.4 | 0.417 |
| 7.0 | 0.426 |
| 8.7 | 0.428 |
| 10.1 | 0.432 |
| 20.3 | 0.458 |
| 22.1 | 0.459 |
| 25.4 | 0.474 |
| 29.9 | 0.481 |
| 34.6 | 0.487 |
| 42.4 | 0.526 |
| 58.1 | 0.561 |
| 69.2 | 0.573 |
| 82.0 | 0.605 |
| 94.4 | 0.600 |
| 117.6 | 0.614 |

1000° F

| TIME (HOURS) | DEFORMATION (% IN 2") |
|-----------------|--------------------------|
| SPEC. NO. 22 | |
| STRESS = 15,000 | |
| LIFE = — | |
| 1.6 | 0.027 |
| 6.9 | 0.040 |
| 17.8 | 0.052 |
| 42.9 | 0.085 |
| 66.7 | 0.098 |
| 78.4 | 0.107 |
| 114.9 | 0.138 |
| 138.5 | 0.143 |
| 172.7 | 0.169 |
| 209.9 | 0.164 |
| 234.8 | 0.182 |
| 283.6 | 0.182 |
| 330.9 | 0.192 |
| 378.8 | 0.213 |
| 450.5 | 0.231 |
| 546.6 | 0.254 |
| 667.2 | 0.273 |
| 786.7 | 0.291 |
| 858.5 | 0.299 |
| 931.4 | 0.314 |
| 980.0 | 0.345 |

| TIME (HOURS) | DEFORMATION (% IN 2") |
|-----------------|--------------------------|
| SPEC. NO. 24 | |
| STRESS = 25,000 | |
| LIFE = — | |
| 5.8 | 0.091 |
| 20.0 | 0.113 |
| 40.6 | 0.148 |
| 63.7 | 0.188 |
| 89.2 | 0.230 |
| 122.9 | 0.252 |
| 159.0 | 0.295 |
| 254.8 | 0.358 |
| 302.6 | 0.386 |
| 350.6 | 0.426 |
| 422.6 | 0.450 |
| 518.2 | 0.513 |
| 589.9 | 0.560 |
| 699.0 | 0.633 |
| 841.2 | 0.713 |
| 951.0 | 0.790 |

1000° F

| TIME (HOURS) | DEFORMATION (% IN 2") |
|-----------------|--------------------------|
| SPEC NO. 21 | |
| STRESS = 10,000 | |
| LIFE = — | |
| 8.1 | 0.043 |
| 24.6 | 0.050 |
| 77.9 | 0.082 |
| 113.8 | 0.084 |
| 150.7 | 0.095 |
| 186.4 | 0.108 |
| 220.9 | 0.117 |
| 247.2 | 0.126 |
| 306.6 | 0.131 |
| 392.5 | 0.147 |
| 511.1 | 0.168 |
| 619.8 | 0.193 |
| 714.6 | 0.202 |
| 858.8 | 0.238 |
| 1026.7 | 0.248 |

| TIME (HOURS) | DEFORMATION (% IN 2") |
|-----------------|--------------------------|
| SPEC. NO. 23 | |
| STRESS = 20,000 | |
| LIFE = — | |
| 3.5 | 0.042 |
| 8.3 | 0.068 |
| 10.1 | 0.092 |
| 25.9 | 0.095 |
| 45.6 | 0.139 |
| 70.8 | 0.161 |
| 116.3 | 0.205 |
| 153.1 | 0.232 |
| 187.6 | 0.257 |
| 238.9 | 0.282 |
| 284.7 | 0.313 |
| 321.5 | 0.345 |
| 380.9 | 0.371 |
| 452.5 | 0.426 |
| 524.9 | 0.500 |
| 596.4 | 0.531 |

| TIME (HOURS) | DEFORMATION (% IN 2") |
|-----------------|--------------------------|
| SPEC. NO. 25 | |
| STRESS = 30,000 | |
| LIFE = — | |
| 0.4 | 0.037 |
| 1.6 | 0.060 |
| 4.6 | 0.074 |
| 8.4 | 0.086 |
| 17.6 | 0.103 |
| 43.2 | 0.157 |
| 89.5 | 0.228 |
| 126.8 | 0.259 |
| 185.7 | 0.315 |
| 233.5 | 0.353 |
| 307.5 | 0.400 |
| 353.3 | 0.431 |
| 424.7 | 0.457 |
| 497.6 | 0.498 |
| 641.3 | 0.577 |
| 762.8 | 0.658 |
| 882.0 | 0.733 |
| 1001.7 | 0.814 |
| 1097.3 | 0.903 |
| 1182.2 | 1.009 |

TABLE 8 (CONTINUED)

1000 ° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|-----------------|--------------------------|-----------------|--------------------------|-----------------|--------------------------|
| SPEC. NO. 26 | | 280.9 | 0.402 | 94.2 | 0.312 |
| STRESS = 32,500 | | 328.4 | 0.470 | 141.9 | 0.381 |
| LIFE = — | | 363.6 | 0.489 | 164.9 | 0.415 |
| 0.4 | 0.020 | 401.1 | 0.527 | 213.7 | 0.469 |
| 2.0 | 0.027 | 449.0 | 0.583 | 261.2 | 0.524 |
| 5.3 | 0.038 | 520.3 | 0.685 | 332.7 | 0.581 |
| 14.2 | 0.061 | 594.4 | 0.758 | 405.0 | 0.651 |
| 21.2 | 0.087 | 640.2 | 0.836 | 500.6 | 0.715 |
| 28.9 | 0.105 | 712.6 | 0.946 | 598.4 | 0.790 |
| 38.1 | 0.129 | 738.0 | 0.952 | 693.6 | 0.853 |
| 62.1 | 0.175 | 794.7 | 1.132 | 813.3 | 0.951 |
| 110.4 | 0.244 | SPEC. NO. 28 | | 910.2 | 1.025 |
| 134.4 | 0.272 | | | STRESS = 40,000 | |
| 158.5 | 0.302 | LIFE = — | | SPEC. NO. 30 | |
| 182.0 | 0.338 | 1.9 | 0.041 | STRESS = 45,000 | |
| 206.5 | 0.354 | 3.4 | 0.053 | LIFE = — | |
| 255.9 | 0.382 | 7.2 | 0.084 | 0.6 | 0.021 |
| 326.9 | 0.417 | 19.3 | 0.141 | 2.2 | 0.051 |
| 399.1 | 0.460 | 27.7 | 0.193 | 3.4 | 0.072 |
| 470.9 | 0.498 | 32.4 | 0.215 | 4.6 | 0.084 |
| 542.7 | 0.534 | 53.1 | 0.290 | 6.1 | 0.103 |
| 617.1 | 0.568 | 68.2 | 0.332 | 20.3 | 0.152 |
| 687.1 | 0.597 | 79.9 | 0.380 | 29.2 | 0.205 |
| 735.4 | 0.621 | 93.4 | 0.417 | 42.5 | 0.240 |
| 809.6 | 0.661 | 116.6 | 0.457 | 55.3 | 0.282 |
| 879.1 | 0.683 | 162.2 | 0.532 | 69.1 | 0.317 |
| 950.4 | 0.726 | 212.3 | 0.616 | 74.1 | 0.351 |
| 1022.6 | 0.770 | 259.7 | 0.709 | 81.1 | 0.368 |
| SPEC. NO. 27 | | 309.1 | 0.779 | 94.3 | 0.392 |
| | | STRESS = 35,000 | | 117.4 | 0.428 |
| TIME = — | | 355.5 | 0.855 | 143.3 | 0.460 |
| 0.4 | 0.014 | 403.6 | 0.956 | 162.9 | 0.491 |
| 1.4 | 0.018 | 451.1 | 1.052 | 190.7 | 0.549 |
| 2.6 | 0.033 | SPEC. NO. 29 | | 213.1 | 0.554 |
| 6.6 | 0.044 | | | STRESS = 42,500 | |
| 17.1 | 0.088 | LIFE = — | | 237.2 | 0.594 |
| 21.7 | 0.091 | 1.7 | 0.043 | 260.8 | 0.643 |
| 40.9 | 0.154 | 3.9 | 0.059 | 308.9 | 0.684 |
| 66.4 | 0.187 | 5.9 | 0.063 | 380.4 | 0.753 |
| 88.8 | 0.212 | 10.2 | 0.102 | 452.3 | 0.813 |
| 101.8 | 0.240 | 20.6 | 0.120 | 501.3 | 0.853 |
| 136.5 | 0.287 | 26.7 | 0.153 | 571.8 | 0.942 |
| 171.9 | 0.316 | 43.8 | 0.199 | 644.0 | 1.021 |
| 209.3 | 0.339 | 67.8 | 0.263 | | |

TABLE 8 (CONTINUED)

1000° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---|--------------------------|---|--------------------------|
| SPEC. NO. 31 STRESS = 50,000 LIFE = — | | SPEC. NO. 33 STRESS = 70,000 LIFE = — | |
| 0.8 | 0.026 | 0.6 | 0.032 |
| 2.7 | 0.054 | 1.7 | 0.055 |
| 4.9 | 0.069 | 5.3 | 0.124 |
| 14.1 | 0.130 | 9.4 | 0.189 |
| 27.4 | 0.197 | 19.8 | 0.244 |
| 51.5 | 0.298 | 26.0 | 0.316 |
| 63.2 | 0.328 | 43.7 | 0.406 |
| 109.6 | 0.460 | 57.9 | 0.513 |
| 134.3 | 0.520 | 67.1 | 0.525 |
| 170.4 | 0.594 | 91.0 | 0.634 |
| 206.9 | 0.662 | 103.2 | 0.682 |
| 255.1 | 0.733 | 115.5 | 0.718 |
| 327.1 | 0.837 | 139.0 | 0.962 |
| 425.0 | 0.968 | 163.2 | 1.058 |
| 493.9 | 1.011 | 175.5 | 1.118 |
| SPEC. NO. 32 STRESS = 55,000 LIFE = — | | 187.8 | 1.154 |
| 0.6 | 0.015 | | |
| 2.5 | 0.052 | | |
| 3.5 | 0.063 | | |
| 5.5 | 0.085 | | |
| 6.9 | 0.099 | | |
| 8.2 | 0.119 | | |
| 16.6 | 0.168 | | |
| 24.0 | 0.216 | | |
| 31.7 | 0.247 | | |
| 42.9 | 0.292 | | |
| 68.1 | 0.431 | | |
| 91.3 | 0.560 | | |
| 115.8 | 0.664 | | |
| 148.7 | 0.840 | | |
| 186.0 | 0.971 | | |
| 210.3 | 1.084 | | |

TABLE 9
DEFORMATION-TIME DATA FOR USS 12 MoV STEEL

600° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|--|--------------------------|--|--------------------------|--|--------------------------|
| SPEC NO. 1 STRESS = 150,000 LIFE = — | | SPEC NO. 3 STRESS = 180,000 LIFE = — | | 4.3 0.408 19.6 0.413 29.9 0.414 45.2 0.417 69.2 0.417 92.8 0.405 116.6 0.412 140.4 0.435 151.6 0.436 185.1 0.435 211.8 0.439 259.8 0.440 308.4 0.450 381.0 0.458 464.3 0.450 538.9 0.456 | |
| 0.5 | 0.105 | 3.9 | 0.290 | | |
| 2.9 | 0.122 | 20.3 | 0.276 | | |
| 15.8 | 0.121 | 44.0 | 0.293 | | |
| 18.9 | 0.136 | 54.4 | 0.286 | | |
| 44.0 | 0.127 | 76.7 | 0.291 | | |
| 67.0 | 0.125 | 91.5 | 0.300 | | |
| 116.5 | 0.140 | 139.1 | 0.312 | | |
| 162.8 | 0.118 | 163.1 | 0.313 | | |
| 173.1 | 0.123 | 212.2 | 0.321 | | |
| 235.0 | 0.133 | 259.4 | 0.333 | | |
| 317.0 | 0.124 | 307.2 | 0.325 | | |
| 450.2 | 0.131 | 391.7 | 0.344 | | |
| 522.0 | 0.140 | 523.7 | 0.344 | | |
| SPEC NO. 2 STRESS = 175,000 LIFE = — | | SPEC NO. 4 STRESS = 185,000 LIFE = — | | SPEC NO. 6 STRESS = 192,500 LIFE = — | |
| 1.1 | 0.231 | 0.4 | 0.437 | 0.4 | 0.530 |
| 2.3 | 0.238 | 1.7 | 0.466 | 18.7 | 0.540 |
| 5.7 | 0.250 | 2.7 | 0.469 | 42.6 | 0.528 |
| 8.2 | 0.267 | 5.3 | 0.477 | 67.1 | 0.564 |
| 16.8 | 0.243 | 17.0 | 0.484 | 91.3 | 0.552 |
| 20.4 | 0.248 | 29.2 | 0.486 | 116.3 | 0.544 |
| 22.6 | 0.254 | 41.6 | 0.488 | 163.1 | 0.550 |
| 25.5 | 0.268 | 76.3 | 0.492 | 187.0 | 0.555 |
| 42.1 | 0.266 | 91.0 | 0.487 | 234.4 | 0.561 |
| 65.4 | 0.261 | 113.8 | 0.473 | SPEC NO. 7 STRESS = 195,000 LIFE = — | |
| 78.7 | 0.254 | 148.9 | 0.482 | 0.6 | 0.449 |
| 101.3 | 0.254 | 184.5 | 0.482 | 1.9 | 0.458 |
| 115.8 | 0.254 | 208.3 | 0.486 | 2.9 | 0.457 |
| 138.1 | 0.273 | 232.2 | 0.496 | 19.8 | 0.473 |
| 151.1 | 0.278 | 280.4 | 0.497 | 43.3 | 0.486 |
| 186.5 | 0.291 | 311.5 | 0.500 | 67.6 | 0.481 |
| 257.4 | 0.299 | SPEC NO. 5 STRESS = 190,000 LIFE = — | | 92.0 | 0.485 |
| 330.1 | 0.306 | 0.7 | 0.394 | 115.9 | 0.482 |
| 450.0 | 0.310 | 1.9 | 0.407 | 140.1 | 0.484 |
| 497.1 | 0.312 | | | 189.3 | 0.484 |
| 585.2 | 0.343 | | | | |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 MoV STEEL

600° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---------------------|-----------------------|------------------|-----------------------|------------------|-----------------------|
| SPEC NO. 7 (CONT'D) | | 692.3 | 0.468 | SPEC NO. 12 | |
| 212.0 | 0.483 | 839.0 | 0.477 | STRESS = 207,500 | |
| 260.1 | 0.488 | 1003.8 | 0.493 | LIFE = _____ | |
| 309.3 | 0.496 | 1148.6 | 0.501 | 0.4 | 0.744 |
| 404.0 | 0.497 | SPEC NO. 10 | | 19.2 | 0.786 |
| 476.2 | 0.488 | STRESS = 202,500 | | 25.0 | 0.833 |
| 486.3 | 0.510 | LIFE = _____ | | 32.7 | 0.836 |
| SPEC NO. 8 | | 0.5 | 0.544 | 43.3 | 0.826 |
| STRESS = 197,500 | | 1.5 | 0.567 | 66.6 | 0.833 |
| LIFE = _____ | | 3.5 | 0.593 | 90.9 | 0.826 |
| 0.4 | 0.562 | 6.7 | 0.599 | 114.9 | 0.830 |
| 1.2 | 0.564 | 17.2 | 0.615 | 138.8 | 0.830 |
| 2.6 | 0.567 | 41.0 | 0.605 | 162.8 | 0.832 |
| 6.5 | 0.587 | 89.1 | 0.619 | 187.1 | 0.837 |
| 10.7 | 0.608 | 113.2 | 0.605 | 211.1 | 0.840 |
| 21.4 | 0.605 | 137.4 | 0.614 | 259.9 | 0.841 |
| 45.1 | 0.592 | 161.4 | 0.624 | 331.9 | 0.844 |
| 69.2 | 0.595 | 186.6 | 0.625 | 403.9 | 0.852 |
| 93.2 | 0.609 | 233.3 | 0.634 | SPEC NO. 13 | |
| 117.3 | 0.613 | 281.2 | 0.633 | STRESS = 210,000 | |
| 141.3 | 0.619 | 305.3 | 0.639 | LIFE = _____ | |
| 190.8 | 0.610 | SPEC NO. 11 | | 0.4 | 1.308 |
| 237.7 | 0.635 | STRESS = 205,000 | | 1.3 | 1.338 |
| 261.7 | 0.626 | LIFE = _____ | | 2.2 | 1.355 |
| 309.3 | 0.633 | 0.6 | 0.705 | 7.2 | 1.379 |
| SPEC NO. 9 | | 1.8 | 0.712 | 17.6 | 1.438 |
| STRESS = 200,000 | | 4.7 | 0.735 | 25.6 | 1.456 |
| LIFE = _____ | | 5.8 | 0.731 | 41.3 | 1.432 |
| 1.0 | 0.423 | 10.2 | 0.747 | 53.3 | 1.442 |
| 5.8 | 0.438 | 20.7 | 0.741 | 65.9 | 1.462 |
| 17.4 | 0.431 | 44.8 | 0.770 | 91.4 | 1.464 |
| 67.8 | 0.456 | 68.3 | 0.775 | 115.6 | 1.489 |
| 92.5 | 0.450 | 92.6 | 0.780 | | |
| 140.0 | 0.458 | 116.7 | 0.765 | | |
| 188.0 | 0.444 | 140.3 | 0.769 | | |
| 237.8 | 0.452 | 164.4 | 0.780 | | |
| 283.8 | 0.457 | 212.8 | 0.777 | | |
| 330.9 | 0.445 | 248.8 | 0.767 | | |
| 406.4 | 0.451 | 309.1 | 0.776 | | |
| 500.0 | 0.467 | 357.3 | 0.773 | | |
| | | 415.4 | 0.785 | | |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 Mo V STEEL

800° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---|--------------------------|---|--------------------------|-----------------|--------------------------|
| SPEC NO. 15 STRESS = 100,000 LIFE = _____ | | | | | |
| 1.6 | 0.023 | | | | |
| 3.4 | 0.035 | | | | |
| 4.4 | 0.036 | | | | |
| 17.3 | 0.064 | | | | |
| 46.5 | 0.083 | | | | |
| 68.2 | 0.082 | | | | |
| 117.8 | 0.090 | | | | |
| 143.6 | 0.081 | | | | |
| 187.5 | 0.080 | | | | |
| 213.7 | 0.079 | | | | |
| 260.2 | 0.084 | | | | |
| 318.3 | 0.099 | | | | |
| 430.2 | 0.113 | | | | |
| 499.7 | 0.126 | | | | |
| SPEC NO. 16 STRESS = 125,000 LIFE = _____ | | | | | |
| 8.1 | 0.160 | | | | |
| 31.6 | 0.164 | | | | |
| 105.5 | 0.182 | | | | |
| 152.1 | 0.194 | | | | |
| 199.2 | 0.197 | | | | |
| 296.2 | 0.201 | | | | |
| 381.3 | 0.208 | | | | |
| 476.8 | 0.221 | | | | |
| 571.6 | 0.236 | | | | |
| 668.9 | 0.243 | | | | |
| 987.9 | 0.262 | | | | |
| SPEC NO. 17 STRESS = 135,000 LIFE = 138.9 | | | | | |
| 0.4 | 0.111 | | | | |
| 1.5 | 0.125 | | | | |
| 2.5 | 0.133 | | | | |
| 7.8 | 0.165 | | | | |
| 21.5 | 0.185 | | | | |
| 45.0 | 0.193 | | | | |
| | | SPEC NO. 18 STRESS = 140,000 LIFE = _____ | | | |
| 68.3 | 0.195 | | | | |
| 93.1 | 0.205 | | | | |
| 116.9 | 0.224 | | | | |
| 128.7 | 0.224 | | | | |
| | | SPEC NO. 19 STRESS = 145,000 LIFE = 530.7 | | | |
| 0.4 | 0.144 | | | | |
| 1.5 | 0.169 | | | | |
| 4.2 | 0.169 | | | | |
| 7.3 | 0.183 | | | | |
| 17.7 | 0.173 | | | | |
| 24.5 | 0.192 | | | | |
| 42.2 | 0.195 | | | | |
| 66.9 | 0.214 | | | | |
| 113.9 | 0.227 | | | | |
| 137.9 | 0.238 | | | | |
| 185.2 | 0.250 | | | | |
| 233.2 | 0.268 | | | | |
| 305.3 | 0.275 | | | | |
| 353.9 | 0.285 | | | | |
| 401.6 | 0.291 | | | | |
| 474.1 | 0.306 | | | | |
| | | SPEC NO. 20 STRESS = 155,000 LIFE = 114.1 | | | |
| 0.5 | 0.191 | | | | |
| 1.3 | 0.200 | | | | |
| 2.2 | 0.218 | | | | |
| 4.0 | 0.243 | | | | |
| 5.4 | 0.256 | | | | |
| 20.8 | 0.267 | | | | |
| 28.0 | 0.277 | | | | |
| 69.5 | 0.307 | | | | |
| 95.5 | 0.319 | | | | |
| | | SPEC NO. 21 STRESS = 160,000 LIFE = 103.5 | | | |
| 0.4 | 0.344 | | | | |
| 1.0 | 0.356 | | | | |
| 1.9 | 0.372 | | | | |
| 2.9 | 0.367 | | | | |
| 4.3 | 0.377 | | | | |
| 5.2 | 0.383 | | | | |
| 6.2 | 0.392 | | | | |
| 6.9 | 0.394 | | | | |
| 7.9 | 0.398 | | | | |
| 19.7 | 0.382 | | | | |
| 24.7 | 0.407 | | | | |
| 31.2 | 0.426 | | | | |
| 41.0 | 0.415 | | | | |
| 67.3 | 0.433 | | | | |
| 91.0 | 0.450 | | | | |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 Mo V STEEL

800° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|---|-----------------------|---|-----------------------|---|-----------------------|
| SPEC NO. 22 STRESS = 165,000 LIFE = 270.7 | | 91.9 | 0.742 | 7.4 | 0.537 |
| 2.5 | 0.333 | 116.7 | 0.752 | 19.2 | 0.542 |
| 7.9 | 0.360 | 152.1 | 0.755 | 25.2 | 0.541 |
| 19.6 | 0.377 | 173.5 | 0.778 | 29.9 | 0.546 |
| 44.4 | 0.395 | SPEC NO. 25 STRESS = 175,000 LIFE = 103.8 | | 43.0 | 0.561 |
| 68.3 | 0.414 | 0.5 | 0.440 | 76.3 | 0.576 |
| 79.2 | 0.431 | 2.8 | 0.483 | 90.3 | 0.593 |
| 92.1 | 0.444 | 4.2 | 0.496 | SPEC NO. 28 STRESS = 185,000 LIFE = 116.6 | |
| 116.3 | 0.452 | 5.3 | 0.500 | 0.4 | 0.572 |
| 163.9 | 0.478 | 6.2 | 0.505 | 1.6 | 0.611 |
| 187.6 | 0.481 | 7.3 | 0.508 | 2.2 | 0.618 |
| 236.7 | 0.509 | 8.1 | 0.514 | 3.3 | 0.615 |
| 261.2 | 0.523 | 20.5 | 0.524 | 4.2 | 0.621 |
| SPEC NO. 23 STRESS = 170,000 LIFE = 186.8 | | 25.7 | 0.545 | 5.2 | 0.628 |
| 0.3 | 0.302 | 32.2 | 0.547 | 6.2 | 0.642 |
| 1.9 | 0.337 | 46.9 | 0.551 | 7.2 | 0.646 |
| 3.2 | 0.348 | 69.6 | 0.574 | 8.2 | 0.652 |
| 4.4 | 0.357 | 78.9 | 0.581 | 9.3 | 0.659 |
| 5.5 | 0.360 | 91.1 | 0.586 | 22.6 | 0.653 |
| 18.6 | 0.376 | SPEC NO. 26 STRESS = 180,000 LIFE = 102.0 | | 44.0 | 0.685 |
| 42.8 | 0.403 | 0.5 | 0.480 | 67.5 | 0.686 |
| 67.9 | 0.406 | 2.4 | 0.497 | 92.3 | 0.704 |
| 90.5 | 0.421 | 3.7 | 0.515 | SPEC NO. 29 STRESS = 200,000 LIFE = 36.8 | |
| 114.3 | 0.443 | 4.8 | 0.523 | NO DATA | |
| 139.2 | 0.456 | 5.9 | 0.528 | | |
| 163.5 | 0.470 | 7.9 | 0.545 | | |
| 186.7 | 0.492 | 19.0 | 0.562 | | |
| SPEC NO. 24 STRESS = 175,000 LIFE = 175.8 | | 25.1 | 0.590 | | |
| 0.4 | 0.577 | 32.0 | 0.605 | | |
| 1.5 | 0.616 | 68.2 | 0.628 | | |
| 2.5 | 0.616 | SPEC NO. 27 STRESS = 185,000 LIFE = 92.1 | | | |
| 7.9 | 0.630 | 0.3 | 0.453 | | |
| 19.7 | 0.654 | 1.4 | 0.485 | | |
| 43.2 | 0.701 | | | | |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 MoV STEEL

900° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|--|--------------------------|--|--------------------------|--|--------------------------|
| SPEC NO. 31 STRESS = 25,000 LIFE = _____ | | SPEC NO. 33 STRESS = 40,000 LIFE = _____ | | 643.9 0.592 715.9 0.625 | |
| 19.9 | 0.015 | 4.7 | 0.025 | SPEC NO. 35 STRESS = 50,000 LIFE = _____ | |
| 33.6 | 0.029 | 19.9 | 0.040 | 27.6 | 0.048 |
| 78.7 | 0.074 | 23.5 | 0.044 | 57.2 | 0.092 |
| 92.6 | 0.087 | 43.1 | 0.081 | 93.9 | 0.141 |
| 117.3 | 0.108 | 54.8 | 0.115 | 117.4 | 0.196 |
| 164.4 | 0.149 | 66.4 | 0.128 | 140.4 | 0.234 |
| 188.1 | 0.160 | 90.9 | 0.174 | 164.5 | 0.275 |
| 212.2 | 0.173 | 114.4 | 0.234 | 201.9 | 0.329 |
| 235.9 | 0.188 | 137.7 | 0.276 | 236.3 | 0.373 |
| 260.4 | 0.199 | 162.5 | 0.322 | 307.8 | 0.459 |
| 283.5 | 0.216 | 186.3 | 0.360 | 355.7 | 0.508 |
| 332.1 | 0.231 | 222.4 | 0.425 | 427.9 | 0.569 |
| 404.1 | 0.268 | 244.9 | 0.458 | 549.2 | 0.643 |
| 500.3 | 0.289 | 308.1 | 0.494 | 620.5 | 0.671 |
| 596.6 | 0.313 | 331.5 | 0.505 | 715.7 | 0.732 |
| 692.4 | 0.337 | 378.8 | 0.540 | 826.2 | 0.775 |
| 716.3 | 0.349 | 451.2 | 0.622 | 909.6 | 0.773 |
| 811.8 | 0.365 | 522.9 | 0.645 | 1004.5 | 0.801 |
| SPEC NO. 32 STRESS = 30,000 LIFE = _____ | | SPEC NO. 34 STRESS = 45,000 LIFE = _____ | | SPEC NO. 36 STRESS = 52,000 LIFE = _____ | |
| 20.4 | 0.011 | 8.9 | 0.036 | 18.6 | 0.083 |
| 44.1 | 0.034 | 20.0 | 0.045 | 26.4 | 0.114 |
| 68.1 | 0.067 | 43.9 | 0.072 | 31.7 | 0.135 |
| 81.0 | 0.090 | 67.8 | 0.106 | 42.9 | 0.171 |
| 116.3 | 0.119 | 92.1 | 0.149 | 52.5 | 0.218 |
| 140.2 | 0.144 | 115.8 | 0.197 | 67.3 | 0.271 |
| 189.7 | 0.189 | 139.7 | 0.225 | 77.7 | 0.302 |
| 212.6 | 0.226 | 164.2 | 0.257 | 91.1 | 0.326 |
| 260.6 | 0.247 | 188.0 | 0.304 | 116.1 | 0.403 |
| 308.2 | 0.275 | 236.0 | 0.367 | 139.6 | 0.455 |
| 356.2 | 0.291 | 260.1 | 0.383 | 162.9 | 0.521 |
| 428.4 | 0.318 | 309.3 | 0.434 | 210.9 | 0.616 |
| 524.7 | 0.353 | 380.2 | 0.478 | 235.2 | 0.675 |
| 633.5 | 0.390 | 453.6 | 0.519 | 284.3 | 0.726 |
| 693.6 | 0.391 | 524.7 | 0.556 | 331.0 | 0.799 |
| 764.9 | 0.411 | 596.8 | 0.574 | 403.4 | 0.889 |
| 909.0 | 0.441 | | | | |
| 1004.2 | 0.447 | | | | |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 Mo V STEEL

900° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|----------------------|-----------------------|-----------------|-----------------------|-----------------|-----------------------|
| SPEC NO. 36 (CONT'D) | | 261.5 | 0.590 | 57.0 | 0.185 |
| 475.5 | 0.926 | 286.2 | 0.637 | 67.7 | 0.214 |
| 546.4 | 0.966 | 311.4 | 0.687 | 81.2 | 0.263 |
| 642.3 | 1.002 | 356.5 | 0.728 | 91.5 | 0.302 |
| SPEC NO. 37 | | 405.2 | 0.783 | 116.8 | 0.414 |
| STRESS = 55,000 | | 452.0 | 0.815 | 139.3 | 0.478 |
| LIFE = — | | 524.0 | 0.879 | 163.7 | 0.548 |
| 3.4 | 0.015 | 572.0 | 0.914 | 200.7 | 0.670 |
| 19.0 | 0.039 | 644.0 | 0.952 | 236.2 | 0.731 |
| 43.6 | 0.060 | 669.0 | 0.971 | 260.8 | 0.790 |
| 68.1 | 0.093 | 740.0 | 1.011 | 310.6 | 0.888 |
| 81.5 | 0.106 | SPEC NO. 39 | | 355.7 | 0.933 |
| 116.5 | 0.144 | STRESS = 60,000 | | 379.8 | 0.969 |
| 139.5 | 0.161 | LIFE = — | | 427.3 | 1.000 |
| 163.7 | 0.194 | 4.6 | 0.025 | 499.0 | 1.071 |
| 187.7 | 0.220 | 7.5 | 0.039 | 523.2 | 1.099 |
| 211.7 | 0.242 | 22.7 | 0.087 | SPEC NO. 41 | |
| 261.0 | 0.285 | 69.5 | 0.168 | STRESS = 65,000 | |
| 310.8 | 0.337 | 94.3 | 0.235 | LIFE = — | |
| 355.7 | 0.379 | 117.9 | 0.307 | 3.6 | 0.015 |
| 404.1 | 0.405 | 141.8 | 0.369 | 8.5 | 0.035 |
| 499.1 | 0.460 | 166.4 | 0.435 | 27.2 | 0.083 |
| 571.5 | 0.493 | 191.0 | 0.498 | 34.7 | 0.095 |
| 643.4 | 0.529 | 214.2 | 0.544 | 44.0 | 0.116 |
| 739.6 | 0.578 | 262.4 | 0.649 | 67.7 | 0.203 |
| 834.8 | 0.619 | 310.6 | 0.715 | 91.5 | 0.287 |
| SPEC NO. 38 | | 359.1 | 0.782 | 116.0 | 0.377 |
| STRESS = 57,500 | | 383.7 | 0.811 | 139.9 | 0.455 |
| LIFE = — | | 408.3 | 0.834 | 163.5 | 0.534 |
| 2.3 | 0.012 | 454.6 | 0.873 | 212.1 | 0.657 |
| 20.0 | 0.063 | 502.7 | 0.908 | 235.7 | 0.691 |
| 44.2 | 0.111 | 573.9 | 0.953 | 261.1 | 0.736 |
| 69.0 | 0.178 | 669.9 | 1.001 | 308.0 | 0.835 |
| 92.5 | 0.248 | SPEC NO. 40 | | 356.6 | 0.919 |
| 117.6 | 0.310 | STRESS = 62,500 | | 405.2 | 0.954 |
| 146.1 | 0.354 | LIFE = — | | 524.1 | 1.037 |
| 164.6 | 0.425 | 2.5 | 0.026 | SPEC NO. 42 | |
| 188.7 | 0.476 | 3.9 | 0.028 | STRESS = 67,500 | |
| 212.7 | 0.518 | 4.8 | 0.033 | LIFE = — | |
| 237.0 | 0.566 | 28.3 | 0.083 | 3.0 | 0.034 |
| | | 43.6 | 0.127 | 4.9 | 0.094 |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 Mo V STEEL

900° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|--|--------------------------|--|--------------------------|--|--------------------------|
| SPEC NO. 42 (CONT'D) | | SPEC NO. 44 STRESS = 72,500 LIFE = — | | 166.2 | 0.834 |
| 11.4 | 0.078 | 3.5 | 0.041 | 180.1 | 0.853 |
| 22.7 | 0.097 | 4.4 | 0.048 | 213.5 | 0.977 |
| 30.0 | 0.119 | 8.5 | 0.071 | 237.9 | 1.040 |
| 47.0 | 0.177 | 22.6 | 0.088 | SPEC NO. 46 STRESS = 77,500 LIFE = — | |
| 71.5 | 0.279 | 30.4 | 0.109 | 1.6 | 0.038 |
| 86.2 | 0.327 | 35.9 | 0.123 | 6.2 | 0.061 |
| 97.4 | 0.381 | 47.2 | 0.166 | 17.7 | 0.103 |
| 166.1 | 0.415 | 57.4 | 0.220 | 25.2 | 0.130 |
| 120.1 | 0.462 | 71.5 | 0.262 | 42.1 | 0.169 |
| 143.3 | 0.519 | 81.8 | 0.300 | 52.0 | 0.211 |
| 167.0 | 0.599 | 95.4 | 0.334 | 66.5 | 0.255 |
| 190.9 | 0.653 | 120.4 | 0.399 | 76.3 | 0.314 |
| 214.9 | 0.711 | 143.8 | 0.465 | 90.4 | 0.359 |
| 262.7 | 0.823 | 167.1 | 0.510 | 115.5 | 0.460 |
| 310.6 | 0.892 | 191.1 | 0.570 | 138.7 | 0.560 |
| 359.0 | 0.957 | 215.0 | 0.634 | 162.1 | 0.662 |
| 407.4 | 1.013 | 239.5 | 0.679 | 186.1 | 0.756 |
| SPEC NO. 43 STRESS = 70,000 LIFE = — | | 264.1 | 0.719 | 210.0 | 0.850 |
| 0.5 | 0.016 | 313.7 | 0.772 | 234.5 | 0.941 |
| 1.6 | 0.026 | 335.3 | 0.817 | 259.1 | 1.020 |
| 2.6 | 0.045 | 383.3 | 0.881 | 283.5 | 1.067 |
| 3.6 | 0.048 | 431.6 | 0.927 | 308.6 | 1.128 |
| 4.1 | 0.050 | 479.7 | 0.962 | 330.2 | 1.201 |
| 7.6 | 0.056 | 527.2 | 1.012 | SPEC NO. 47 STRESS = 80,000 LIFE = — | |
| 25.2 | 0.109 | SPEC NO. 45 STRESS = 75,000 LIFE = — | | 1.3 | 0.029 |
| 31.2 | 0.125 | 0.4 | 0.052 | 2.2 | 0.042 |
| 43.0 | 0.158 | 1.5 | 0.063 | 5.6 | 0.072 |
| 55.1 | 0.219 | 4.5 | 0.077 | 16.8 | 0.089 |
| 67.4 | 0.258 | 9.0 | 0.103 | 21.6 | 0.097 |
| 92.9 | 0.333 | 21.3 | 0.134 | 41.2 | 0.123 |
| 117.2 | 0.409 | 34.2 | 0.192 | 64.5 | 0.183 |
| 138.8 | 0.467 | 47.1 | 0.273 | 77.6 | 0.252 |
| 186.8 | 0.584 | 58.6 | 0.394 | 89.7 | 0.281 |
| 210.5 | 0.630 | 71.0 | 0.399 | 100.2 | 0.327 |
| 285.7 | 0.775 | 94.9 | 0.509 | 115.0 | 0.361 |
| 307.6 | 0.854 | 118.6 | 0.648 | 137.0 | 0.450 |
| 332.3 | 0.885 | 142.1 | 0.747 | | |
| 403.6 | 0.984 | | | | |
| 500.0 | 1.083 | | | | |

TABLE 9 (CONTINUED)
DEFORMATION-TIME DATA FOR USS 12 Mo V STEEL

900° F

| TIME (HOURS) | DEFORMATION (% IN 2") | TIME (HOURS) | DEFORMATION (% IN 2") |
|----------------------|-----------------------|------------------|-----------------------|
| SPEC NO. 47 (CONT'D) | | 19.0 | 0.170 |
| 150.1 | 0.484 | 24.2 | 0.181 |
| 160.7 | 0.514 | 43.7 | 0.279 |
| 185.5 | 0.585 | 69.1 | 0.408 |
| 211.5 | 0.658 | 91.0 | 0.525 |
| 232.4 | 0.721 | 114.8 | 0.675 |
| 244.3 | 0.761 | 127.2 | 0.747 |
| 256.4 | 0.806 | 139.0 | 0.813 |
| 269.1 | 0.831 | 151.3 | 0.916 |
| 304.6 | 0.911 | 162.1 | 0.956 |
| 329.1 | 0.951 | 175.5 | 1.042 |
| 354.1 | 0.977 | 186.1 | 1.095 |
| 402.2 | 1.080 | SPEC NO. 50 | |
| SPEC NO. 48 | | STRESS = 95,000 | |
| STRESS = 85,000 | | LIFE = 186.9 | |
| LIFE = — | | 3.6 | 0.032 |
| 0.9 | 0.038 | 19.5 | 0.087 |
| 4.1 | 0.073 | 43.2 | 0.170 |
| 6.4 | 0.086 | 91.2 | 0.405 |
| 15.3 | 0.123 | 115.3 | 0.554 |
| 30.1 | 0.205 | 139.3 | 0.680 |
| 39.4 | 0.308 | 163.6 | 0.794 |
| 54.4 | 0.425 | 176.9 | 0.907 |
| 63.6 | 0.454 | SPEC NO. 51 | |
| 75.5 | 0.516 | STRESS = 100,000 | |
| 87.6 | 0.555 | LIFE = 91.1 | |
| 112.9 | 0.671 | 0.6 | 0.102 |
| 135.7 | 0.770 | 2.3 | 0.111 |
| 159.6 | 0.918 | 4.4 | 0.132 |
| 172.4 | 0.974 | 8.3 | 0.156 |
| 183.8 | 1.021 | 17.3 | 0.212 |
| SPEC NO. 49 | | 25.6 | 0.241 |
| STRESS = 90,000 | | 42.8 | 0.325 |
| LIFE = — | | 66.2 | 0.415 |
| 0.4 | 0.049 | 89.2 | 0.549 |
| 1.8 | 0.078 | | |
| 3.4 | 0.095 | | |
| 4.6 | 0.102 | | |
| 5.7 | 0.105 | | |
| 7.7 | 0.121 | | |

TABLE 10
INCREMENTAL LOADING DATA FOR POTOMAC M STEEL

600° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|
| SPEC. NO. 3 STRESS = 150,000 | | SPEC. NO. 6 STRESS = 225,000 | | SPEC. NO. 9 STRESS = 240,000 | |
| 15,400 | 0.083 | 25,000 | 0.143 | 9,710 | 0.061 |
| 41,000 | 0.183 | 50,000 | 0.263 | 20,000 | 0.113 |
| 66,600 | 0.285 | 75,000 | 0.372 | 30,000 | 0.163 |
| 91,900 | 0.380 | 100,000 | 0.525 | 40,000 | 0.219 |
| 100,000 | 0.407 | 125,000 | 0.691 | 50,000 | 0.285 |
| 110,000 | 0.452 | 150,000 | 0.824 | 60,000 | 0.326 |
| 118,000 | 0.488 | 170,000 | 1.001 | 80,000 | 0.455 |
| 130,000 | 0.542 | 190,000 | 1.215 | 100,000 | 0.609 |
| 140,000 | 0.582 | 210,000 | 1.505 | 120,000 | 0.708 |
| 150,000 | 0.637 | 220,000 | 1.600 | 150,000 | 0.940 |
| | | 225,000 | 1.685 | 180,000 | 1.237 |
| SPEC. NO. 4 STRESS = 200,000 | | SPEC. NO. 7 STRESS = 230,000 | | 200,000 | 1.330 |
| 14,930 | 0.075 | 10,750 | 0.041 | 220,000 | 1.995 |
| 39,800 | 0.194 | 20,000 | 0.094 | 240,000 | 2.510 |
| 64,700 | 0.313 | 30,000 | 0.138 | | |
| 89,600 | 0.460 | 40,000 | 0.185 | | |
| 114,500 | 0.604 | 50,000 | 0.237 | | |
| 139,300 | 0.770 | 60,000 | 0.421 | | |
| 160,000 | 0.911 | 90,000 | 0.440 | | |
| 170,000 | 0.986 | 120,000 | 0.597 | | |
| 180,000 | 1.071 | 150,500 | 0.781 | | |
| 189,000 | 1.183 | 170,000 | 0.906 | | |
| 195,000 | 1.245 | 190,000 | 1.106 | | |
| 200,000 | 1.293 | 210,000 | 1.225 | | |
| | | 220,000 | 1.330 | | |
| | | 230,000 | 1.410 | | |
| SPEC. NO. 5 STRESS = 215,000 | | SPEC. NO. 8 STRESS = 235,000 | | | |
| 15,000 | 0.097 | 10,000 | 0.054 | | |
| 40,000 | 0.191 | 20,000 | 0.104 | | |
| 65,000 | 0.356 | 30,000 | 0.148 | | |
| 90,000 | 0.488 | 40,000 | 0.188 | | |
| 115,000 | 0.660 | 50,000 | 0.250 | | |
| 140,000 | 0.815 | 60,000 | 0.307 | | |
| 165,000 | 1.010 | 70,000 | 0.368 | | |
| 177,500 | 1.110 | 80,000 | 0.410 | | |
| 190,000 | 1.255 | 90,000 | 0.441 | | |
| 202,500 | 1.405 | 140,000 | 0.787 | | |
| 215,000 | 1.560 | 190,000 | 1.220 | | |
| | | 235,000 | 1.860 | | |

TABLE 10 (CONTINUED)

800° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|---------------------------------|---------------|----------------------------------|---------------|----------------------------------|---------------|
| SPEC. NO. 10 STRESS = 55,000 | | SPEC. NO. 13 STRESS = 100,000 | | SPEC. NO. 19 STRESS = 180,000 | |
| 9,760 | 0.042 | 9,250 | 0.010 | 14,900 | 0.103 |
| 15,000 | 0.072 | 13,900 | 0.053 | 39,800 | 0.240 |
| 20,000 | 0.082 | 20,000 | 0.075 | 64,600 | 0.387 |
| 25,000 | 0.098 | 25,000 | 0.132 | 89,500 | 0.532 |
| 30,000 | 0.118 | 30,000 | 0.152 | 115,000 | 0.697 |
| 35,000 | 0.128 | 40,000 | 0.206 | 139,200 | 0.878 |
| 40,000 | 0.161 | 50,000 | 0.274 | 151,000 | 0.981 |
| 45,000 | 0.181 | 60,000 | 0.320 | 164,000 | 1.088 |
| 50,000 | 0.192 | 70,000 | 0.391 | 173,000 | 1.180 |
| 55,000 | 0.221 | 80,000 | 0.432 | 180,000 | 1.272 |
| SPEC. NO. 11 STRESS = 65,000 | | SPEC. NO. 16 STRESS = 160,000 | | SPEC. NO. 20 STRESS = 200,000 | |
| 10,000 | 0.034 | 14,600 | 0.066 | 15,000 | 0.063 |
| 20,000 | 0.073 | 39,000 | 0.194 | 30,000 | 0.143 |
| 30,000 | 0.109 | 63,400 | 0.308 | 45,000 | 0.219 |
| 40,000 | 0.152 | 87,600 | 0.439 | 60,000 | 0.292 |
| 45,000 | 0.174 | 112,000 | 0.572 | 75,000 | 0.368 |
| 50,000 | 0.194 | 125,000 | 0.631 | 90,000 | 0.452 |
| 55,000 | 0.211 | 135,000 | 0.722 | 105,000 | 0.526 |
| 60,000 | 0.226 | 145,000 | 0.774 | 120,000 | 0.621 |
| 65,000 | 0.251 | 150,000 | 0.827 | 135,000 | 0.725 |
| SPEC. NO. 12 STRESS = 76,000 | | SPEC. NO. 18 STRESS = 170,000 | | 150,000 | 0.830 |
| 9,660 | 0.024 | 14,900 | 0.053 | 165,000 | 0.926 |
| 20,000 | 0.085 | 39,800 | 0.183 | 180,000 | 1.071 |
| 30,000 | 0.138 | 64,600 | 0.326 | 190,000 | 1.155 |
| 40,000 | 0.183 | 77,000 | 0.401 | 200,000 | 1.223 |
| 50,000 | 0.218 | 89,400 | 0.465 | | |
| 60,000 | 0.272 | 101,500 | 0.532 | | |
| 68,000 | 0.336 | 114,200 | 0.609 | | |
| 76,000 | 0.387 | 125,000 | 0.685 | | |
| | | 135,000 | 0.745 | | |
| | | 145,000 | 0.823 | | |
| | | 155,000 | 0.906 | | |
| | | 165,000 | 0.999 | | |
| | | 170,000 | 1.040 | | |

TABLE 10 (CONTINUED)

1000 ° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|
| SPEC. NO. 24 STRESS = 25,000 | | SPEC. NO. 28 STRESS = 40,000 | | SPEC. NO. 32 STRESS = 55,000 | |
| 9,250 | 0.043 | 9,900 | 0.063 | 13,800 | 0.077 |
| 13,000 | 0.052 | 15,000 | 0.093 | 25,000 | 0.136 |
| 16,000 | 0.066 | 20,000 | 0.127 | 30,000 | 0.160 |
| 19,000 | 0.081 | 25,000 | 0.148 | 35,000 | 0.195 |
| 21,000 | 0.094 | 30,000 | 0.185 | 40,000 | 0.213 |
| 23,000 | 0.115 | 34,000 | 0.218 | 45,000 | 0.256 |
| 25,000 | 0.136 | 37,000 | 0.238 | 50,000 | 0.281 |
| | | 40,000 | 0.260 | 52,500 | 0.300 |
| | | | | 55,000 | 0.321 |
| SPEC. NO. 25 STRESS = 30,000 | | SPEC. NO. 29 STRESS = 42,500 | | SPEC. NO. 33 STRESS = 70,000 | |
| 9,460 | 0.051 | 9,500 | 0.073 | 10,000 | 0.057 |
| 15,000 | 0.080 | 15,000 | 0.103 | 20,000 | 0.108 |
| 20,000 | 0.180 | 20,000 | 0.132 | 30,000 | 0.168 |
| 25,000 | 0.143 | 25,000 | 0.172 | 40,000 | 0.232 |
| 30,000 | 0.175 | 30,000 | 0.195 | 50,000 | 0.295 |
| | | 35,000 | 0.233 | 60,000 | 0.353 |
| | | 40,000 | 0.259 | 70,000 | 0.426 |
| | | 42,500 | 0.284 | | |
| SPEC. NO. 26 STRESS = 32,500 | | SPEC. NO. 30 STRESS = 40,000 | | | |
| 9,725 | 0.042 | 10,000 | 0.060 | | |
| 14,550 | 0.070 | 15,000 | 0.094 | | |
| 19,000 | 0.101 | 20,000 | 0.110 | | |
| 23,000 | 0.128 | 25,000 | 0.142 | | |
| 27,000 | 0.163 | 30,000 | 0.163 | | |
| 29,000 | 0.175 | 35,000 | 0.192 | | |
| 31,000 | 0.198 | 40,000 | 0.223 | | |
| 32,500 | 0.199 | 45,000 | 0.255 | | |
| SPEC. NO. 27 STRESS = 35,000 | | SPEC. NO. 31 STRESS = 50,000 | | | |
| 9,510 | 0.051 | 10,000 | 0.070 | | |
| 15,000 | 0.092 | 20,000 | 0.130 | | |
| 20,000 | 0.118 | 30,000 | 0.179 | | |
| 25,000 | 0.156 | 40,000 | 0.250 | | |
| 30,000 | 0.181 | 50,000 | 0.308 | | |
| 35,000 | 0.211 | | | | |

TABLE II
INCREMENTAL LOADING DATA FOR USS 12 Mo V STEEL

600° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | |
|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|-------|
| SPEC. NO. 1 STRESS = 150,000 | | SPEC. NO. 4 STRESS = 185,000 | | SPEC. NO. 7 STRESS = 195,000 | | |
| 10,000 | 0.066 | 9,525 | 0.057 | 10,000 | 0.041 | |
| 20,000 | 0.104 | 20,000 | 0.103 | 20,000 | 0.090 | |
| 30,000 | 0.142 | 30,000 | 0.160 | 30,000 | 0.138 | |
| 40,000 | 0.169 | 40,000 | 0.222 | 40,000 | 0.201 | |
| 50,000 | 0.215 | 50,000 | 0.265 | 50,000 | 0.236 | |
| 70,000 | 0.287 | 80,000 | 0.434 | 60,000 | 0.288 | |
| 90,000 | 0.350 | 110,000 | 0.610 | 70,000 | 0.342 | |
| 110,000 | 0.402 | 140,000 | 0.843 | 80,000 | 0.387 | |
| 130,000 | 0.549 | 170,000 | 1.160 | 90,000 | 0.440 | |
| 150,000 | 0.676 | 175,000 | 1.220 | 115,000 | 0.578 | |
| SPEC. NO. 2 STRESS = 175,000 | | SPEC. NO. 5 STRESS = 190,000 | | SPEC. NO. 8 STRESS = 197,500 | | |
| 10,000 | 0.037 | 10,000 | 0.042 | 10,000 | 0.058 | |
| 20,000 | 0.085 | 20,000 | 0.084 | 20,000 | 0.108 | |
| 30,000 | 0.118 | 30,000 | 0.138 | 30,000 | 0.165 | |
| 40,000 | 0.157 | 40,000 | 0.188 | 40,000 | 0.216 | |
| 50,000 | 0.200 | 50,000 | 0.240 | 50,000 | 0.269 | |
| 60,000 | 0.237 | 60,000 | 0.289 | 60,000 | 0.321 | |
| 90,000 | 0.355 | 70,000 | 0.342 | 70,000 | 0.377 | |
| 120,000 | 0.498 | 80,000 | 0.375 | 80,000 | 0.436 | |
| 150,000 | 0.705 | 90,000 | 0.441 | 90,000 | 0.489 | |
| 160,000 | 0.763 | 115,000 | 0.591 | 115,000 | 0.661 | |
| 170,000 | 0.829 | 140,000 | 0.743 | 140,000 | 0.857 | |
| 175,000 | 0.894 | 165,000 | 0.962 | 165,000 | 1.089 | |
| SPEC. NO. 3 STRESS = 180,000 | | SPEC. NO. 6 STRESS = 192,500 | | 190,000 | | 1.489 |
| 10,000 | 0.031 | 10,000 | 0.037 | 190,000 | 1.489 | |
| 20,000 | 0.067 | 20,000 | 0.081 | 197,500 | 1.559 | |
| 30,000 | 0.101 | 30,000 | 0.161 | | | |
| 40,000 | 0.134 | 40,000 | 0.218 | | | |
| 50,000 | 0.189 | 50,000 | 0.256 | | | |
| 60,000 | 0.218 | 60,000 | 0.314 | | | |
| 70,000 | 0.264 | 70,000 | 0.369 | | | |
| 80,000 | 0.294 | 80,000 | 0.430 | | | |
| 90,000 | 0.344 | 90,000 | 0.489 | | | |
| 115,000 | 0.449 | 115,000 | 0.646 | | | |
| 140,000 | 0.588 | 140,000 | 0.838 | | | |
| 165,000 | 0.790 | 165,000 | 1.114 | | | |
| 180,000 | 0.939 | 192,500 | 1.560 | | | |

TABLE II (CONTINUED)

600 ° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|----------------------------------|---------------|----------------------------------|---------------|----------------------------------|---------------|
| SPEC. NO. 9 STRESS = 200,000 | | 165,000 | 1.014 | SPEC. NO. 14 STRESS = 255,000 | |
| 10,000 | 0.019 | 190,000 | 1.401 | 10,000 | 0.056 |
| 20,000 | 0.055 | 205,000 | 1.650 | 20,000 | 0.115 |
| 30,000 | 0.088 | SPEC. NO. 12 STRESS = 207,500 | | 30,000 | 0.189 |
| 40,000 | 0.122 | 10,000 | 0.043 | 40,000 | 0.241 |
| 50,000 | 0.189 | 20,000 | 0.092 | 50,000 | 0.284 |
| 60,000 | 0.199 | 30,000 | 0.140 | 60,000 | 0.348 |
| 90,000 | 0.292 | 40,000 | 0.197 | 80,000 | 0.445 |
| 115,000 | 0.404 | 50,000 | 0.247 | 100,000 | 0.550 |
| 140,000 | 0.540 | 60,000 | 0.290 | 115,000 | 0.642 |
| 165,000 | 0.720 | 70,000 | 0.330 | 140,000 | 0.830 |
| 190,000 | 1.021 | 80,000 | 0.394 | 165,000 | 1.050 |
| 200,000 | 1.064 | 90,000 | 0.443 | 190,000 | 1.421 |
| SPEC. NO. 10 STRESS = 202,500 | | 115,000 | 0.593 | 215,000 | 2.380 |
| 10,000 | 0.038 | 140,000 | 0.758 | 225,000 | 3.260 |
| 20,000 | 0.096 | 165,000 | 1.006 | | |
| 30,000 | 0.140 | 190,000 | 1.390 | | |
| 40,000 | 0.202 | 207,500 | 1.758 | | |
| 50,000 | 0.250 | SPEC. NO. 13 STRESS = 210,000 | | | |
| 60,000 | 0.295 | 9,760 | 0.062 | | |
| 70,000 | 0.345 | 20,000 | 0.084 | | |
| 80,000 | 0.387 | 30,000 | 0.106 | | |
| 90,000 | 0.447 | 40,000 | 0.155 | | |
| 115,000 | 0.579 | 50,000 | 0.192 | | |
| 140,000 | 0.756 | 75,000 | 0.241 | | |
| 165,000 | 0.973 | 100,000 | 0.373 | | |
| 190,000 | 1.305 | 125,000 | 0.506 | | |
| 202,500 | 1.457 | 150,000 | 0.666 | | |
| SPEC. NO. 11 STRESS = 205,000 | | 175,000 | 0.889 | | |
| 10,000 | 0.144 | 185,000 | 1.215 | | |
| 20,000 | 0.097 | 195,000 | 1.292 | | |
| 30,000 | 0.148 | 205,000 | 1.650 | | |
| 40,000 | 0.195 | 210,000 | 1.924 | | |
| 50,000 | 0.253 | | | | |
| 60,000 | 0.299 | | | | |
| 70,000 | 0.343 | | | | |
| 80,000 | 0.397 | | | | |
| 90,000 | 0.468 | | | | |
| 115,000 | 0.587 | | | | |
| 140,000 | 0.766 | | | | |

TABLE II (CONTINUED)

800° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|----------------------------------|-----------------|----------------------------------|-----------------|----------------------------------|-----------------|
| SPEC. NO. 15 STRESS = 100,000 | | SPEC. NO. 18 STRESS = 140,000 | | SPEC. NO. 21 STRESS = 160,000 | |
| 9,772 | 0.040 | 9,525 | 0.047 | 10,000 | 0.021 |
| 14,630 | 0.052 | 20,000 | 0.099 | 20,000 | 0.084 |
| 20,000 | 0.071 | 30,000 | 0.147 | 30,000 | 0.131 |
| 30,000 | 0.113 | 40,000 | 0.209 | 40,000 | 0.185 |
| 40,000 | 0.153 | 50,000 | 0.261 | 50,000 | 0.240 |
| 50,000 | 0.187 | 60,000 | 0.323 | 60,000 | 0.298 |
| 60,000 | 0.234 | 70,000 | 0.386 | 70,000 | 0.357 |
| 70,000 | 0.272 | 90,000 | 0.504 | 80,000 | 0.416 |
| 80,000 | 0.310 | 110,000 | 0.633 | 90,000 | 0.483 |
| 90,000 | 0.360 | 130,000 | 0.799 | 115,000 | 0.653 |
| 100,000 | 0.404 | 135,000 | 0.849 | 140,000 | 0.900 |
| SPEC. NO. 16 STRESS = 125,000 | | SPEC. NO. 19 STRESS = 145,000 | | SPEC. NO. 22 STRESS = 165,000 | |
| 9,750 | 0.042 | 10,000 | 0.061 | 10,000 | 0.042 |
| 20,000 | 0.096 | 20,000 | 0.117 | 20,000 | 0.111 |
| 30,000 | 0.141 | 30,000 | 0.170 | 30,000 | 0.163 |
| 40,000 | 0.192 | 40,000 | 0.221 | 40,000 | 0.217 |
| 50,000 | 0.257 | 50,000 | 0.278 | 50,000 | 0.281 |
| 60,000 | 0.310 | 60,000 | 0.325 | 60,000 | 0.321 |
| 70,000 | 0.355 | 70,000 | 0.385 | 70,000 | 0.381 |
| 80,000 | 0.415 | 80,000 | 0.433 | 80,000 | 0.436 |
| 90,000 | 0.474 | 90,000 | 0.503 | 90,000 | 0.508 |
| 100,000 | 0.544 | 115,000 | 0.671 | 115,000 | 0.694 |
| 110,000 | 0.614 | 145,000 | 0.961 | 140,000 | 0.907 |
| 120,000 | 0.649 | SPEC. NO. 20 STRESS = 150,000 | | 165,000 | 1.206 |
| 125,000 | 0.731 | 10,000 | 0.093 | SPEC. NO. 23 STRESS = 170,000 | |
| SPEC. NO. 17 STRESS = 135,000 | | 20,000 | 0.110 | 10,000 | 0.061 |
| 10,000 | 0.043 | 30,000 | 0.163 | 20,000 | 0.114 |
| 20,000 | 0.101 | 40,000 | 0.220 | 30,000 | 0.161 |
| 30,000 | 0.150 | 50,000 | 0.276 | 40,000 | 0.216 |
| 40,000 | 0.213 | 60,000 | 0.324 | 50,000 | 0.261 |
| 50,000 | 0.258 | 70,000 | 0.388 | 60,000 | 0.329 |
| 60,000 | 0.298 | 80,000 | 0.449 | 70,000 | 0.386 |
| 70,000 | 0.347 | 90,000 | 0.508 | 80,000 | 0.441 |
| 80,000 | 0.395 | 115,000 | 0.665 | 90,000 | 0.444 |
| 90,000 | 0.453 | 140,000 | 0.892 | 115,000 | 0.671 |
| 115,000 | 0.614 | 155,000 | 1.033 | 140,000 | 0.845 |
| 135,000 | 0.780 | | | 165,000 | 1.114 |
| | | | | 170,000 | 1.190 |

TABLE II (CONTINUED)

800° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|----------------------------------|---------------|----------------------------------|---------------|----------------------------------|---------------|
| SPEC. NO. 24 STRESS = 175,000 | | 165,000 | 1.360 | 175,000 | 0.963 |
| 9,610 | 0.034 | 180,000 | 1.600 | 185,000 | 1.089 |
| 20,000 | 0.101 | SPEC. NO. 27 STRESS = 185,000 | | 195,000 | 1.352 |
| 30,000 | 0.152 | 10,000 | 0.044 | 200,000 | 1.485 |
| 38,500 | 0.199 | 20,000 | 0.076 | SPEC. NO. 30 STRESS = 205,000 | |
| 50,000 | 0.273 | 30,000 | 0.117 | 10,000 | 0.042 |
| 60,000 | 0.316 | 40,000 | 0.164 | 20,000 | 0.088 |
| 70,000 | 0.379 | 50,000 | 0.202 | 30,000 | 0.153 |
| 87,400 | 0.474 | 60,000 | 0.232 | 40,000 | 0.208 |
| 111,500 | 0.649 | 70,000 | 0.284 | 50,000 | 0.275 |
| 136,000 | 0.865 | 80,000 | 0.322 | 60,000 | 0.314 |
| 160,000 | 1.210 | 90,000 | 0.362 | 70,000 | 0.357 |
| 175,000 | 1.462 | 115,000 | 0.446 | 80,000 | 0.405 |
| SPEC. NO. 25 STRESS = 175,000 | | 140,000 | 0.648 | 90,000 | 0.466 |
| 9,750 | 0.030 | 165,000 | 0.865 | 115,000 | 0.626 |
| 20,000 | 0.072 | 185,000 | 1.150 | 140,000 | 0.830 |
| 30,000 | 0.110 | SPEC. NO. 28 STRESS = 185,000 | | 165,000 | 1.120 |
| 40,000 | 0.150 | 9,750 | 0.043 | 190,000 | 1.595 |
| 50,000 | 0.186 | 20,000 | 0.074 | 205,000 | 1.945 |
| 60,000 | 0.223 | 30,000 | 0.126 | | |
| 70,000 | 0.268 | 40,000 | 0.167 | | |
| 80,000 | 0.310 | 50,000 | 0.208 | | |
| 110,000 | 0.460 | 60,000 | 0.250 | | |
| 140,000 | 0.675 | 90,000 | 0.377 | | |
| 150,000 | 0.745 | 120,000 | 0.565 | | |
| 160,000 | 0.870 | 150,000 | 0.810 | | |
| 170,000 | 1.000 | 170,000 | 1.051 | | |
| 175,000 | 1.045 | 185,000 | 1.305 | | |
| SPEC. NO. 26 STRESS = 180,000 | | SPEC. NO. 29 STRESS = 200,000 | | | |
| 10,000 | 0.031 | 10,000 | 0.034 | | |
| 20,000 | 0.115 | 20,000 | 0.076 | | |
| 30,000 | 0.287 | 30,000 | 0.110 | | |
| 40,000 | 0.344 | 40,000 | 0.147 | | |
| 50,000 | 0.398 | 50,000 | 0.185 | | |
| 60,000 | 0.475 | 60,000 | 0.223 | | |
| 70,000 | 0.525 | 90,000 | 0.348 | | |
| 80,000 | 0.568 | 115,000 | 0.466 | | |
| 90,000 | 0.647 | 140,000 | 0.644 | | |
| 115,000 | 0.811 | 165,000 | 0.885 | | |
| 140,000 | 1.030 | | | | |

TABLE II (CONTINUED)

900° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|
| SPEC. NO. 31 STRESS = 25,000 | | 30,000 | 0.172 | 55,000 | 0.313 |
| 10,025 | 0.049 | 35,000 | 0.200 | 60,000 | 0.341 |
| 14,625 | 0.069 | 40,000 | 0.225 | SPEC. NO. 40 STRESS = 62,500 | |
| 18,000 | 0.095 | 45,000 | 0.261 | 9,700 | 0.041 |
| 20,000 | 0.108 | 50,000 | 0.282 | 14,650 | 0.066 |
| 22,000 | 0.119 | SPEC. NO. 36 STRESS = 52,500 | | 20,000 | 0.091 |
| 24,000 | 0.132 | 9,760 | 0.055 | 30,000 | 0.154 |
| 25,000 | 0.139 | 20,000 | 0.105 | 40,000 | 0.205 |
| SPEC. NO. 32 STRESS = 30,000 | | 30,000 | 0.172 | 50,000 | 0.267 |
| 10,000 | 0.055 | 40,000 | 0.234 | 55,000 | 0.298 |
| 15,000 | 0.072 | 45,000 | 0.261 | 60,000 | 0.325 |
| 20,000 | 0.103 | 50,000 | 0.281 | 62,500 | 0.346 |
| 25,000 | 0.132 | 52,500 | 0.295 | SPEC. NO. 41 STRESS = 65,000 | |
| 30,000 | 0.157 | SPEC. NO. 37 STRESS = 55,000 | | 10,000 | 0.038 |
| SPEC. NO. 33 STRESS = 40,000 | | 9,950 | 0.055 | 20,000 | 0.102 |
| 9,750 | 0.042 | 14,925 | 0.087 | 30,000 | 0.152 |
| 14,600 | 0.069 | 20,000 | 0.111 | 40,000 | 0.218 |
| 20,000 | 0.103 | 30,000 | 0.160 | 50,000 | 0.273 |
| 25,000 | 0.127 | 40,000 | 0.227 | 60,000 | 0.326 |
| 30,000 | 0.154 | 50,000 | 0.277 | 65,000 | 0.377 |
| 35,000 | 0.190 | 55,000 | 0.314 | SPEC. NO. 42 STRESS = 67,500 | |
| 40,000 | 0.222 | SPEC. NO. 38 STRESS = 57,500 | | 10,000 | 0.057 |
| SPEC. NO. 34 STRESS = 45,000 | | 9,750 | 0.061 | 20,000 | 0.100 |
| 10,000 | 0.042 | 14,600 | 0.081 | 30,000 | 0.157 |
| 15,000 | 0.068 | 20,000 | 0.114 | 40,000 | 0.222 |
| 20,000 | 0.112 | 30,000 | 0.170 | 50,000 | 0.284 |
| 25,000 | 0.126 | 40,000 | 0.229 | 60,000 | 0.340 |
| 30,000 | 0.159 | 50,000 | 0.282 | 67,500 | 0.387 |
| 35,000 | 0.175 | 55,000 | 0.317 | SPEC. NO. 39 STRESS = 60,000 | |
| 40,000 | 0.210 | 57,500 | 0.334 | 9,525 | 0.045 |
| 45,000 | 0.244 | SPEC. NO. 35 STRESS = 50,000 | | 14,280 | 0.071 |
| 9,750 | 0.054 | 20,000 | 0.106 | 30,000 | 0.163 |
| 15,000 | 0.090 | 30,000 | 0.163 | 40,000 | 0.216 |
| 20,000 | 0.110 | 40,000 | 0.216 | 50,000 | 0.275 |
| 25,000 | 0.151 | 50,000 | 0.275 | | |

TABLE II (CONTINUED)

900 ° F

| STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) | STRESS (PSI) | STRAIN (%) |
|---------------------------------|---------------|---------------------------------|---------------|----------------------------------|---------------|
| SPEC. NO. 43 STRESS = 70,000 | | 60,000 | 0.335 | SPEC. NO. 50 STRESS = 95,000 | |
| 10,000 | 0.028 | 70,000 | 0.399 | 10,000 | 0.041 |
| 20,000 | 0.108 | 75,000 | 0.422 | 20,000 | 0.111 |
| 30,000 | 0.161 | 77,500 | 0.444 | 30,000 | 0.171 |
| 40,000 | 0.218 | SPEC. NO. 47 STRESS = 80,000 | | 40,000 | 0.224 |
| 45,000 | 0.241 | 10,000 | 0.038 | 50,000 | 0.283 |
| 50,000 | 0.275 | 20,000 | 0.086 | 60,000 | 0.346 |
| 55,000 | 0.298 | 30,000 | 0.123 | 70,000 | 0.403 |
| 60,000 | 0.336 | 40,000 | 0.165 | 80,000 | 0.446 |
| 65,000 | 0.365 | 50,000 | 0.213 | 90,000 | 0.528 |
| 70,000 | 0.397 | 60,000 | 0.258 | 95,000 | 0.556 |
| SPEC. NO. 44 STRESS = 72,500 | | 70,000 | 0.298 | SPEC. NO. 51 STRESS = 100,000 | |
| 9,750 | 0.039 | 80,000 | 0.333 | 9,760 | 0.054 |
| 14,600 | 0.068 | SPEC. NO. 48 STRESS = 85,000 | | 14,600 | 0.074 |
| 20,000 | 0.099 | 9,750 | 0.028 | 20,000 | 0.109 |
| 30,000 | 0.162 | 14,620 | 0.048 | 30,000 | 0.162 |
| 40,000 | 0.214 | 20,000 | 0.099 | 40,000 | 0.225 |
| 50,000 | 0.277 | 30,000 | 0.155 | 50,000 | 0.279 |
| 60,000 | 0.331 | 40,000 | 0.225 | 60,000 | 0.338 |
| 65,000 | 0.374 | 50,000 | 0.299 | 70,000 | 0.397 |
| 70,000 | 0.400 | 60,000 | 0.340 | 80,000 | 0.468 |
| 72,500 | 0.417 | 70,000 | 0.390 | 90,000 | 0.530 |
| SPEC. NO. 45 STRESS = 75,000 | | 80,000 | 0.469 | 100,000 | 0.614 |
| 10,000 | 0.045 | 85,000 | 0.498 | | |
| 20,000 | 0.097 | SPEC. NO. 49 STRESS = 90,000 | | | |
| 30,000 | 0.153 | 10,000 | 0.040 | | |
| 40,000 | 0.210 | 20,000 | 0.092 | | |
| 50,000 | 0.273 | 30,000 | 0.145 | | |
| 60,000 | 0.336 | 40,000 | 0.214 | | |
| 68,000 | 0.393 | 50,000 | 0.255 | | |
| 75,000 | 0.444 | 60,000 | 0.327 | | |
| SPEC. NO. 46 STRESS = 77,500 | | 70,000 | 0.385 | | |
| 9,750 | 0.042 | 80,000 | 0.435 | | |
| 14,600 | 0.073 | 90,000 | 0.513 | | |
| 20,000 | 0.091 | | | | |
| 30,000 | 0.143 | | | | |
| 40,000 | 0.211 | | | | |
| 50,000 | 0.271 | | | | |

TABLE 12
CREEP DEFORMATION AND RUPTURE DATA FOR UNIMACH 2 (THERMOLD J) STEEL

600°F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS.) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|--|--------|--------|--------|-------|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % |
| A - 108 | 90,000 | — | — | 0.38 | — | — | — | — | — |
| A - 92 | 110,000 | — | 0.53 | 0.41 | 220 | — | — | — | — |
| A - 113 | 120,000 | — | 0.06 | 0.44 | 20 | — | — | — | — |
| A - 99 | 135,000 | — | 0.103 | 0.51 | 19 | 1035 | — | — | — |
| A - 23 | 140,000 | — | 0.14 | 0.52 | 10 | 70 | — | — | — |
| A - 107 | 140,000 | — | 0.07 | 0.52 | 25 | — | — | — | — |
| A - 77 | 160,000 | — | 0.103 | 0.62 | 12 | 850 | — | — | — |
| A - 89 | 160,000 | — | 0.065 | 0.62 | 30 | — | — | — | — |
| A - 25 | 180,000 | — | 0.133 | 0.74 | 9 | 95 | — | — | — |
| A - 20 | 180,000 | — | 0.09 | 0.74 | 90 | — | — | — | — |
| A - 79 | 190,000 | — | 0.16 | 0.83 | 1.2 | 66.8 | — | — | — |
| A - 114 | 200,000 | — | 0.17 | 0.91 | 0.3 | 23 | — | — | — |
| A - 83 | 200,000 | — | 0.20 | 0.91 | 0.2 | 24.3 | — | — | — |
| A - 54 | 220,000 | — | 0.13 | 1.40 | 0.6 | 20 | — | — | — |
| A - 62 | 220,000 | — | 0.22 | 1.20 | 0.1 | 1.1 | — | — | — |
| A - 52 | 230,000 | — | 0.25 | 1.41 | — | 0.5 | — | — | — |
| A - 21 | 230,000 | — | 0.32 | 1.53 | — | 0.2 | 510 | — | — |
| A - 95 | 235,000 | — | 0.33 | 1.65 | — | 0.7 | 295 | — | — |
| A - 91 | 235,000 | — | 0.27 | 1.47 | — | 0.2 | — | — | — |
| A - 30 | 240,000 | — | 0.40 | 1.80 | — | 0.2 | 195 | — | — |
| A - 19 | 250,000 | — | 0.49 | 2.30 | — | 0.1 | 46 | 1275 | — |
| A - 58 | 255,000 | — | 0.51 | 2.77 | — | — | 12.5 | 278 | — |
| A - 32 | 260,000 | — | 0.66 | 2.76 | — | — | 0.4 | 33 | — |
| A - 101 | 265,000 | — | 0.91 | 3.24 | — | — | — | 2.5 | — |
| A - 100 | 268,000 | — | 0.80 | 4.70 | — | — | — | 2.0 | — |
| A - 123 | 268,000 | — | 0.63 | 2.81 | — | — | — | — | 463 |
| A - 37 | 269,000 | ON LOAD. | 6.0 | — | — | — | — | — | — |
| A - 29 | 270,000 | ON LOAD. | 3.0 | — | — | — | — | — | — |
| A - 118 | 227,000 | — | 0.31 | 1.37 | — | 11 | 2250 | — | — |

TABLE 12 (CONTINUED)

800° F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS.) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|--|--------|--------|--------|-------|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % |
| A - 116 | 30,000 | — | 0.028 | 0.12 | — | — | — | — | — |
| A - 121 | 35,000 | — | 0.057 | 0.14 | 930 | — | — | — | — |
| A - 74 | 70,000 | — | 0.11 | 0.27 | 235 | 988 | — | — | — |
| A - 75 | 70,000 | — | 0.11 | 0.27 | 14 | 625 | — | — | — |
| A - 122 | 90,000 | — | 0.19 | 0.35 | 110 | 630 | — | — | — |
| A - 109 | 115,000 | — | 0.24 | 0.45 | 2.3 | 34 | — | — | — |
| A - 80 | 130,000 | — | 0.26 | 0.53 | 1.0 | 3.5 | — | — | — |
| A - 65 | 135,000 | 819.1 | 0.65 | 0.55 | 2.0 | 30 | — | — | — |
| A - 57 | 140,000 | — | 0.31 | 0.58 | 0.5 | 2.2 | 560 | — | — |
| A - 59 | 150,000 | 217.4 | 2.0 | 0.64 | 0.5 | 2.5 | — | — | — |
| A - 63 | 160,000 | — | 0.47 | 0.70 | 0.1 | 0.5 | 60 | — | — |
| A - 66 | 170,000 | 348.4 | 1.35 | 0.78 | — | 0.1 | 33 | 328 | — |
| A - 53 | 180,000 | — | 0.66 | 0.86 | 0.4 | 1.3 | 60 | 550 | — |
| A - 96 | 185,000 | 204.1 | 2.5 | 0.90 | — | — | 12 | 120 | — |
| A - 90 | 185,000 | 252.8 | 1.5 | 1.01 | — | — | 17 | — | — |
| A - 105 | 190,000 | 97.6 | 3.0 | 1.05 | — | — | 8 | 85 | — |
| A - 24 | 200,000 | 135.8 | 3.5 | 1.32 | — | — | 4 | 23 | — |
| A - 27 | 220,000 | 125.8 | 2.5 | 1.73 | — | — | 1.0 | 6.0 | — |
| A - 69 | 222,000 | 31.5 | 3.0 | 1.80 | — | — | 0.4 | 3.0 | — |
| A - 51 | 225,000 | 24.3 | 4.0 | 1.60 | — | — | 0.3 | 1.9 | — |
| A - 34 | 230,000 | 60.3 | 4.5 | 2.25 | — | — | 0.7 | 1.7 | 21 |
| A - 40 | 240,000 | 54.3 | 10.0 | 7.0 | — | — | 0.25 | 0.5 | 7 |
| A - 76 | 250,000 | 5.3 | — | 5.4 | — | — | 0.1 | 0.3 | 1.6 |
| A - 120 | 251,000 | 1.9 | 9.0 | 4.7 | — | — | — | — | 0.1 |

TABLE 12 (CONTINUED)

900° F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS.) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|--|--------|--------|--------|-------|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % |
| A - 98 | 8,000 | — | 0.60 | 0.03 | 750 | — | — | — | — |
| A - 72 | 15,000 | — | 0.055 | 0.06 | 400 | — | — | — | — |
| A - 67 | 15,000 | — | 0.13 | 0.06 | 220 | 810 | — | — | — |
| A - 78 | 25,000 | — | 0.27 | 0.09 | 83 | 360 | — | — | — |
| A - 56 | 35,000 | — | 0.22 | 0.14 | 92 | 300 | — | — | — |
| A - 87 | 40,000 | — | 0.315 | 0.16 | 30 | 243 | 1015 | — | — |
| A - 43 | 50,000 | — | 0.42 | 0.19 | 77 | 254 | 752 | 1125 | — |
| A - 41 | 60,000 | — | 0.59 | 0.24 | 12 | 72 | 487 | 883 | — |
| A - 86 | 90,000 | — | 1.16 | 0.36 | 11.3 | 46.3 | 253 | 442 | 765 |
| A - 35 | 110,000 | — | 0.95 | 0.45 | 1.4 | 4.7 | 88 | 207 | 405 |
| A - 49 | 115,000 | 296.5 | 1.5 | 0.48 | 3.1 | 12.2 | 109 | 216 | — |
| A - 73 | 115,000 | 221.8 | — | 0.48 | 1.7 | 7.0 | 89 | 203 | — |
| A - 68 | 120,000 | — | 1.03 | 0.50 | 0.3 | 1.5 | 63 | 187 | 408 |
| A - 22 | 130,000 | 134.8 | 3.0 | 0.55 | 0.5 | 2.3 | 37 | 121 | — |
| A - 46 | 130,000 | — | 1.19 | 0.55 | 0.5 | 2.2 | 41.7 | 109 | 236 |
| A - 38 | 135,000 | 219.0 | 1.2 | 0.58 | 0.3 | 2.0 | 38 | 110 | — |
| A - 82 | 140,000 | — | 1.08 | 0.61 | 0.5 | 1.5 | 22 | 92 | 234 |
| A - 97 | 150,000 | 183.5 | 2.12 | 0.67 | 0.3 | 1.0 | 14 | 56.5 | 149 |
| A - 111 | 155,000 | — | 1.24 | 0.70 | 0.1 | 0.4 | 10.8 | 38.5 | 110 |
| A - 26 | 160,000 | 90.8 | 1.0 | 0.73 | 0.2 | 1.0 | 9.0 | 39.5 | — |
| A - 71 | 170,000 | 60.2 | 8.5 | 0.82 | 0.2 | 0.9 | 6.5 | 24 | — |
| A - 42 | 175,000 | 18.4 | 1.0 | 0.86 | — | 0.1 | 1.7 | 12.5 | — |
| A - 103 | 180,000 | 68.8 | 4.5 | 0.91 | 0.1 | 0.2 | 2.0 | 8.5 | 45 |
| A - 64 | 185,000 | 29.2 | 1.5 | 1.00 | — | 0.2 | 2.0 | 7.0 | 40 |
| A - 33 | 187,000 | 35.8 | 2.5 | 1.05 | — | — | 1.5 | 5.6 | 24.8 |
| A - 93 | 195,000 | 21.5 | 3.5 | 1.15 | 0.1 | 0.2 | 0.8 | 3.0 | 17.2 |
| A - 84 | 200,000 | 12.1 | 3.0 | 1.31 | — | 0.1 | 0.5 | 2.2 | 9.5 |
| A - 117 | 205,000 | 9.6 | 3.5 | 1.49 | — | 0.1 | 0.4 | 1.0 | 4.8 |
| AT- 15 | 6,000 | — | 0.10 | 0.02 | 940 | 1500 | — | — | — |
| A - 44 | 70,000 | — | 1.14 | 0.28 | 10 | 70 | 437 | 763 | 1295 |

TABLE 13
CREEP DEFORMATION AND RUPTURE DATA FOR 17-22A(S) STEEL

800°F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|---|-------|-------|-------|------|
| | | | | | 0.05% | 0.10% | 0.30% | 0.50% | 1.0% |
| 1 - 62 | 72,500 | — | 0.07 | 0.29 | 800 | — | — | — | — |
| 1 - 122 | 77,000 | — | 0.11 | 0.32 | 460 | 1180 | — | — | — |
| 1 - 139 | 80,000 | — | 0.07 | 0.34 | 240 | — | — | — | — |
| 1 - 87 | 82,000 | 862.1 | 12.0 | 0.35 | 40 | 660 | — | — | — |
| 1 - 146 | 88,000 | — | 0.13 | 0.39 | 3.0 | 55 | — | — | — |
| 1 - 90 | 95,000 | — | 0.25 | 0.44 | 1.1 | 13 | — | — | — |
| 1 - 74 | 96,000 | — | 0.30 | 0.45 | 1.3 | 10 | 1055 | — | — |
| 1 - 41 | 97,000 | — | 0.33 | 0.46 | 0.4 | 3 | 600 | — | — |
| 1 - 43 | 99,000 | — | 0.34 | 0.49 | 0.6 | 8.5 | 580 | — | — |
| 1 - 132 | 107,500 | — | 0.47 | 0.63 | 0.1 | 0.9 | 105 | — | — |
| 1 - 136 | 111,000 | — | 0.58 | 0.70 | 0.3 | 1.5 | 25 | 485 | — |
| 1 - 96 | 118,000 | — | 1.07 | 0.66 | 0.1 | 0.2 | 5.0 | 24 | 777 |
| 1 - 105 | 120,000 | — | 1.72 | 0.76 | — | 0.1 | 0.8 | 4.2 | 50 |
| 1 - 49 | 122,000 | 26.1 | 11.5 | 0.92 | — | — | — | 0.2 | 1.0 |
| 1 - 61 | 123,000 | 4.3 | 12.3 | 2.06 | — | — | — | 0.1 | 0.3 |
| 1 - 24 | 125,000 | ON LOAD | 10.0 | — | — | — | — | — | — |
| 1 - 35 | 130,000 | 0.1 | 11.3 | 4.63 | — | — | — | — | — |

1000°F

| | | | | | | | | | |
|---------|--------|------|------|------|------|------|-----|------|-----|
| 1 - 89 | 10,000 | — | 0.05 | 0.05 | 1120 | — | — | — | — |
| 1 - 152 | 15,000 | — | 0.10 | 0.08 | 350 | 1410 | — | — | — |
| 1 - 118 | 20,000 | — | 0.10 | 0.11 | 130 | 520 | — | — | — |
| 1 - 110 | 30,000 | — | 0.27 | 0.16 | 23 | 150 | — | — | — |
| 1 - 82 | 32,500 | — | 0.54 | 0.18 | 14 | 57 | 750 | 1790 | — |
| 1 - 119 | 40,000 | — | 0.66 | 0.22 | 10 | 31 | 360 | 775 | — |
| 1 - 100 | 45,500 | — | 1.28 | 0.25 | 2 | 6 | 145 | 370 | 935 |
| 1 - 88 | 50,000 | — | 1.10 | 0.28 | 2 | 10 | 86 | 244 | 618 |
| 1 - 86 | 60,000 | — | 3.66 | 0.33 | 0.2 | 1.3 | 33 | 94 | 286 |
| 1 - 111 | 70,000 | — | 2.44 | 0.40 | 0.1 | 0.5 | 10 | 29 | 88 |
| 1 - 130 | 82,000 | 52.6 | 14.0 | 0.51 | — | 0.2 | 1.4 | 4.1 | 13 |
| 1 - 114 | 85,000 | 47.0 | 10.5 | 0.55 | — | 0.1 | 0.9 | 2.8 | 10 |
| 1 - 67 | 90,000 | 1.2 | 14.7 | 0.65 | — | — | — | — | 0.2 |

TABLE 13 (CONT INUED)

1050 ° F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|---|--------|--------|--------|-------|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % |
| 1 - 48 | 2,000 | — | 0.05 | 0.01 | 1570 | — | — | — | — |
| 1 - 145 | 5,000 | — | 0.06 | 0.03 | 750 | — | — | — | — |
| 1 - 113 | 9,000 | — | 0.11 | 0.05 | 260 | 1130 | — | — | — |
| 1 - 80 | 10,000 | — | 0.09 | 0.05 | 220 | — | — | — | — |
| 1 - 112 | 11,000 | — | 0.11 | 0.06 | 122 | 910 | — | — | — |
| 1 - 158 | 15,000 | — | 0.10 | 0.08 | 24 | 209 | — | — | — |
| 1 - 39 | 15,500 | — | 0.33 | 0.08 | 34 | 170 | 1805 | — | — |
| 1 - 135 | 20,000 | — | 0.29 | 0.11 | 19 | 123 | — | — | — |
| 1 - 26 | 22,000 | — | 0.51 | 0.12 | 19 | 63 | 455 | 1005 | — |
| 1 - 94 | 25,000 | — | 0.54 | 0.13 | 5.0 | 17 | 330 | 885 | — |
| 1 - 116 | 32,000 | — | 1.01 | 0.17 | 2.0 | 11 | 153 | 425 | 1065 |
| 1 - 125 | 37,000 | — | 1.39 | 0.19 | 0.9 | 8.0 | 118 | 278 | 570 |
| 1 - 109 | 45,000 | — | 1.72 | 0.24 | 0.5 | 2.0 | 26 | 62 | 158 |
| 1 - 84 | 50,000 | 190.6 | 3.35 | 0.26 | 0.3 | 1.5 | 17 | 36 | 110 |
| 1 - 153 | 55,000 | — | 1.31 | 0.29 | 0.2 | 0.8 | 10 | 22 | 55 |
| 1 - 68 | 65,000 | 17.9 | 14.5 | 0.38 | — | — | 0.3 | 1.0 | 3.1 |
| 1 - 75 | 70,000 | 4.3 | 18.0 | 0.42 | — | — | 0.1 | 0.3 | 0.8 |

TABLE 14
CREEP DEFORMATION AND RUPTURE DATA FOR POTOMAC M STEEL

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS) | | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|---|--------|--------|--------|-------|-----|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % | |
| 600° F | | | | | | | | | | |
| 1 | 55,000 | — | — | — | — | — | — | — | — | — |
| 2 | 65,000 | — | — | — | — | — | — | — | — | — |
| 3 | 150,000 | — | — | — | — | — | — | — | — | — |
| 4 | 200,000 | — | — | 0.637 | — | — | — | — | — | — |
| 5 | 215,000 | — | — | 1.293 | — | — | 0.3 | — | — | — |
| 6 | 225,000 | — | — | 1.560 | — | — | — | — | — | — |
| 7 | 230,000 | — | — | 1.685 | — | — | — | — | — | — |
| 8 | 235,000 | — | — | 1.410 | — | — | 0.1 | — | — | — |
| 9 | 240,000 | — | — | 1.860 | — | — | — | — | — | 300 |
| 9 | 240,000 | — | — | 2.510 | — | — | — | — | — | — |
| 800° F | | | | | | | | | | |
| 10 | 55,000 | — | — | 0.221 | 65.0 | 970.0 | — | — | — | — |
| 11 | 65,000 | — | — | 0.251 | 680.0 | — | — | — | — | — |
| 12 | 76,000 | — | — | 0.387 | — | 10.0 | — | — | — | — |
| 13 | 100,000 | — | — | 0.564 | 9.0 | 83.0 | — | — | — | — |
| 14 | 140,000 | 40.1 | 1.9 | ? | — | — | — | — | — | — |
| 15 | 150,000 | 40.3 | 2.1 | ? | — | — | — | — | — | — |
| 16 | 160,000 | 496.3 | 2.3 | 0.900 | — | — | 500.0 | — | — | — |
| 17 | 160,000 | 70.4 | 1.0 | ? | — | — | — | — | — | — |
| 18 | 170,000 | 240.1 | 2.0 | 1.040 | — | — | 60.0 | — | — | — |
| 19 | 180,000 | — | — | 1.272 | — | — | 1.6 | — | — | — |
| 20 | 200,000 | 138.7 | 1.8 | 1.223 | — | — | 0.12 | — | 32.0 | — |

TABLE 14 (CONTINUED)

1000° F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|---|--------|--------|--------|--------|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % |
| 21 | 10,000 | — | — | — | 25.0 | 180.0 | — | — | — |
| 22 | 15,000 | — | — | — | 9.5 | 64.0 | 830.0 | — | — |
| 23 | 20,000 | — | — | — | 4.4 | 28.0 | 260.0 | 560.0 | — |
| 24 | 25,000 | — | — | 0.136 | 1.6 | 14.0 | 195.0 | 490.0 | — |
| 25 | 30,000 | — | — | 0.175 | 1.1 | 11.0 | 180.0 | 500.0 | 1190.0 |
| 26 | 32,500 | — | — | 0.199 | 9.0 | 27.0 | 160.0 | 480.0 | — |
| 27 | 35,000 | — | — | 0.211 | 5.5 | 22.0 | 159.0 | 370.0 | 750.0 |
| 28 | 40,000 | — | — | 0.260 | 3.0 | 10.5 | 53.0 | 140.0 | 410.0 |
| 29 | 42,500 | — | — | 0.284 | 2.4 | 10.0 | 90.0 | 250.0 | 880.0 |
| 30 | 45,000 | — | — | 0.255 | 2.0 | 7.0 | 64.0 | 175.0 | 630.0 |
| 31 | 50,000 | — | — | 0.308 | 2.1 | 9.0 | 53.0 | 125.0 | 480.0 |
| 32 | 55,000 | — | — | 0.321 | 2.5 | 6.6 | 43.0 | 81.0 | 190.0 |
| 33 | 70,000 | — | — | 0.426 | 1.5 | 4.5 | 25.0 | 54.0 | 150.0 |

TABLE 15
CREEP DEFORMATION AND RUPTURE DATA FOR USS Mo V STEEL

600 ° F

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|---|--------|--------|--------|--------|
| | | | | | 0.05 % | 0.10 % | 0.30 % | 0.50 % | 1.0 % |
| 1 | 150,000 | — | — | 0.676 | — | — | — | — | — |
| 2 | 175,000 | — | — | 0.894 | — | — | 330.0 | — | — |
| 3 | 180,000 | — | — | 0.939 | — | — | 100.0 | — | — |
| 4 | 185,000 | — | — | 1.340 | — | — | 312.0 | — | — |
| 5 | 190,000 | — | — | 1.320 | — | — | — | — | — |
| 6 | 192,500 | — | — | 1.560 | — | — | — | — | — |
| 7 | 195,000 | — | — | 1.372 | — | — | — | 540.0 | — |
| 8 | 197,500 | — | — | 1.559 | — | — | — | — | — |
| 9 | 200,000 | — | — | 1.064 | — | — | — | — | 1150.0 |
| 10 | 202,500 | — | — | 1.457 | — | — | — | — | — |
| 11 | 205,000 | — | — | 1.650 | — | — | — | — | — |
| 12 | 207,500 | — | — | 1.758 | — | — | — | — | — |
| 13 | 210,000 | — | — | 1.924 | — | — | — | — | — |
| 14 | 225,000 | — | — | 3.260 | — | — | — | — | — |

800 ° F

| | | | | | | | | | |
|----|---------|-------|-----|-------|------|-------|-------|-------|-----|
| 15 | 100,000 | — | — | 0.404 | 14.0 | 200.0 | — | — | — |
| 16 | 125,000 | — | — | 0.731 | — | 56.0 | — | — | — |
| 17 | 135,000 | 138.9 | 1.2 | 0.780 | — | — | — | — | — |
| 18 | 140,000 | — | — | 0.893 | — | — | 470.0 | — | — |
| 19 | 145,000 | 530.7 | 2.7 | 0.961 | — | — | 300.0 | — | — |
| 20 | 155,000 | 114.1 | 1.6 | 1.033 | — | — | 63.0 | — | — |
| 21 | 160,000 | 103.5 | 2.5 | 1.180 | — | — | — | — | — |
| 22 | 165,000 | 270.7 | 2.0 | 1.206 | — | — | — | 225.0 | — |
| 23 | 170,000 | 186.8 | 1.5 | 1.190 | — | — | — | — | — |
| 24 | 175,000 | 175.8 | 2.4 | 1.462 | — | — | — | — | — |
| 25 | 175,000 | 103.8 | 1.7 | 1.045 | — | — | — | — | 5.0 |

TABLE 15 (CONTINUED)

600° F (CONT'D)

| SPECIMEN NUMBER | STRESS (PSI) | RUPTURE TIME (HRS) | ELONGATION (% IN 2") | DEFORMATION ON LOADING (%) | TIME TO REACH INDICATED DEFORMATION (HRS) | | | | |
|-----------------|--------------|--------------------|----------------------|----------------------------|---|-------|-------|-------|------|
| | | | | | 0.05% | 0.10% | 0.30% | 0.50% | 1.0% |
| 26 | 180,000 | 102.0 | 2.3 | 1.600 | — | — | — | 2.5 | — |
| 27 | 185,000 | 92.1 | 2.4 | 1.150 | — | — | — | 6.5 | — |
| 28 | 185,000 | 116.6 | 1.8 | 1.305 | — | — | — | — | — |
| 29 | 200,000 | 36.8 | 1.3 | 1.485 | — | — | — | — | — |
| 30 | 205,000 | — | — | 1.945 | — | — | — | — | — |

900° F

| | | | | | | | | | |
|----|---------|------|-----|-------|------|-------|-------|-------|-------|
| 31 | 25,000 | — | — | 0.139 | 53.0 | 109.0 | 520.0 | — | — |
| 32 | 30,000 | — | — | 0.157 | 55.0 | 94.0 | 370.0 | — | — |
| 33 | 40,000 | — | — | 0.222 | 19.0 | 54.0 | 150.0 | 290.0 | — |
| 34 | 45,000 | — | — | 0.244 | 25.0 | 64.0 | 185.0 | 410.0 | — |
| 35 | 50,000 | — | — | 0.282 | 30.0 | 62.0 | 180.0 | 340.0 | — |
| 36 | 52,500 | — | — | 0.295 | 13.9 | 24.0 | 75.0 | 145.0 | 640.0 |
| 37 | 55,000 | — | — | 0.314 | 29.0 | 75.0 | 270.0 | 580.0 | — |
| 38 | 57,500 | — | — | 0.334 | 17.5 | 39.0 | 111.0 | 200.0 | 720.0 |
| 39 | 60,000 | — | — | 0.341 | 14.5 | 39.0 | 115.0 | 192.0 | 660.0 |
| 40 | 62,500 | — | — | 0.346 | 9.3 | 27.0 | 90.0 | 140.0 | 400.0 |
| 41 | 65,000 | — | — | 0.377 | 18.5 | 37.0 | 94.0 | 153.0 | 470.0 |
| 42 | 67,500 | — | — | 0.387 | 6.5 | 21.0 | 76.0 | 134.0 | 400.0 |
| 43 | 70,000 | — | — | 0.397 | 7.5 | 23.0 | 78.0 | 150.0 | 425.0 |
| 44 | 72,500 | — | — | 0.417 | 7.4 | 28.0 | 80.0 | 160.0 | 500.0 |
| 45 | 75,000 | — | — | 0.444 | — | 10.0 | 55.0 | 90.0 | 220.0 |
| 46 | 77,500 | — | — | 0.444 | 3.6 | 17.0 | 76.0 | 122.0 | 260.0 |
| 47 | 80,000 | — | — | 0.333 | 6.5 | 22.0 | 92.0 | 155.0 | 340.0 |
| 48 | 85,000 | — | — | 0.495 | 2.4 | 9.0 | 38.0 | 74.0 | 108.0 |
| 49 | 90,000 | — | — | 0.513 | 0.4 | 4.8 | 47.0 | 86.0 | 172.0 |
| 50 | 95,000 | — | — | 0.556 | 8.4 | 23.5 | 74.0 | 108.0 | 180.0 |
| 51 | 100,000 | 91.1 | 2.2 | 0.614 | — | 0.5 | 42.0 | 81.0 | — |

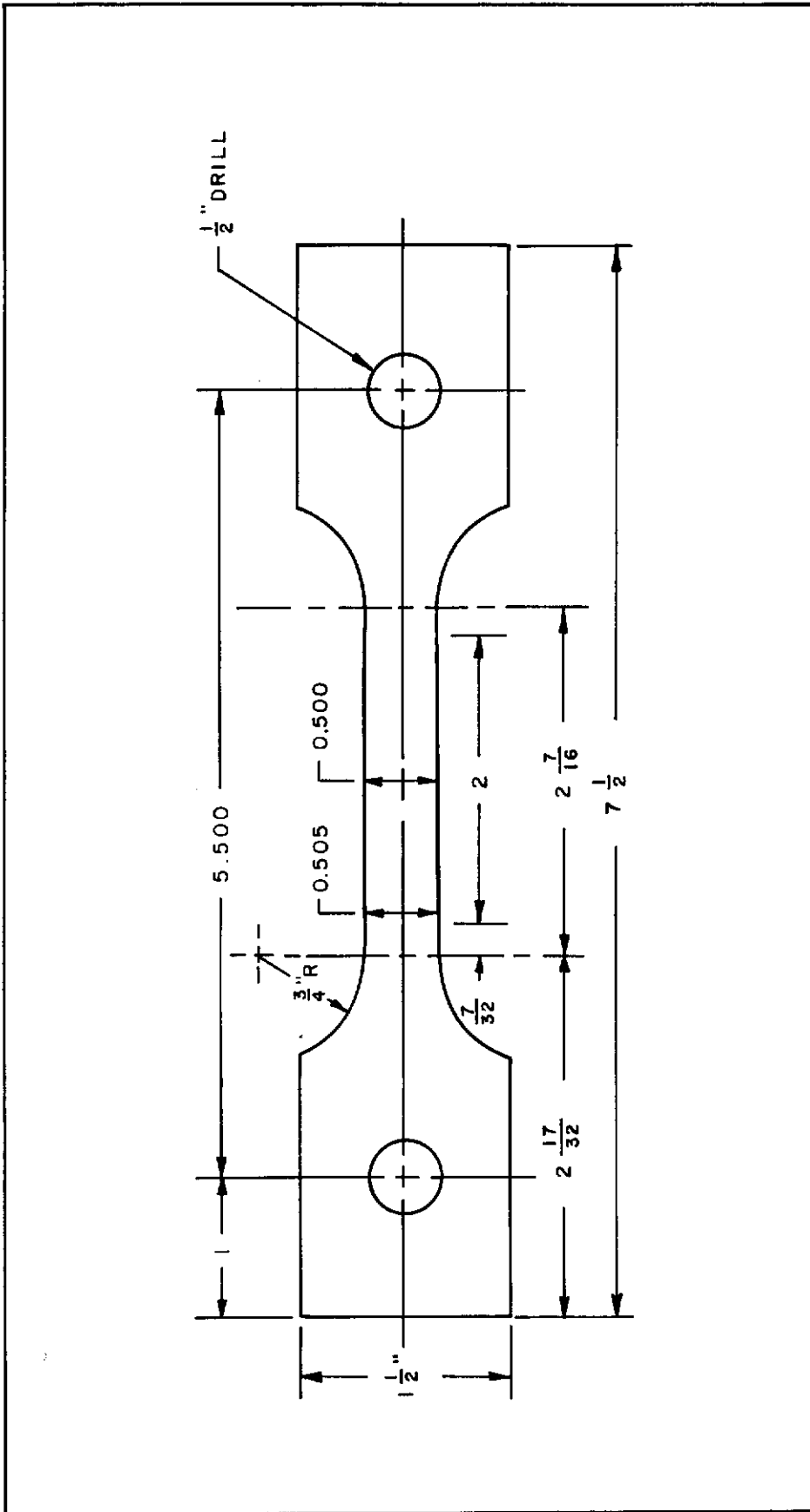


Figure 1. Sheet Tensile Specimen Used by Metcut Research Associates on Unimach 2 (Thermold J) and 17-22A (S)

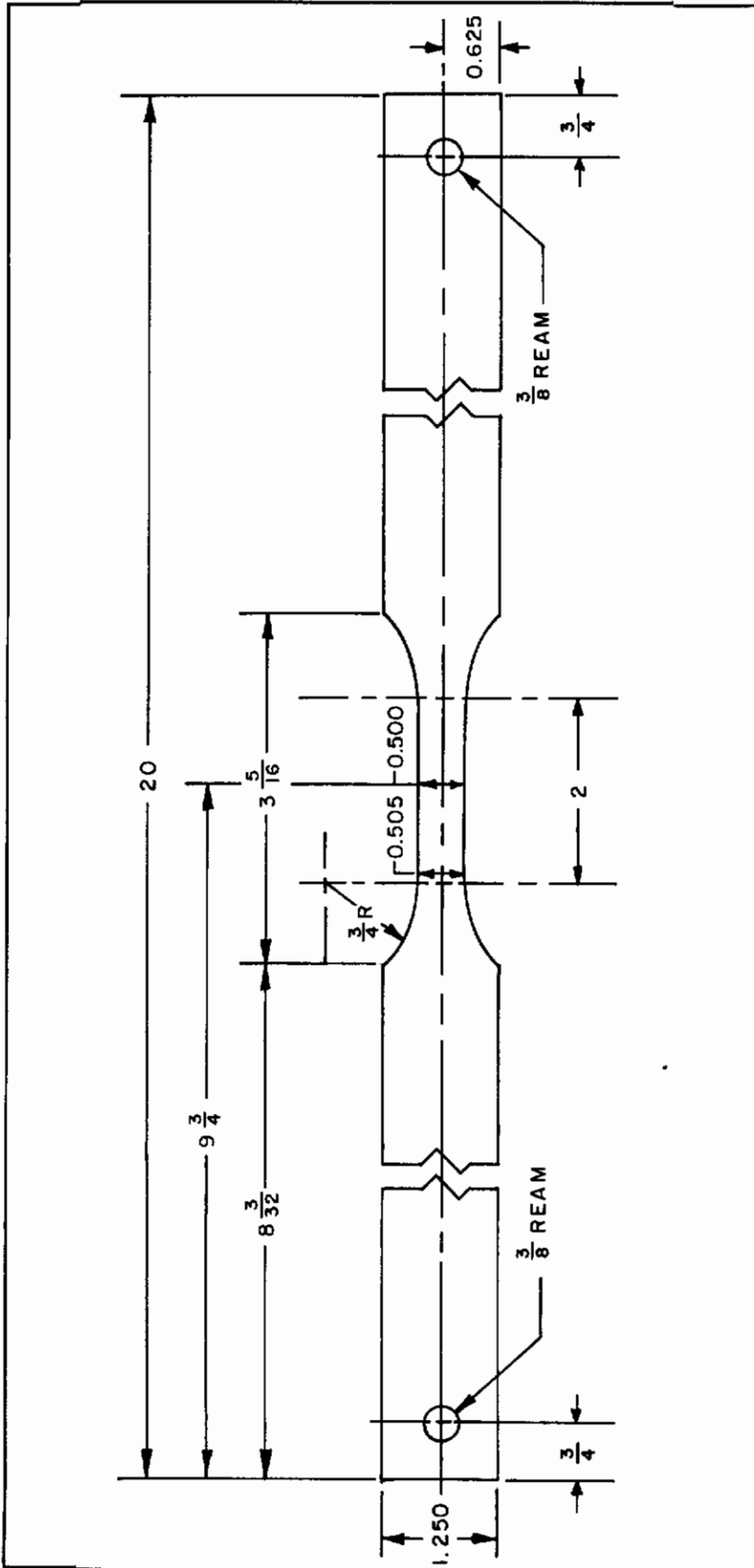


Figure 2. Sheet Creep Specimen Used by Metcut Research Associates on Unimach 2 (Thermold J) and 17-22A (S)

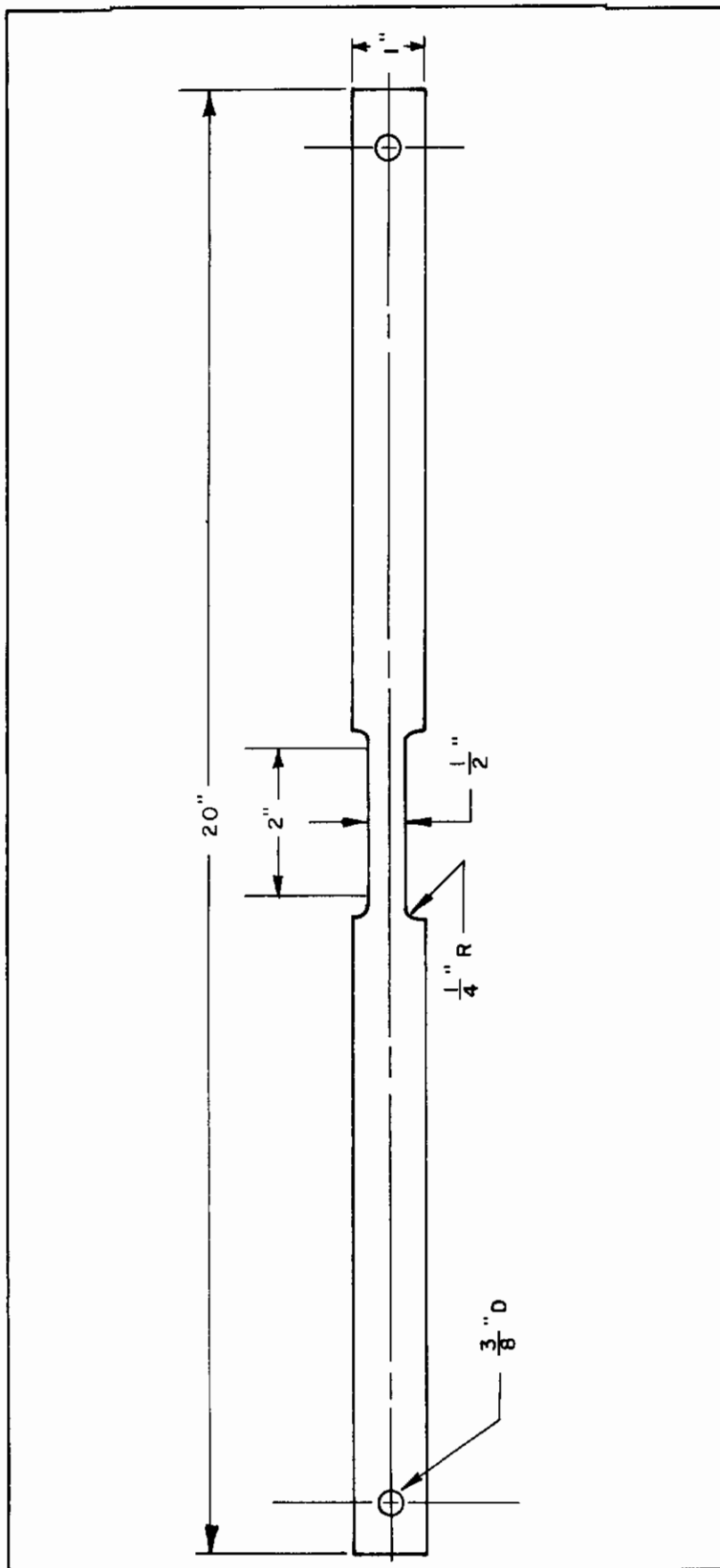


Figure 3. Sheet Creep and Tensile Specimen Used by New England Materials Laboratory on Potomac M and USS 12 MoV

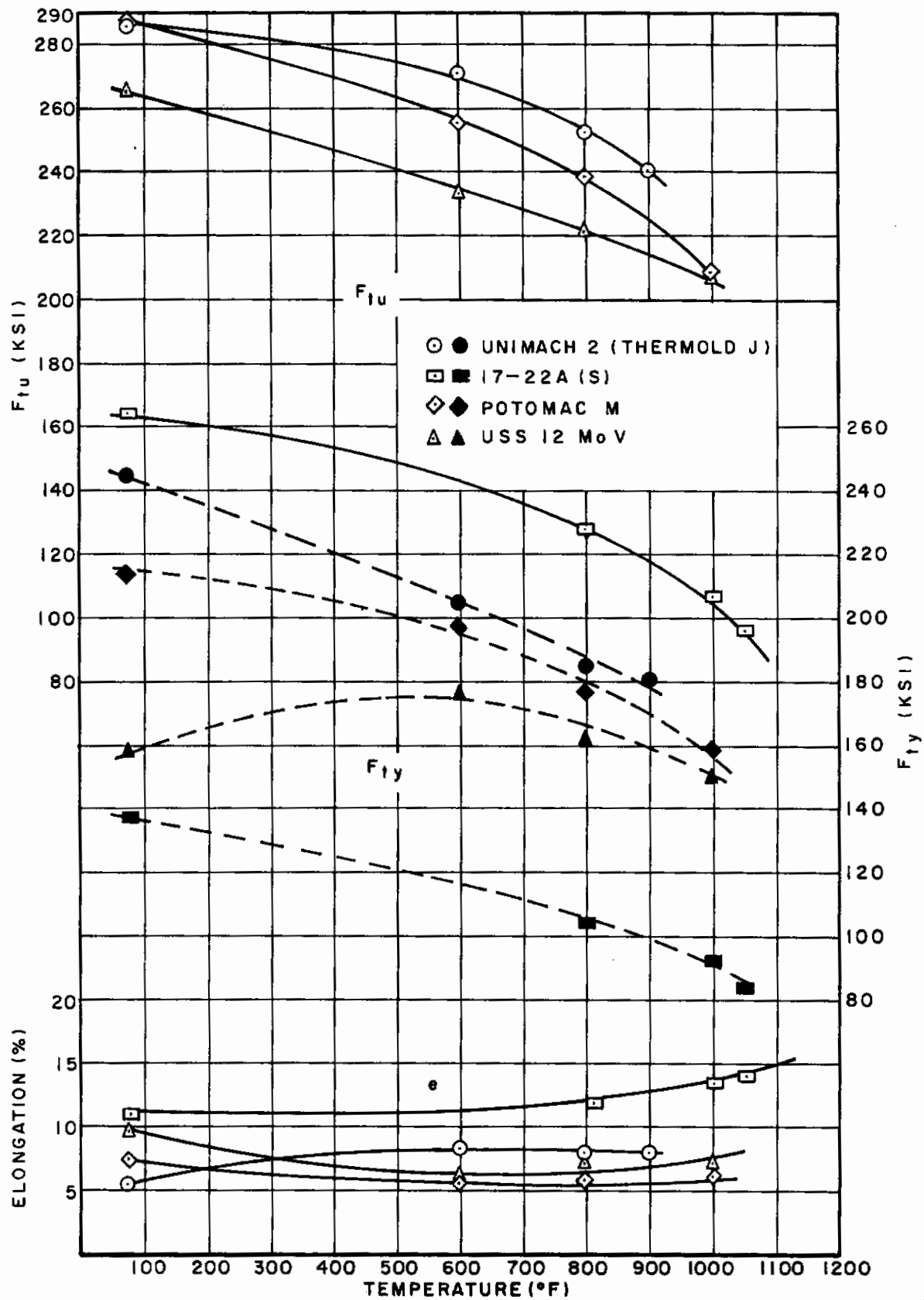


Figure 4. Effect of Temperature on the Tensile Properties of Unimach 2 (Thermold J) 17-22A (S), Potomac M and USS 12 Mo V

ASD-TDR-62-358

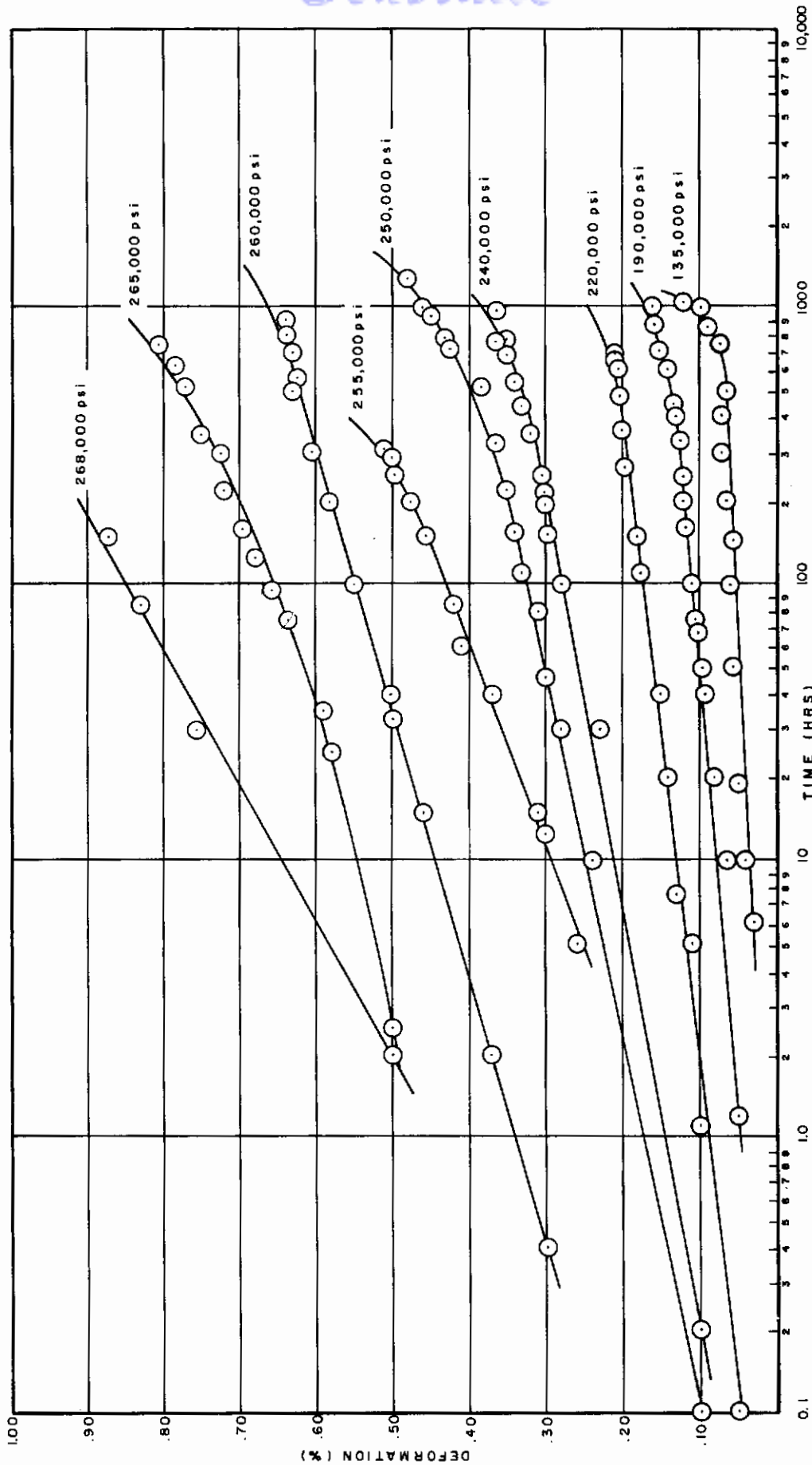


Figure 5. Creep Deformation vs. Time for Unimach 2 (Thermold J) at 600°F

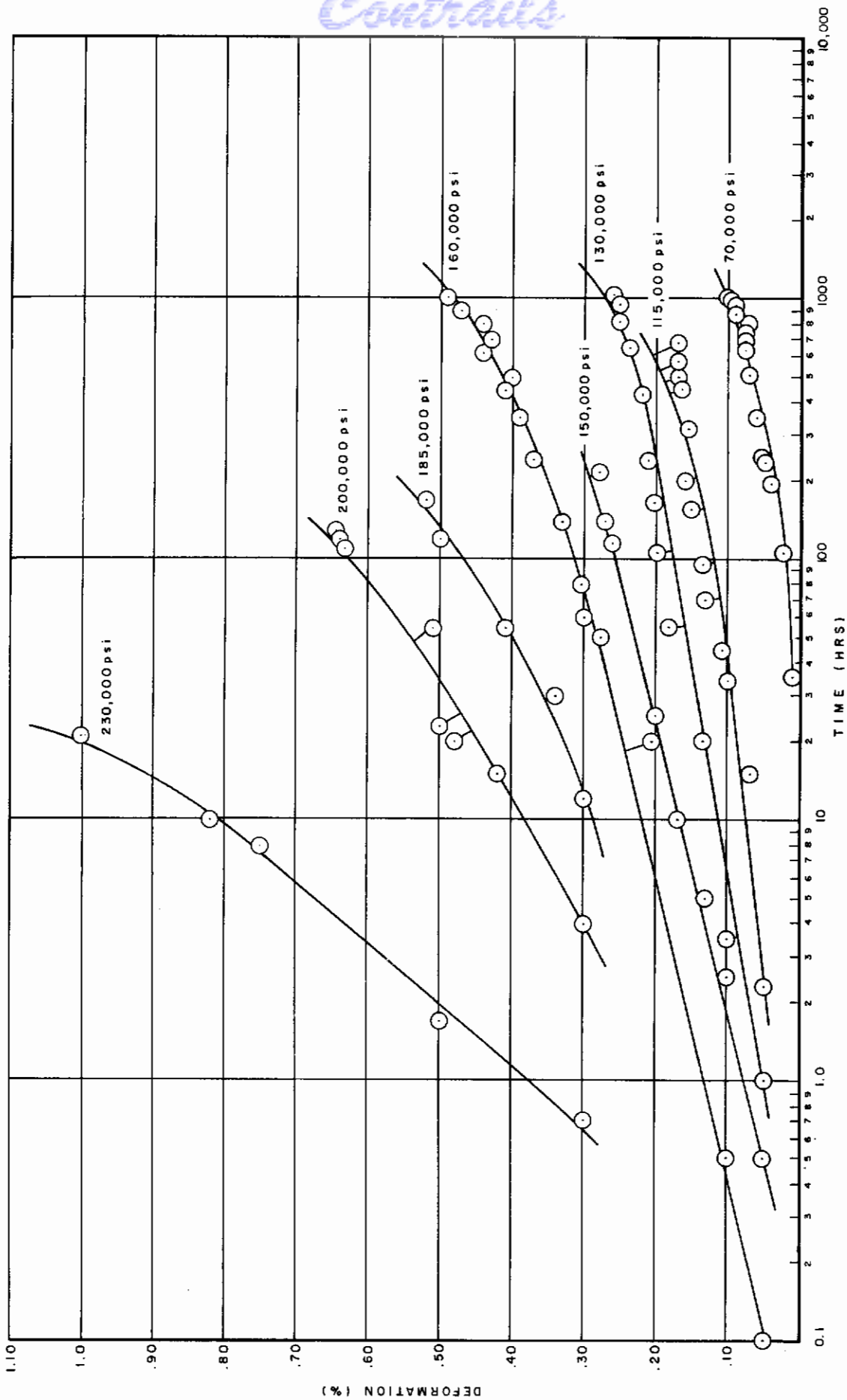


Figure 6. Creep Deformation vs. Time for Unimach 2 (Thermold J) at 800°F

ASD-TDR-62-358

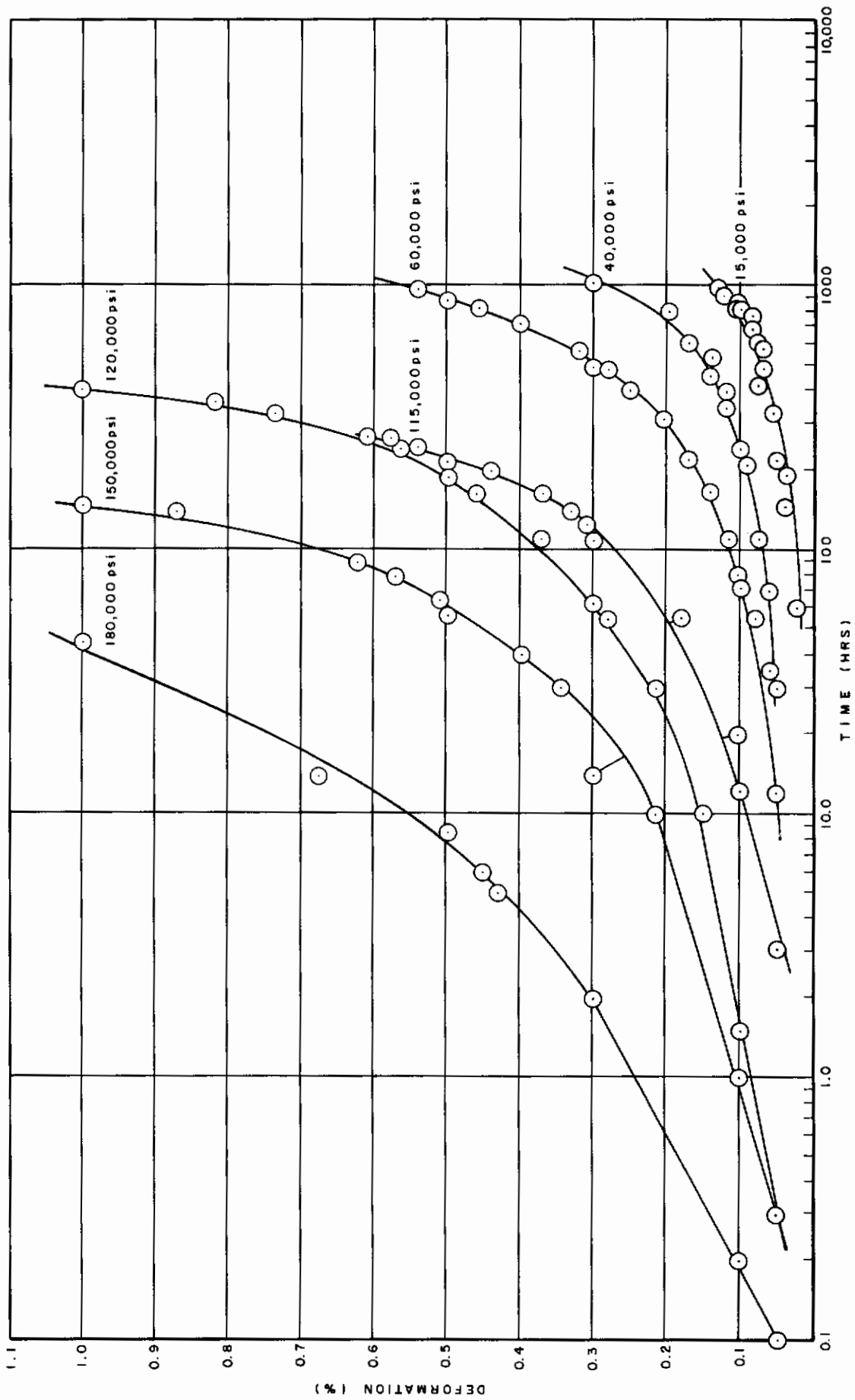


Figure 7. Creep Deformation vs. Time for Unimach Z (Thermold J) at 900°F

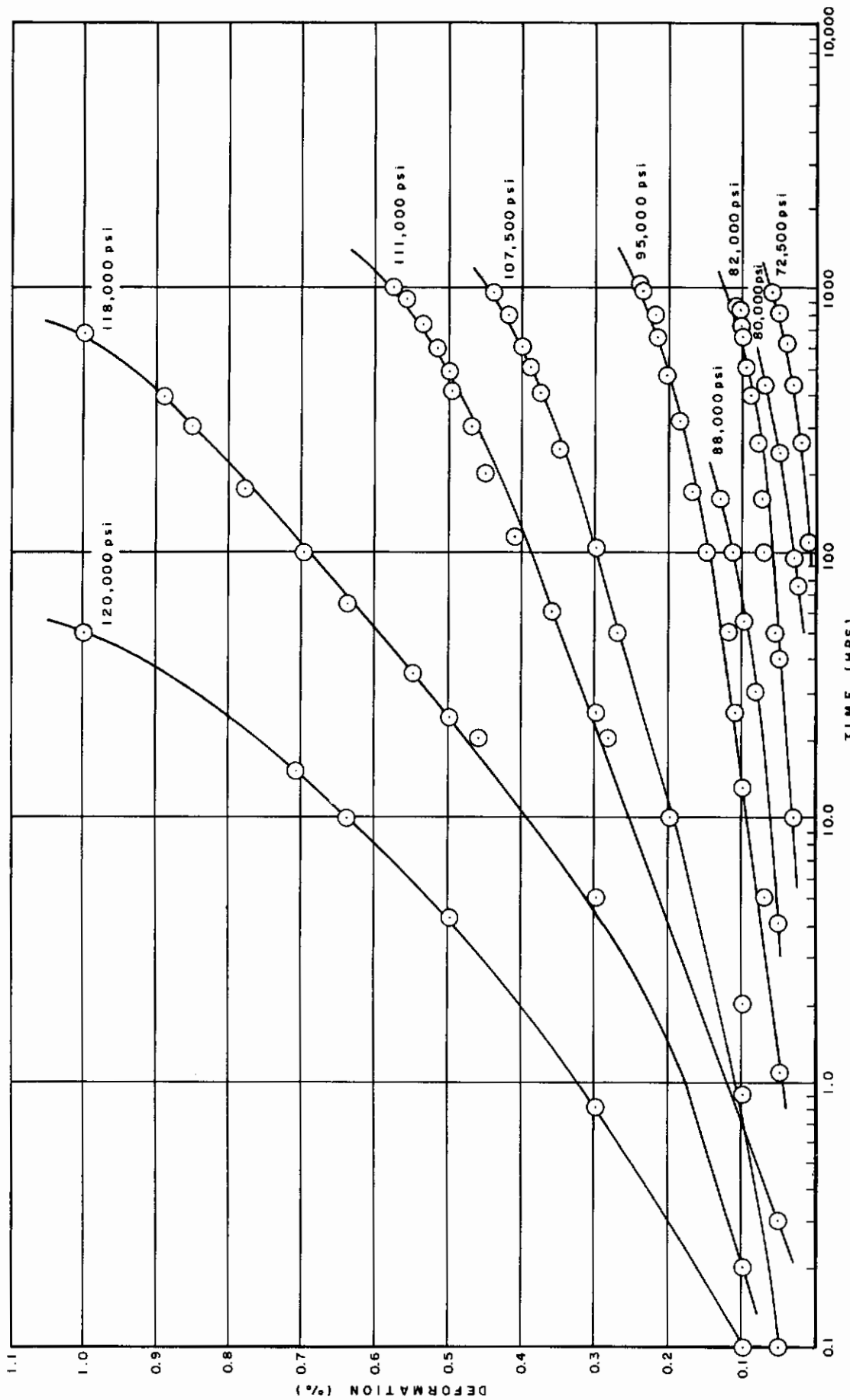


Figure 8. Creep Deformation vs. Time for 17-22A (S) at 800°F

ASD-TDR-62-358

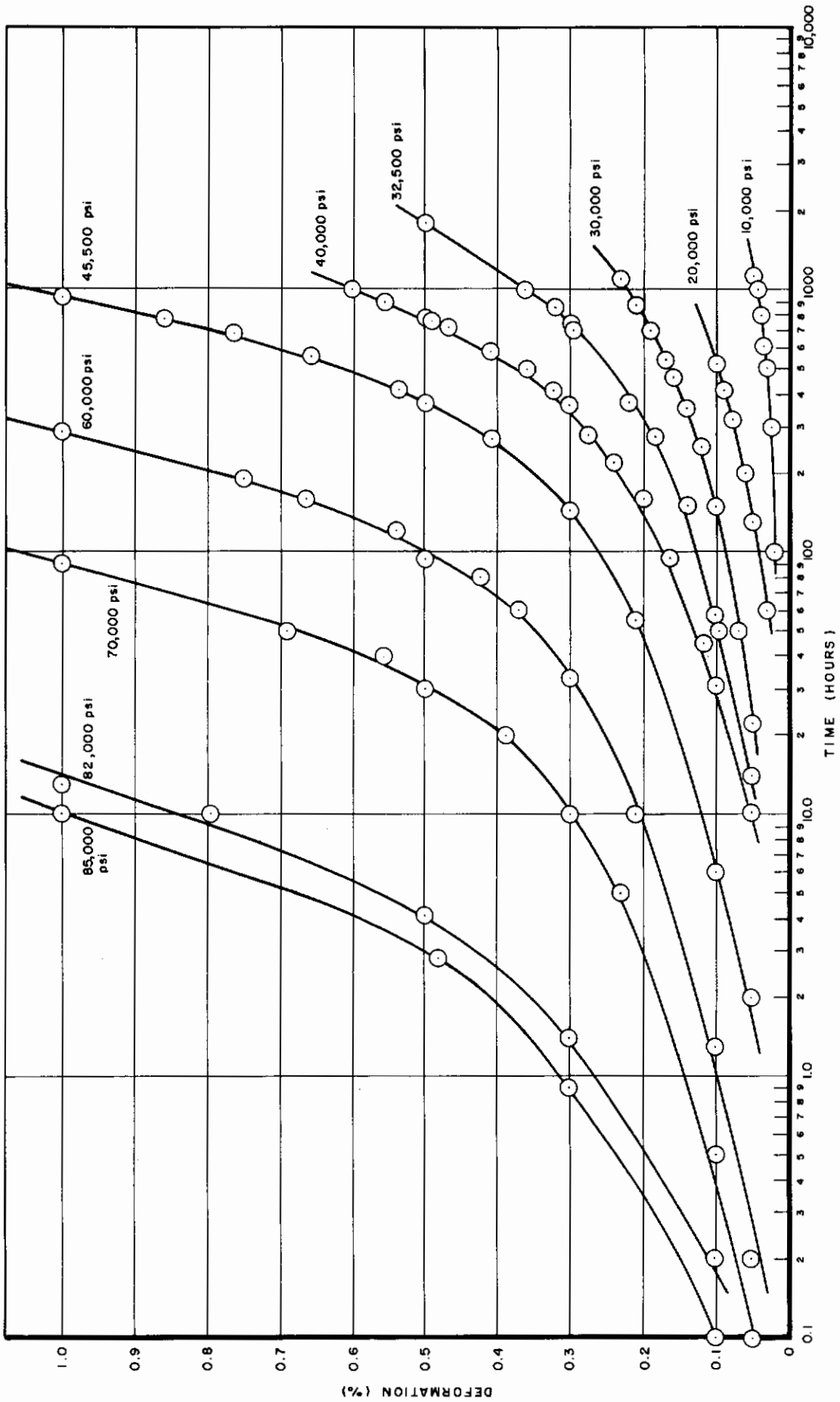


Figure 9. Creep Deformation vs. Time for 17-22A (S) at 1000°F

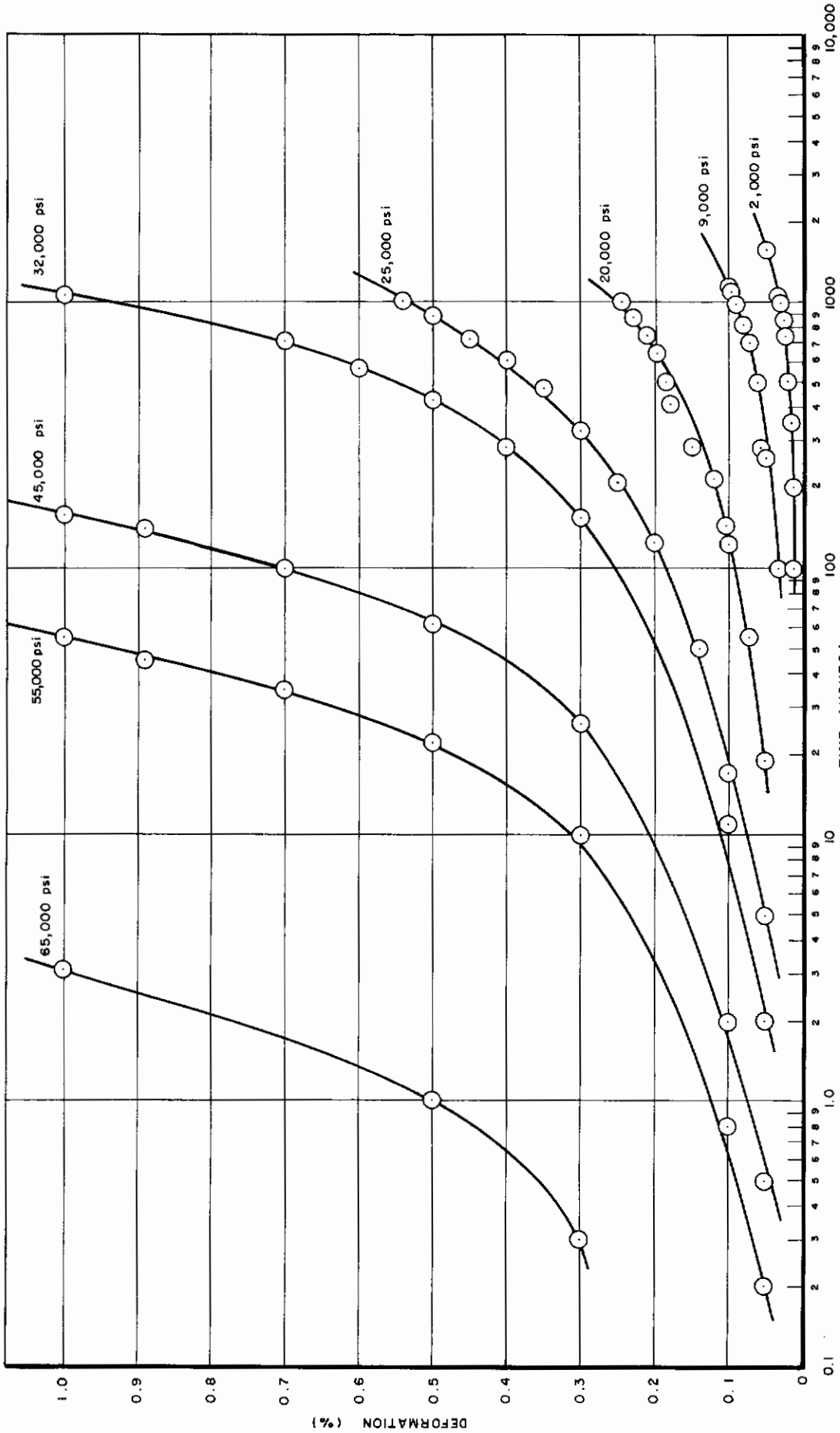


Figure 10. Creep Deformation vs. Time for 17-22A (S) at 1050°F

ASD-TDR-62-358

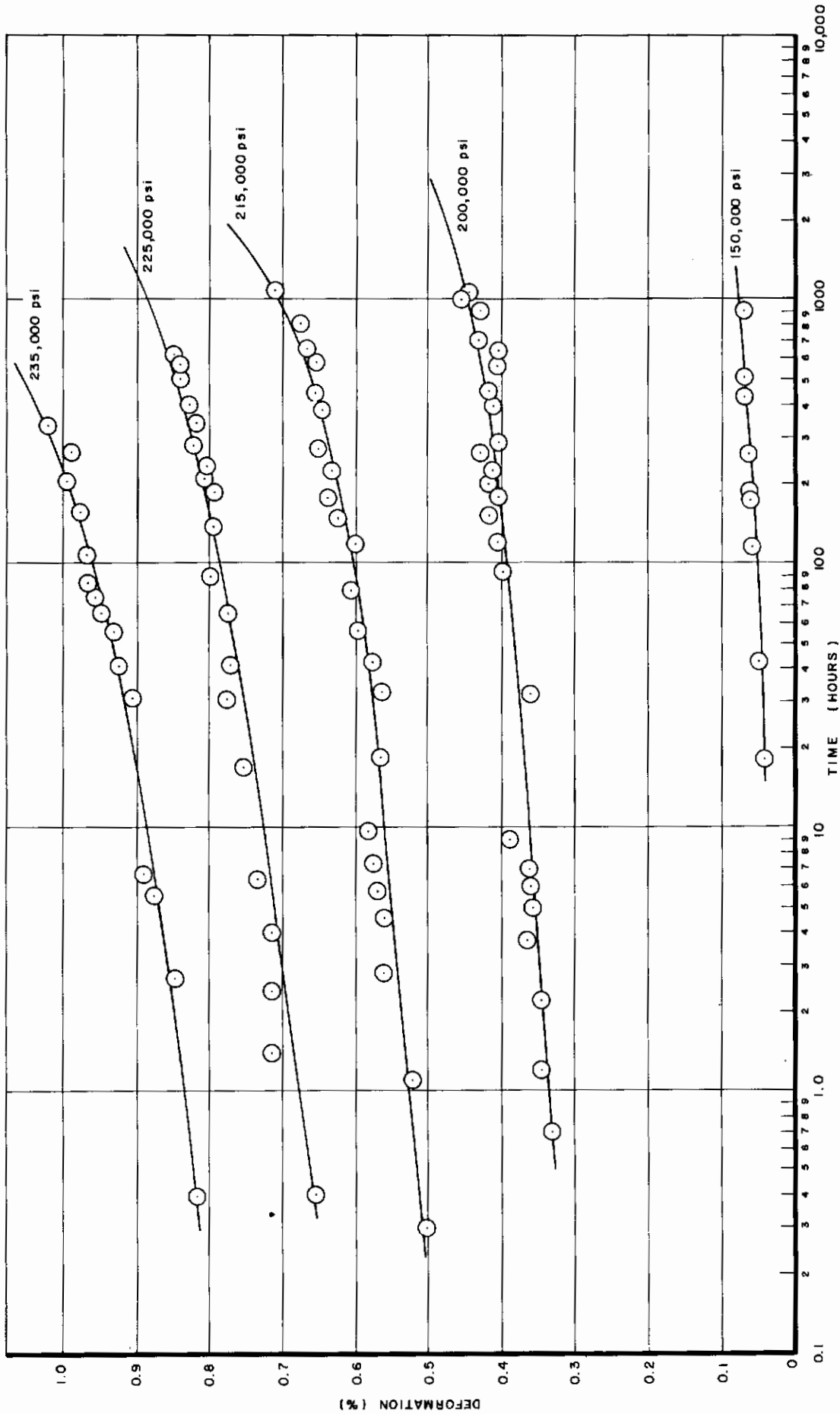


Figure 11. Creep Deformation vs. Time for Potomac M at 600°F

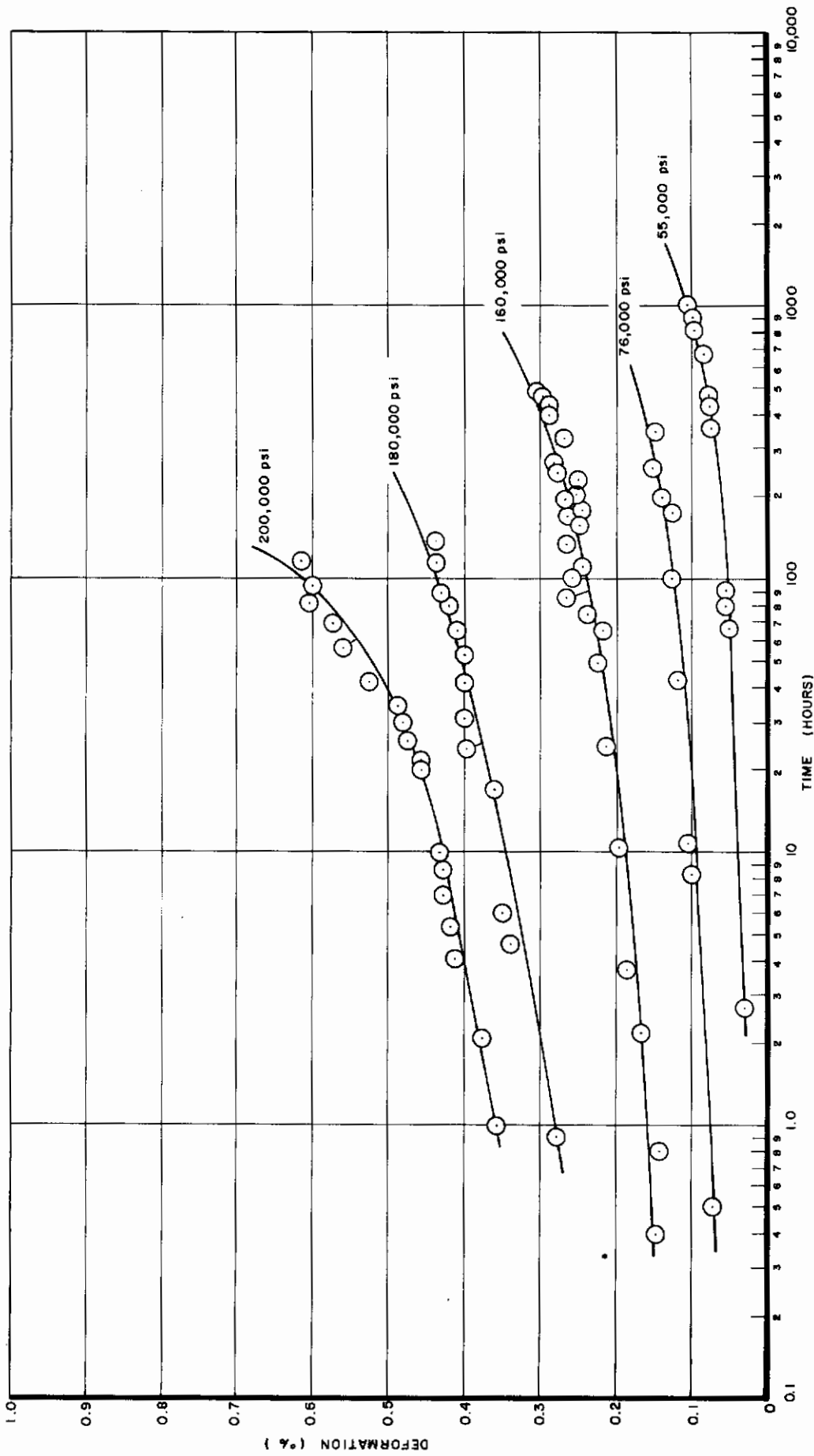


Figure 12. Creep Deformation vs. Time for Potomac M at 800°F

ASD-TDR-62-358

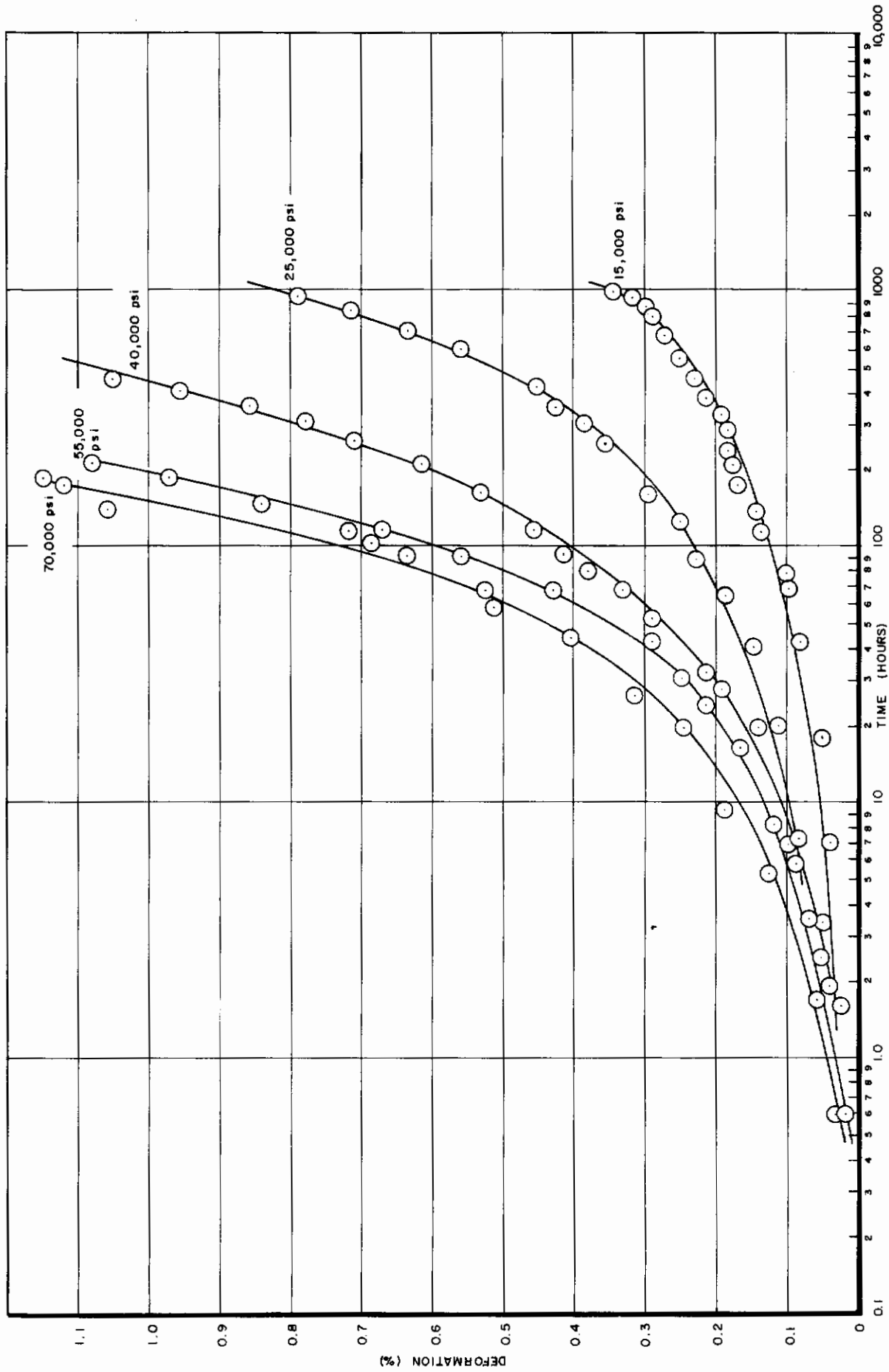


Figure 13. Creep Deformation vs. Time for Potomac M at 1000°F

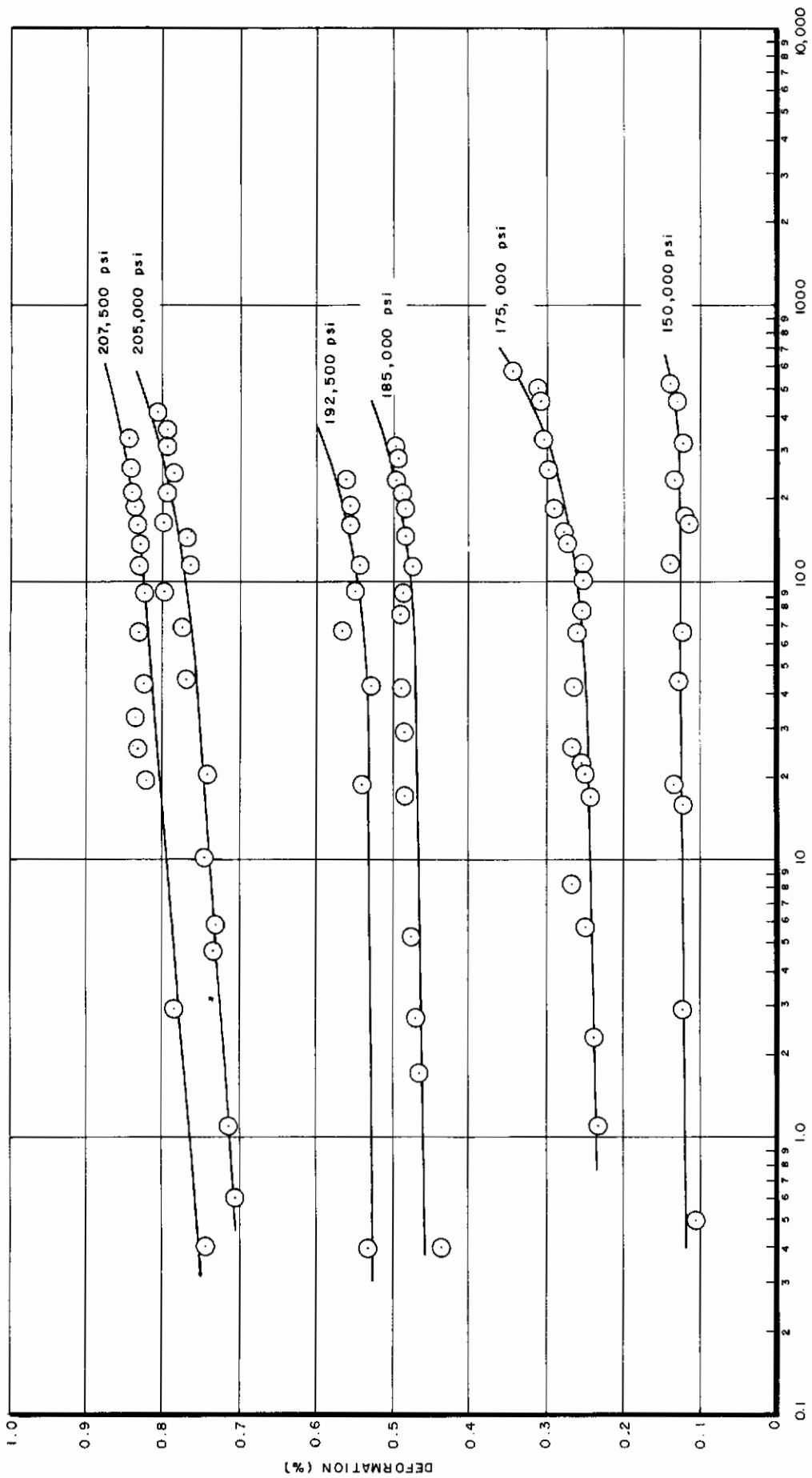


Figure 14. Creep Deformation vs. Time for USS 12 MoV at 600°F

ASD-TDR-62-358

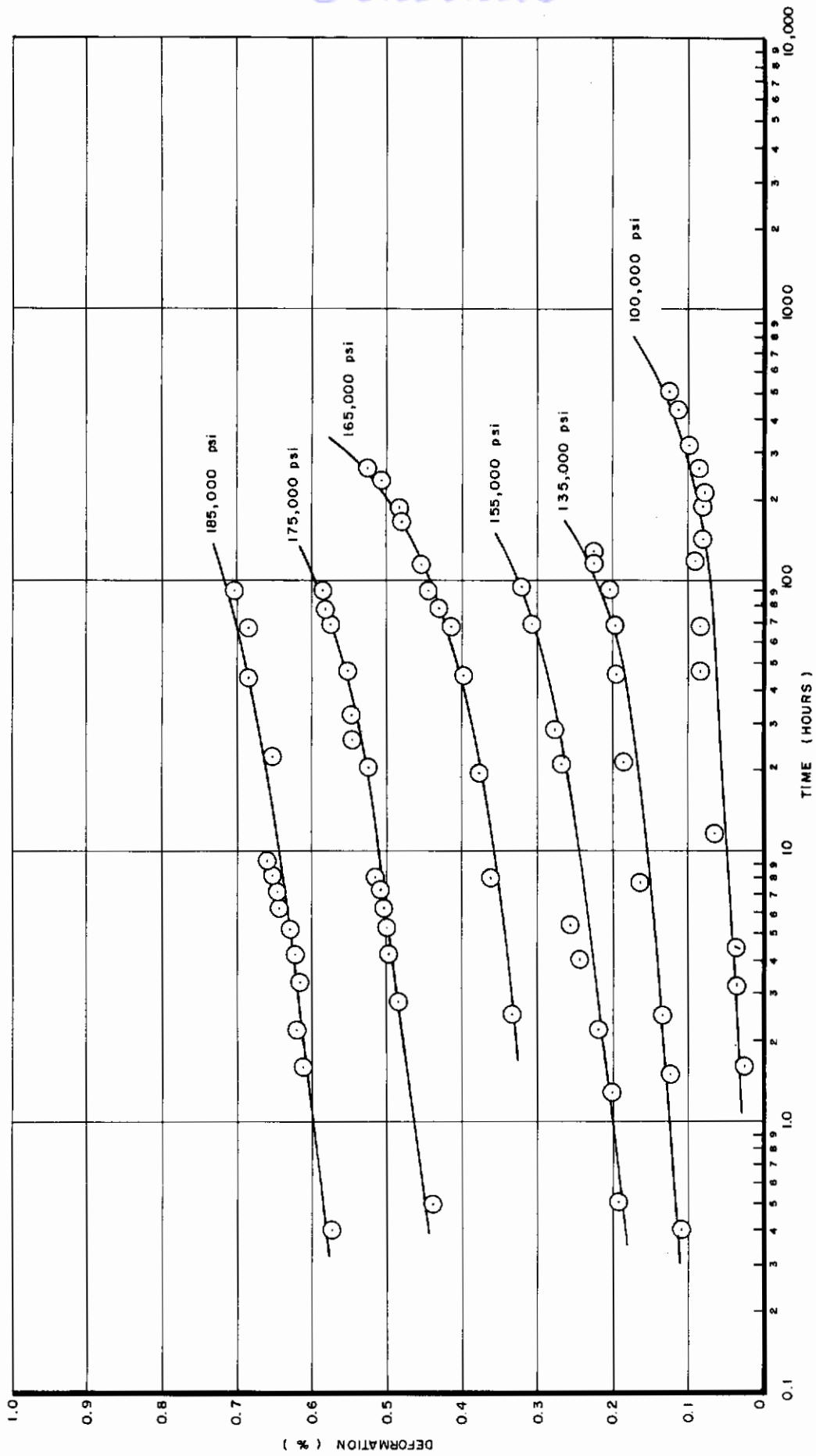


Figure 15. Creep Deformation vs. Time for USS 12 MoV at 800°F

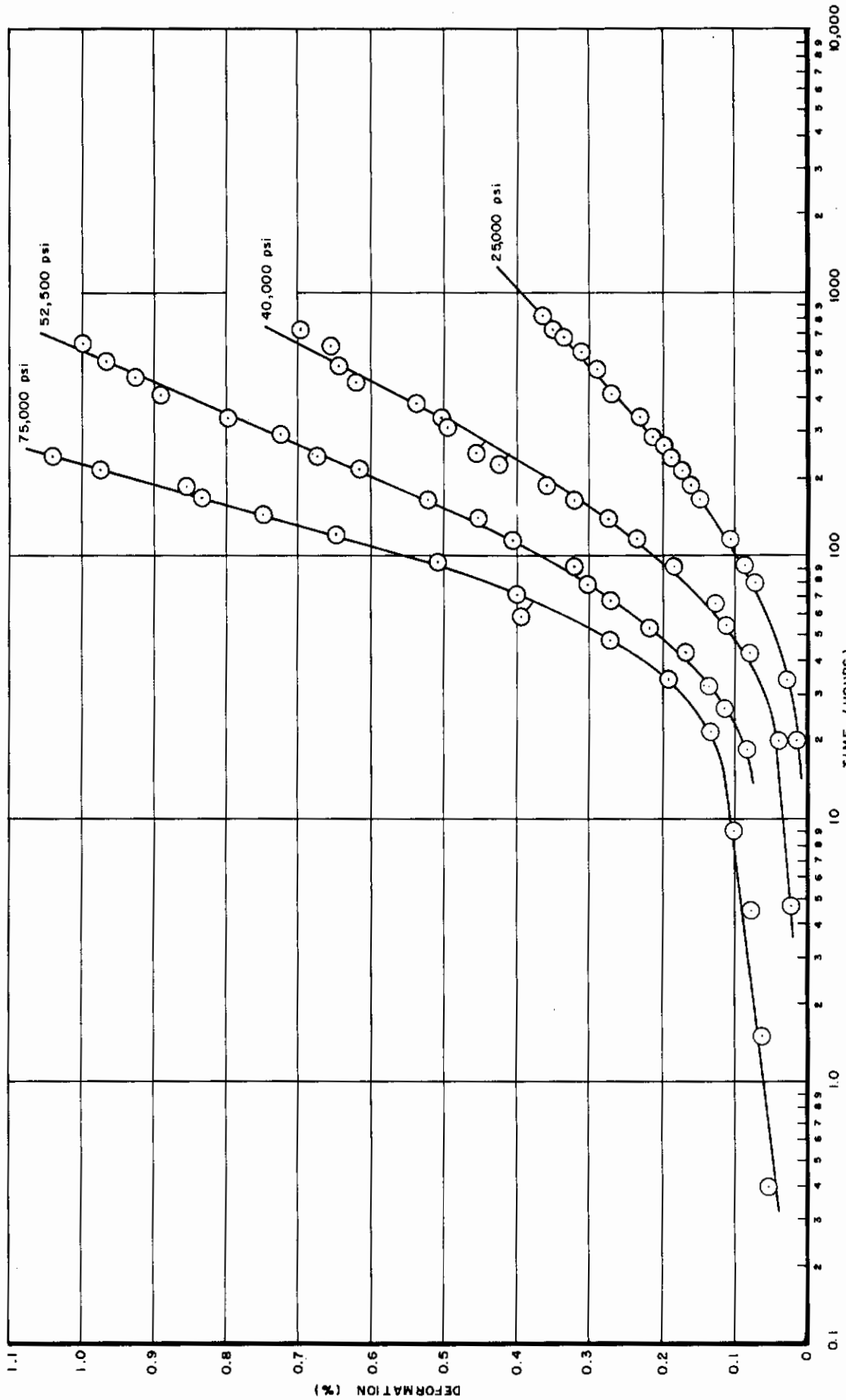


Figure 16. Creep Deformation vs. Time for USS 12 MoV at 900°F

ASD-TDR-62-358

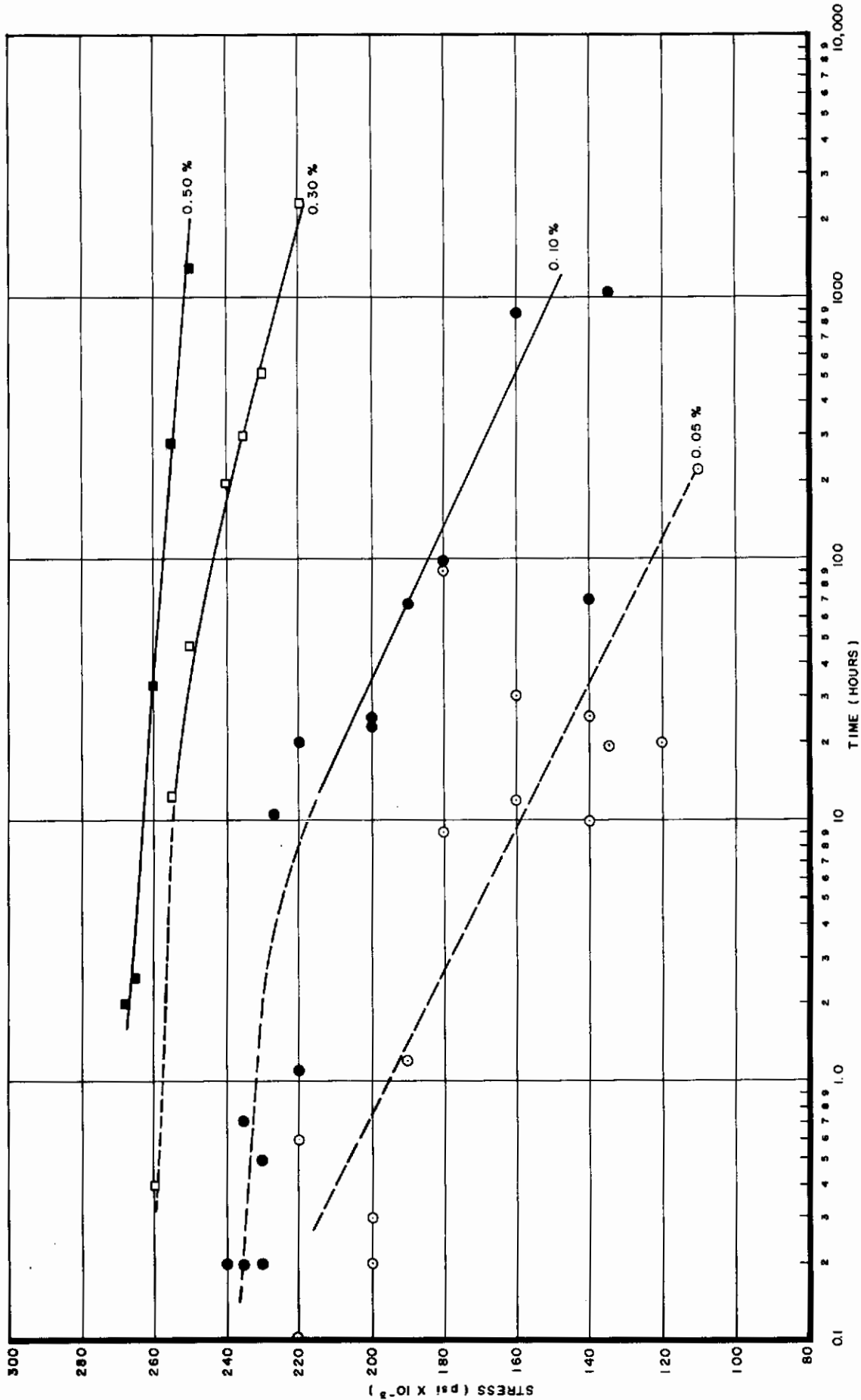


Figure 17. Design Curves for Unimach 2 (Thermoid J) at 600°F

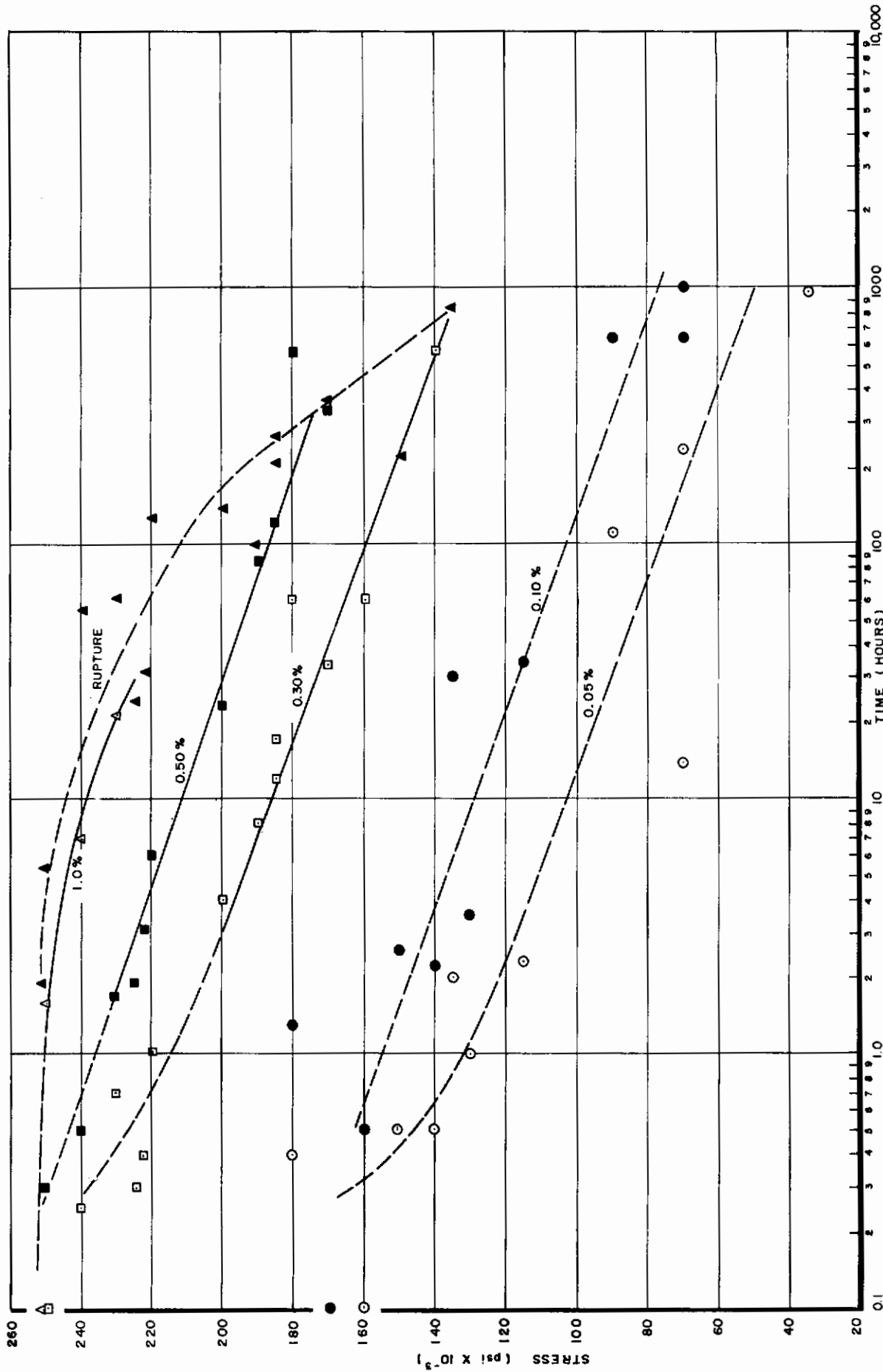


Figure 18. Design Curves for Unimach 2 (Thermold J) at 800°F

ASD-TDR-62-358

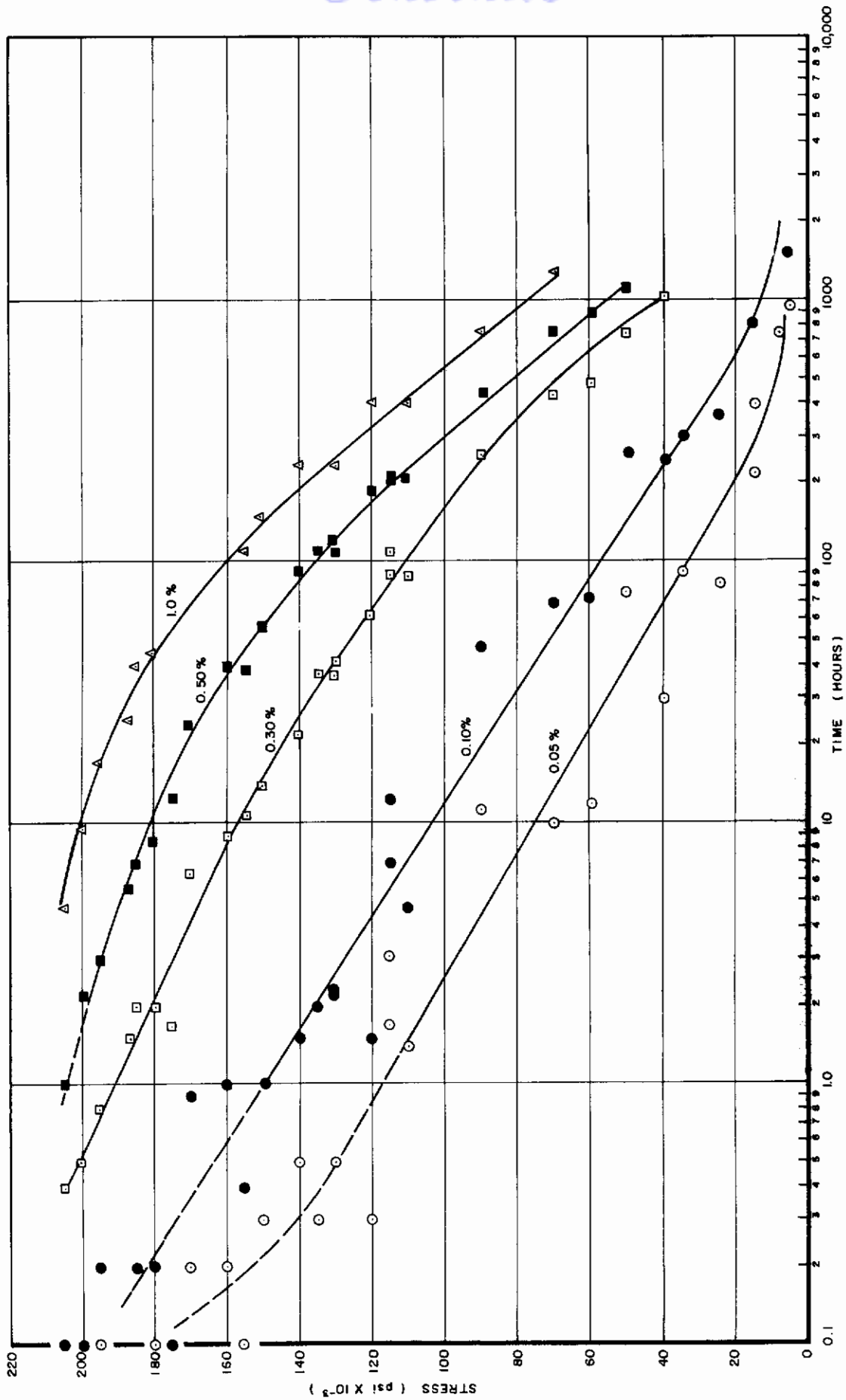


Figure 19. Design Curves for Unimach 2 (Thermold J) at 900°F

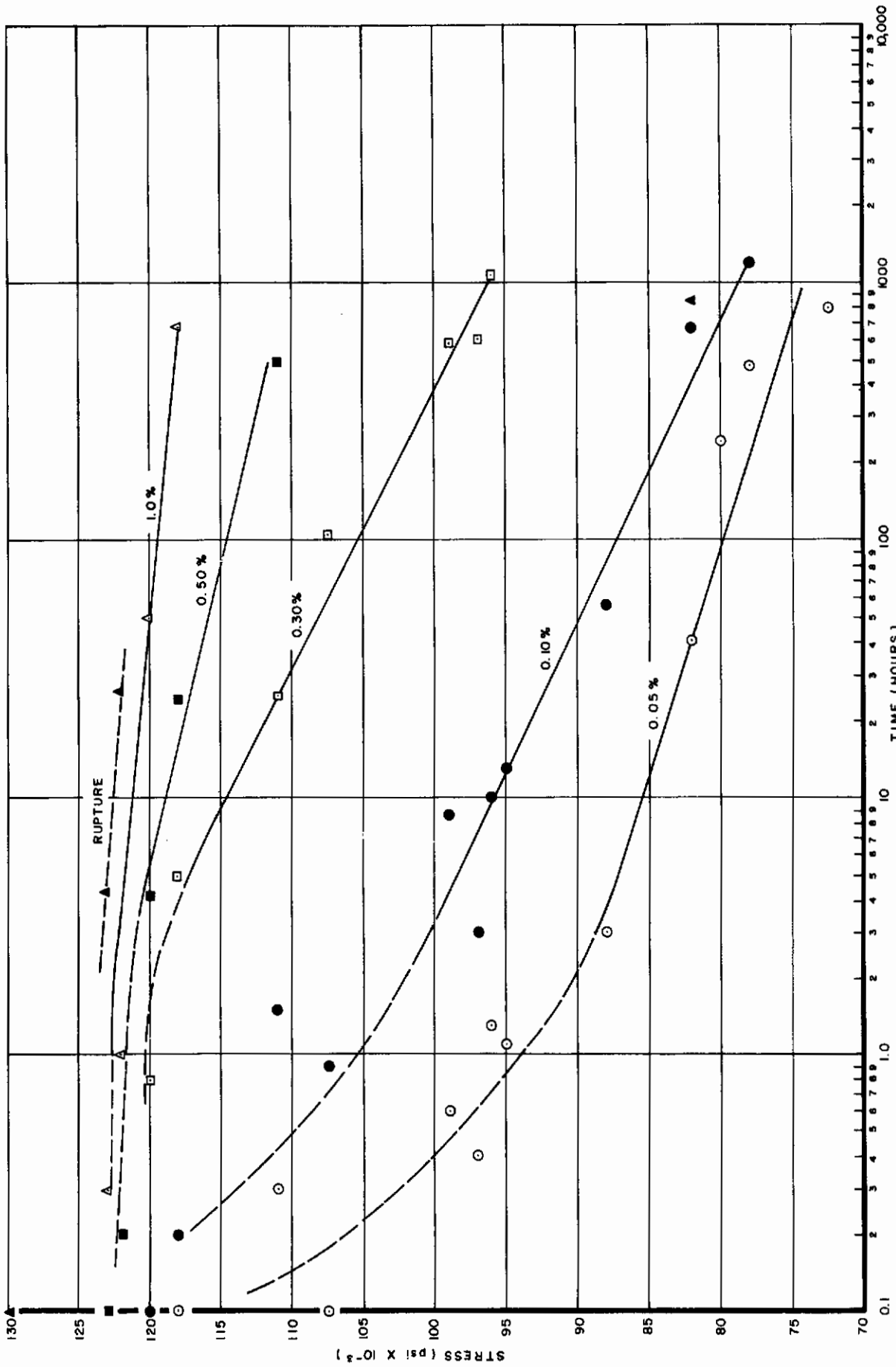


Figure 20. Design Curves for 17-22A (S) at 800° F

ASD-TDR-62-358

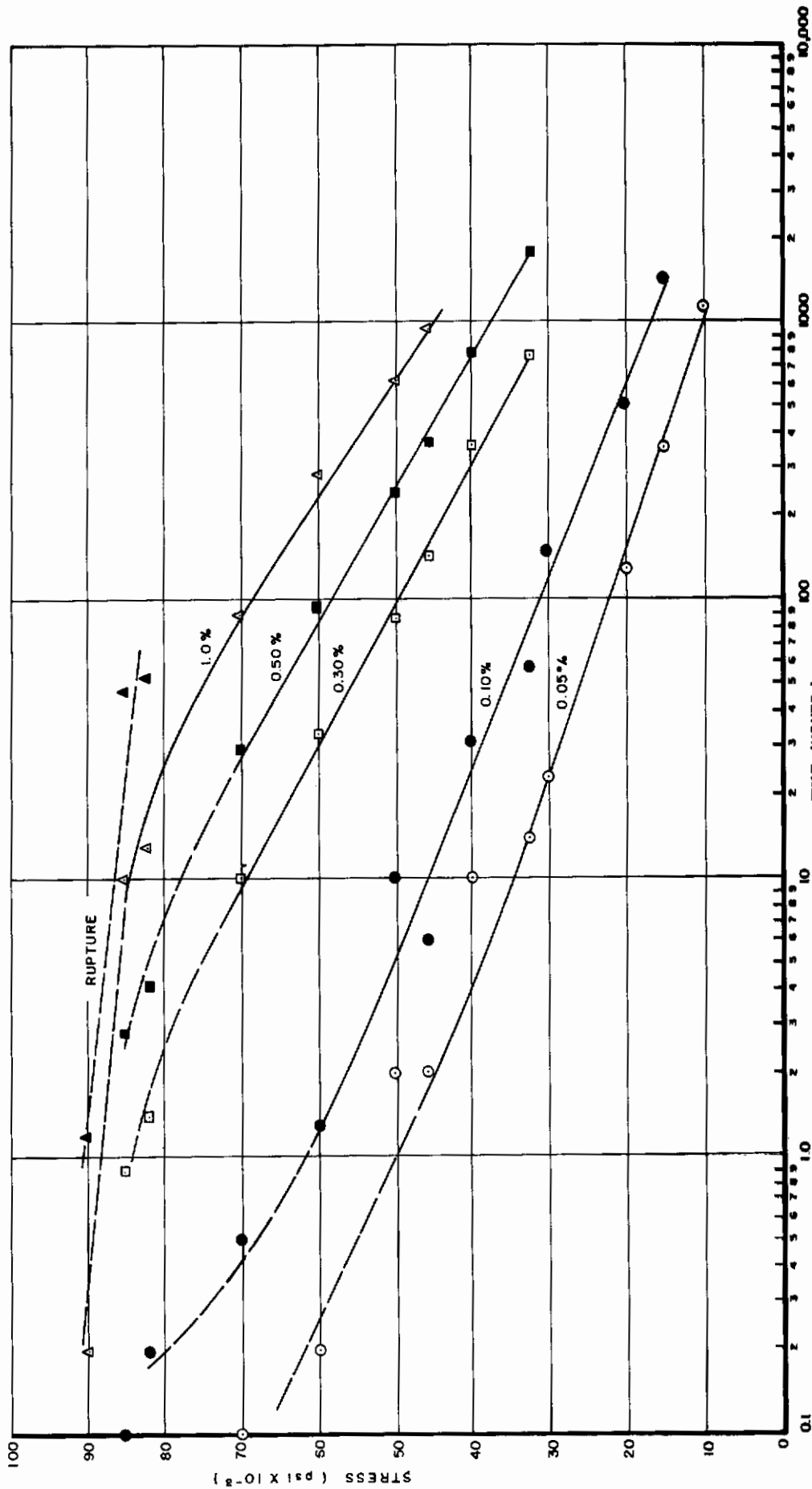


Figure 21. Design Curves for 17-22A (S) at 1000°F

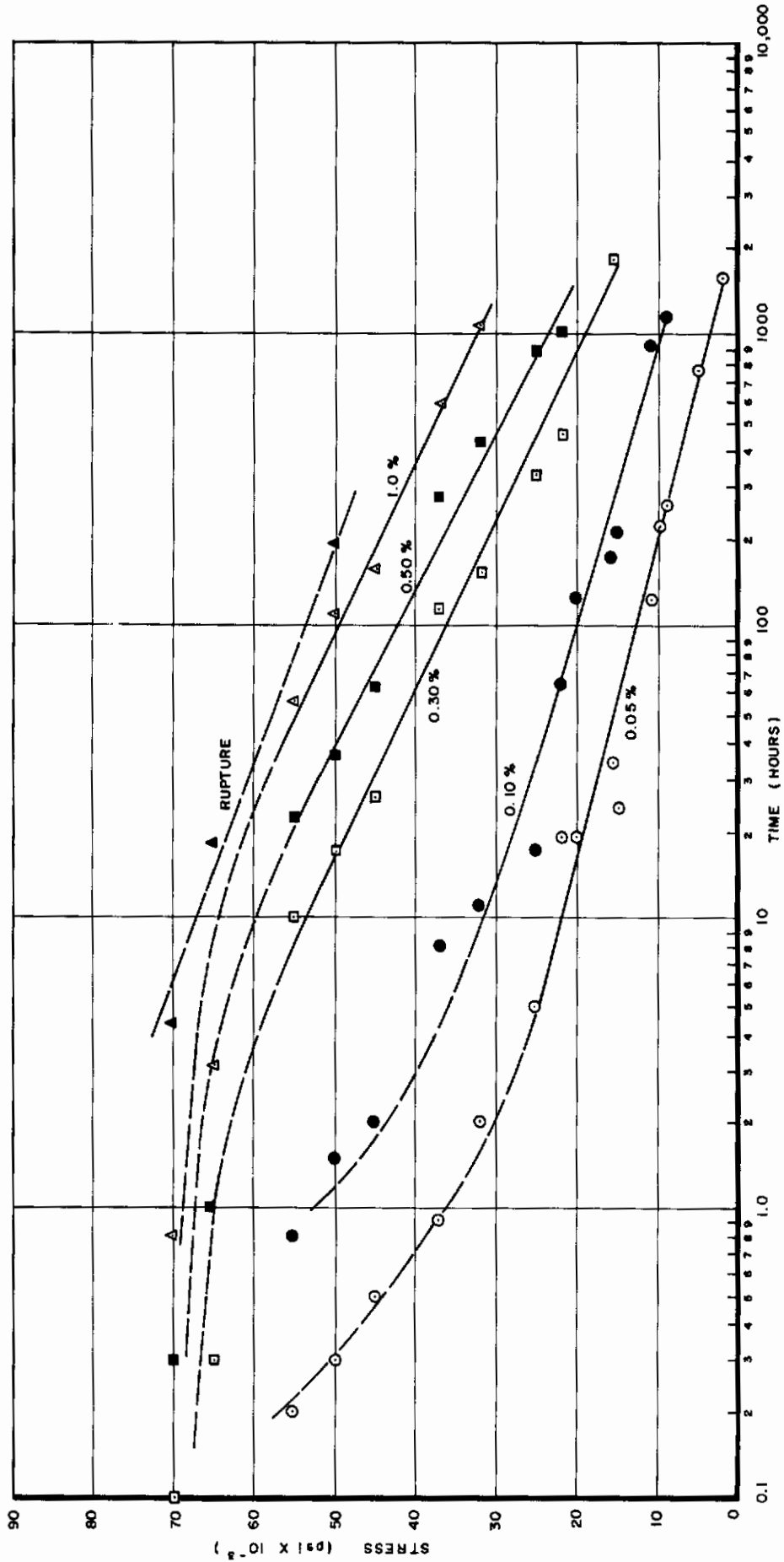


Figure 22. Design Curves for 17-22A (S) at 1050°F