JJ46/II EMM FLAT PLATES

\$ TUBES

FINAL REPORT

on

CAUSES OF CLEAVAGE FRACTURE IN SHIP PLATE FLAT PLATE TESTS AND ADDITIONAL TESTS ON LARGE TUBES

by

HARMER E. DAVIS, G. E. TROXELL, EARL R. PARKER, A. BOODBERG AND M. P. O'BRIEN UNIVERSITY OF CALIFORNIA Under Navy Contract NObs-31222

NRC - 92

## COMMITTEE ON SHIP CONSTRUCTION DIVISION OF ENGINEERING & INDUSTRIAL RESEARCH NATIONAL RESEARCH COUNCIL

Advisory to

BUREAU OF SHIPS, NAVY DEPARTMENT Under Contract NObs-34231

Serial No. SSC-8

Copy No. 10

January 17, 1947

NObs-31222(334)

# NAVY DEPARTMENT BUREAU OF SHIPS WASHINGTON, D. C.

## **JAN 3 1** 1947

Mr. E. M. MacCutcheon Merchant Marine Technical Division U. S. Coast Guard 1300 E Street, N. W. Washington 25, D. C.

Dear Sir:

SUBJECT: Final Report on "Causes of Cleavage Fracture in Ship Plate: Flat Plate Tests and Additional Tests on Large Tubes", (SSC-8), Contract NObs-31222

There is enclosed for your information and file one copy of the subject report as follows:

Report Serial No.

#### Date

Copy No.

SSC-8

January 17, 1947

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Sincerely yours

L. H. Travis

L. H. Travis By direction of Chief of Bureau

Encl: (H.W.)

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January 17, 1947

Chief, Bureau of Ships Navy Department Washington 25, D. C.

Dear Sir:

Attached is Report Serial No. SSC-8, entitled "Causes of Cleavage Fracture in Ship Plate: Flat Plate Tests and Additional Tests on Large Tubes". This report has been submitted by the contractor as the final report on one phase of the work done on Research Project SR-92 under Contract NObs-31222 between the Bureau of Ships, Navy Department and the University of California.

The report has been reviewed and acceptance recommended by representatives of the Committee on Ship Construction, Division of Engineering and Industrial Research, NRC, in accordance with the terms of the contract between the Bureau of Ships, Navy Department and the National Academy of Sciences.

Very truly yours,

Frederick M. Feiker, Chairman Division of Engineering and Industrial Research

Enclosure

The Navy Department through the Jureau of Ships is distributing this report to those agencies and individuals that were actively associated with this research program. This report represents a part of the research work contracted for under the section of the Navy's directive "to investigate the design and construction of welded steel merchant vessels".

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## Final Report

Navy BuShips Contract NObs-31222

Project SR-92

# CAUSES OF CIEAVAGE FRACTURE IN SHIP PLATE

# FLAT PLATE TESTS AND ADDITIONAL TESTS ON LARGE TUBES

August 1946

From: University of California, Berkeley, California M. P. O'Brien, Technical Representative

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Report prepared by:

Harmer E. Davis G. E. Troxell Earl R. Parker A. Boodberg

Engineering Materials Laboratory University of California

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#### ABSTRACT

S . 1

This report summarizes the test results on wide flat plates to date of termination of U. S. Navy BuShips Contract NObs-31222, August 31, 1946.

The materials used in this investigation were three lots of semikilled hull quality steels, one lot of nickel alloy, one lot of fully-killed, and one lot of fully-killed quenched and drawn steel.

The specimens used in the principal program were 3/4 inch thick plates containing a narrow transverse slot having a length equal to one fourth of the specimen width. These were tested in tension in widths ranging from 12 inches to 108 inches. Tests were made at each of a number of temperatures in order to determine the temperature at which the mode of failure changed from shear to cleavage type.

In the tests, observations were made of the following: the maximum load, load at development of cracks, fracture load, energy absorbed to maximum load, mode of fracture, strain distribution over the faces of plates and thickness reductions near the lines of fracture.

Results from tests of wide flat notched plates indicated that transition temperatures of semi-killed steels may vary from freezing to well above room temperature. Tests of two lots of steel of essentially the same chemical composition, except for nitrogen content, revealed that the steel with the higher nitrogen content had a considerably higher transition temperature. The microstructure of the steel with the higher transition temperature was also considerably coarser. No appreciable difference in transition temperatures was found when one lot of steel was tested in the "as-rolled" and in the normalized conditions.

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Improved metallurgical structure of another lot of steel,

accomplished by requenching and redrawing at a lower temperature, resulted in lowering of the transition temperature and an increase in the ability to absorb energy.

The  $3\frac{1}{2}$  percent nickel steel was found to be far superior to the mild steel, having a much lower transition temperature and a higher energy absorption.

It was found that the Charpy keyhole-notch impact tests, tension tests of 3 inch wide edge-notched specimens and tension tests of centrallynotched 12-inch and 72-inch wide flat plates are all useful for rating the steels in order of their relative brittleness. However, the transition temperature for any particular steel, as determined by the various tests, differ considerably, with the larger test specimens giving higher and better defined transition temperatures.

The nominal strength of plates was found to decrease slightly as the width of the test specimen was increased, this tendency being more pronounced for specimens failing in shear.

Transition temperatures were found to decrease as the specimen thickness was decreased, an effect introduced by geometry and the additional rolling.

A number of supplemental studies were made to provide additional information on certain questions raised by the principal tests. Results of some of these studies were reported in previous reports,<sup>1</sup>,<sup>2</sup> while a study of geometrically similar specimens to check the validity of model laws, and results of tests of tension bars at low temperature are given in appendices of this report.

1,2 See Bibliography

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#### FINAL REPORT

# Navy BuShips Contract NObs-31222

#### Project SR-92

CLEAVAGE FRACTURE OF SHIP PLATE AS INFLUENCED BY DESIGN

#### AND METALLURGICAL FACTORS

Flat Plate and Tube Tests

#### August, 1946

From: University of California, Berkeley, California M. P. O'Brien, Technical Representative

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Harmer E. Davis G. E. Troxell Earl R. Parker Alexander Boodberg

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Report Prepared by:

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) Engineering Materials Laboratory ) University of California

## INTRODUCTION

The work covered by this report is part of the research program originated by the Office of Scientific Research and Development, to determine the causes of cleavage type failure of ship plate. The work conducted by the University of California was divided into two parts: Part 1 consisted of tests conducted principally on centrally notched large flat plates, and in Part 2 tests were conducted on built up sections simulating a hatch corner structure. This report is concerned primarily with the work on notched flat plates to August 31, 1946, the date of the termination of the contract. Also reported herein are the results of tests on two large tubular specimens fabricated from ship plate, which tests were made to supplement the information obtained in a previous investigation, NRC-75.

The work on Project NRC-92 started in November, 1944, and was conducted under the auspices of the Office of Scientific Research and Development until August 31, 1945, and was supervised by the War Metallurgy Committee. After that date the program was continued under United States Navy Contract NObs-31222. The chief phase of the investigation was the determination of the temperature at which occurred the transition from ductile, shear type failures to brittle, cleavage type failures for several types of steel and for various widths of plates. The work was confined primarily to 3/4-inch thick plates that had transverse notches at the mid-sections. Six different lots of steel were investigated in this manner, the specimen widths ranging from 3 inches to 108 inches. A program of supplementary tests was also undertaken that included the following: standard tension tests, tension tests on full thickness coupons, Charpy impact tests, hardness tests, chemical analyses, metallographic examinations, and hardness surveys of the fractured plates.

Two previous reports<sup>1,2</sup> covered the progress of the investigation in detail to April 30, 1946. The continuation of the work to August, 1946, and the final results are described in this report.

Test results and the work done in connection with two large tubes are given in Appendix B. These tests complete the work started on MDRC Project NRC-75<sup>3</sup>.

Appendix A of this and the previous report<sup>1</sup> contain drawings showing the percent elongations and paths of fracture for all the plates tested. Appendix C gives the results of standard tension tests that were conducted at low temperatures, and Appendix D gives the results of studies on geometrically similar specimens.

1,2,3 See Bibliography

EXPERIMENTAL WORK

Test Program

The principal phase of the program involved tension tests of wide, 3/4-inch thick flat plate specimens of the various steels, at several temperatures in order to determine the temperature range at which the mode of failure changed from shear to cleavage type. The plates were notched at the mid-section with a transverse slot having a length equal to one quarter of the width of the plate. For most of the steels, plates 12-, 24-, 48-, and 72-inches in width were tested. Two 108-inch wide specimens were also tested, one made of steel B in the as-rolled condition and one made of steel C. The maximum load, the load at development of cracks, the load at failure, the mode of fracture, the amount of energy absorbed to the maximum load, the reduction in thickness near the break, and the strain distribution on the face of the plate were determined for each of the specimens tested.

As an auxiliary program, tension tests under controlled conditions were conducted on 3-inch wide specimens to determine the transition ranges for the various steels. Three 3-inch specimens were easily and cheaply prepared; the four types used in the investigation are shown in Fig. 23.

The description of the steels used and the program of tests are given in Table 1. The summary of physical properties and chemical analyses of the steels are given in Table 2.

Test Procedure

A detailed description of the testing and gaging methods is given in the previous report.<sup>1</sup> Fig. 1 shows a test set-up in the 3-million pound testing machine for a 108-inch wide specimen; the plywood box served as a temperature control chamber. Numerous SR-4 electric strain gages and resistance-wire extensometers were used on the faces of each specimen

L See Bibliography

to measure the elastic and plastic strains. Residual strains were measured by means of a special mechanical gage used on a system of grids that were marked on one face of each specimen tested. The results of these grid measurements are given in Appendix A.

All specimens were loaded until fracture occurred and readings were taken on strain gages at intervals so that a total of at least 10 strain readings were obtained up to a maximum load. From the readings of all resistance-wire extensometers having a length equal to three-fourths of the specimen width, an average elongation for the specimen was computed and plotted, and by integration of the resulting load-strain data the energy absorbed up to a maximum load was determined.

Specimens were maintained at the desired temperature throughout the test by circulating heated or cooled air through a plywood box that enclosed the specimen. A window was provided in this box in order that the formation of cracks and the propagation of the fracture could be observed. Since the earlier results of wide plate tests indicated that there was a tendency for the nominal strength of the plate to decrease as the width of the plate increased, it was decided to test a few 108-inch wide plates to verify this. As no 108-inch wide plates were immediately available, two 72 by 120-inch plates were welded together along the long edge and then trimmed to the 108-inch width so that the welded joint was along the longitudinal axis of the specimen. In order to make sure that the seam had no effect on the strain distribution, several tests were conducted on 23-, 48-, and 72-inch wide plates that were made up of two narrower plates with a longitudinal unionmelt seam. These were equipped with numerous strain gages to check the strain distribution. No appreciable difference was found

between the strain distribution in specimens made of whole plate and those made up with a center seam.

The results of chemical analyses of samples from individual plates of the various steels are given in Table 3, and the results of the standard tension and hardness tests are tabulated in Table 4.

Table 5 gives the summary of results for the notched wide-plate tests, and Table 6 summarizes the thickness reductions along fracture lines for the same plates. The complete results of the 3-inch wide plate tests are summarized in Table 7. Residual strains are given in the Appendix A of this and the previous report.<sup>1</sup>

Results of the Charpy keyhole-notch impact tests for the various steels are given in Figs. 2 to 7 inclusive. Notches were machined perpendicular to the plane of the plate for all Charpy specimens.

Table 8 gives a comparison of the transition temperatures for the various types of specimens tested.

Table 9 summarizes the reductions in thickness of plate obtained from samples of fractured plates of ships that failed in service.

Data on the nominal stress in the large flat specimens at which crack started are given in Table 10,

Transition temperatures as defined by the energy absorbed to maximum load are represented in Figs. 8, 9, and 10 for the 72- and 12-inch wide specimens of the various steels.

Figs. 11, 12 and 13 present the transition ranges, as defined by the percent of fracture in the shear mode, for 72-, 12-, and 3-inch wide specimens for the steels used in the investigation,

L See Bibliography

Figs. 14, 15, 16 and 17 show temperature transition ranges for the various types of 3-inch wide specimens.

Figs. 18 and 19 show the variation of nominal stress of a specimen with width, while Fig. 20 shows the variation of the nominal stress with temperature for the 12- and 72-inch wide specimens.

Figs. 21 and 22 show the influence of specimen width on ductility at maximum load and at failure.

Fig. 23 shows the four types of 3-inch wide specimens used in the investigation.

Figs. 27 to 29 inclusive show typical photomocrographs for the various steels.

#### Discussion of Results

The flat plate tests proved conclusively that it was possible to produce in the laboratory, brittle closvage fractures identical with those found on sections of fractured steel ships. The thickness reductions for the flat plates are listed in Table 6; these may be compared with similar measurements listed in Table 9, which were made on portions of fractured plates cut from ships. Two types of fractures occurred in the laboratory tests, (1) the normal ductile shear-type fracture and (2) the cleavage-type fracture, which may occur without appreciable ductility but which may also be preceded by a great deal of plastic flow. At high temperatures, shear fractures invariably occurred and at sufficiently low temperatures the steels failed by cleavage. At an intermediate temperature, which is called the transition temperature, the fracture occurred either by shear or cleavage or by a mixture of both. Steels may be rated in a relative order of brittleness by comparing the transition temperatures of the materials and by comparing

the energies absorbed by the materials at both high and low temperatures. In the flat plate investigation, transition temperatures were determined by means of Charpy keyhole-notch impact tests and by tension tests on 3-, 12-, 24-, 48-, and 72-inch wide centrally-notched specimens.

One of the most significant results of the investigation is that all of the tests used for determining the relative brittleness of steels rate the steels in approximately the same order. For most steels, the large specimens gave definite transition temperatures. This, however, was not found to be true for the Charpy specimens, which in many cases showed a wide range of temperature over which the transition from shear to cleavage occurred. Figs. 2 to 7 clearly illustrate this effect. The transition temperatures for the Charpy tests, listed in Table 8 are consequently not definitely defined and it is necessary to consider the energy absorptions for the various steels in order to have a clear picture of the merits of the Charpy test in determining the relative brittleness of steels. The Charpy test results reported herein were included primarily to show the variation which can be expected from plate to plate in a single steel. A more complete investigation of the steels by use of the Charpy test has been included in the program of work of Project NObs-31217 conducted at Pennsylvania State College. 

The wider specimens usually showed higher transition temperatures. The differences between the transition temperatures of the 12- and the 72-inch wide plates for a particular steel range from 4 to  $40^{\circ}$ F. The transition temperature of steel C was the highest of all the steels tested and was essentially the same for all plate widths. However, the transition temperatures of the steels with lower transition ranges were invariably lower for the 12-inch specimens than for the 72-inch specimens. Because of the greater

spread between transition temperatures of the different steels, the 12-inch wide specimen seems to be more suitable than the wider specimens for rating the steel in order of their relative brittleness.

From theoretical considerations, it is reasonable to expect that the wider notched plates would have higher transition temperatures than the narrower ones. It is somewhat surprising, however, that in several cases there was little effect of plate width on the transition temperature while with other steels large differences in transition temperature were found. There seems to be no simple explanation for these results. The transition temperature very likely is a function of the amount of plastic flow which has occurred prior to the onset of fracture. It is possible that a more detailed study of the conditions of local plastic flow around the notches of the individual plates would disclose the reasons for the differences in behavior of the various steels.

From the theoretical considerations developed in the section "Studies of Formation and Growth of Cracks in Notched Plates" of NDRC Report, OSRD 6452,<sup>2</sup> it follows, that for a notch of a given sharpness, the transition temperature should increase with increasing plate thickness up to a certain thickness after which increasing the plate thickness still further should cause no change in transition temperature. Apparently this is true because the transverse stress developed by restraint is small in thin plates but, with increasing thickness, it gradually increases to a maximum value which would probably remain constant with further increase in plate thickness. To obtain an estimate of the effect of plate thickness, some special tests were conducted. The results of these tests are shown in Figs. 14 and 15. Plate thicknesses ranging from  $\frac{1}{2}$ - to 1 1/8-inch were tested in the form of 3-inch wide edge-notched bars to determine the transition temperatures

2 See Bibliography

of each thickness of plate. Two series were tested: (1) plates from the same heat rolled to each of the various thicknesses and (2) plates from the thickest rolled plate machined to each of the various thicknesses. The first series (results shown in Fig. 14) involved differences in metallurgical structure brought about by the differences in rolling procedures as well as differences in specimen thickness. The second series (results shown in Fig. 15) involved only differences in specimen thickness because all specimens were machined from the same plate. The effect of plate thickness upon the transition temperature is very evident in Fig. 14. The results indicate that when the plate thickness exceeds one inch, the transition temperature is apparently independent of plate thickness. This conclusion is not definite, however, and additional tests on thicker plates and on other steels should be made. It is possible that the thickness effect differs for various steels.

The effect of additional rolling, as shown by comparing Fig. 15 and 14, is to raise the transition temperature of the steel. This effect is in agreement with the known effects of rolling upon the other mechanical properties of steel.

Comparison of Fig. 14 and 16 indicate that the width and depth of notch and minor variations in width of the specimen have little effect on the transition temperature ranges of edge notched narrow specimens.

From examination of results for steel C in Fig. 17, which gives a comparison of the transition ranges for various types of 3-inch wide specimens, it appears that sheared edges of the plates as received from the mill had undergone strain aging and contained small cracks which acted as more severe stress raisers than notches made with hacksaws either at the edges or in the center of the specimen.

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The test results for the 3-inch wide plates indicates that the steels can be arranged in approximately the same order by means of these tests as by tension test of wide notched plates, although the actual transition temperatures may differ for the two types of tests.

Tests of 108-inch wide specimens failed to indicate that there is a definite drop in nominal strength as the test specimen width is increased beyond 72 inches. Examination of Figs. 18 and 19 show that there is a considerable drop in nominal strength of notched test specimens, as the width is increased to 24 inches. Further increases in specimen width have little effect on the strength.

The reduction in nominal strength is somewhat more pronounced for specimens failing in shear than for those that break by cleavage.

Variation of nominal stress with temperature is not very evident for "special" steels used in this investigation as can be seen from examination of Fig. 20. The strength of steels N, Q, and QS is not affected by temperature, while that of the semi-killed steel group (steels A, B, and C) tends to be lower at temperatures below the transition temperature for the particular steel. The fully-killed steel H does not exhibit any appreciable decrease in strength with lower temperatures for the l2-inch specimens, but behaves in the same manner as the semi-killed steel group in tests of 72-inch specimens.

Comparisons of the elongation at maximum load and at fracture of plates that behaved in a ductile and a relatively brittle manner are given in Figs. 21 and 22. The elongations are shown in percent, and to compare plates of different sizes, the locations of the gage points on which the measurements were taken are plotted as fractions of the specimen width. A marked difference can be could between specimens that failed in shear

and those that failed by cleavage. For specimens failing by shear, narrower plates exhibited much greater ductility; this, however, was not true for specimens that failed by cleavage.

During the course of the tests, certain specimens exhibited anomalous behaviors. In particular, specimens H8, H10, and H82X which were cut from the same large plate and tested at the same temperature behaved entirely differently. Specimen H1O absorbed more than twice the amount of energy than was absorbed by its supposed duplicate, specimen H82X, specimen H8 absorbed more than three times as much energy as specimen H82X. These specimens were studied in detail to determine the cause for the discrepancy. A study of the surface of the fracture near the base of the notch revealed that the specimens which had absorbed the abnormally high amount of energy had many openings in the metal running perpendicular to the surface of the fracture and perpendicular to the apex of the notch. This effect is shown in Fig. 25a which shows the surface of the fracture adjacent to the base of the notch. Fig. 24 shows the location in the plate specimen of the portion of the fracture shown in Fig. 25. Similar photographs of the portion of the fracture near the base of the notch for specimen H10 and H82X are shown in Figs. 25b and 25c respectively. The openings in the metal perpendicular to the fracture surface were progressively fewer in number and smaller in size for the specimens which fractured with low energy. This superficial examination indicated that the metal was opening along seams of nonmetallic inclusions. The cause for the opening was the Poisson's ratio contraction in the thickness direction brought about by the longitudinal extension of the metal by the load. Sections were then taken through the thickness and perpendicular to the fracture surface for microscopic

examination. The results are shown in Figs. 25d, 25e, and 25f. These photomicrographs show the small transverse fractures progressing along lines of nonmetallic inclusions. Specimen H10 had many more lines of nonmetallic inclusions, along which the transverse fractures could occur easily than did specimen H82X. Specimen H8 had still more lines of nonmetallics than did specimen H10. The extensive separation of the metal in specimen H8 along lines of inclusions prevented the transverse stress from building up to its normal (probably high) value, and thus effectively increased the shear stress and promoted plastic flow; thus a large amount of energy was absorbed although the specimen eventually failed by cleavage. The specimen acted essentially as though it were composed of a number of thinner plates placed face to face to form a composite thick plate. Specimen H82X was cut from a different part of the original large plate which happened to contain fewer nonmetallics and consequently behaved in a more normal manner than did specimens H8 and H10 (see Fig. 10 which gives the energy vs. temperature curve for this steel). The conclusion reached as a result of this study is rather unusual. Nonmetallic inclusions, ordinarily considered undesirable, acted in this case to make the steel less notch-sensitive. and hence improved its performance.

Another unusual result was obtained with the Q steel which had been quenched and drawn. In the original heat treated condition, this steel was not particularly outstanding. However, when requenched from 1600°F and redrawn at 1245°F for 2 hours, its performance was markedly improved. Its transition temperature was lowered slightly, but more important was the improvement obtained in the amount of energy required to rupture the material. The microstructures of this steel are shown in Fig. 26. The microstructure

of the QS steel was very much like that of steel Q, but in some of the specimens of steel Q there appeared to be some free ferrite. The worst example of this was found in specimen Q-1 which fractured with low energy at a temperature considerably above the normal transition temperature for this steel. When this specimen was examined microscopically, it was found to have an unusual microstructure. (See Fig. 26c) Much more free ferrite was present in this specimen than in the others of the Q series. The presence of free ferrite in quenched and drawn steels of this type has also been found in other tests to be associated with abnormal brittleness. The brittle behavior of specimen Q-1 thus seems to be in line with the known behaviors of the steels having similar microstructures. The free ferrite could be the result of (1) inadequate quench or (2) reheating slightly above the lower transformation during the tempering treatment.

There is still a deplorable lack of fundamental information about the behavior of steel in the vicinity of a notch. The wide flat plate tests have clearly demonstrated that each steel behaves differently and that even the relative behaviors are different for different plate sizes The need for a fundamental study of the behavior of steels in the notched condition is clearly indicated by the results of the tests performed on wide flat notched plates.

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Conclusions

The following conclusions seem justified on the basis of the results of the entire investigation including the work done under References 1 and 2 (see Bibliography) as well as the new work presented for the first

time in this report.

1. Fractures were obtained in the laboratory which were identical in appearance and reduction in thickness with those found in sections of fractured ships.

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2. All steels tested were arranged approximately in the same order of relative brittleness by Charpy keyhole-notch tests and by tests of notched plates of different widths. Transition temperatures determined by Charpy tests are lower than those determined by notched flat plate tests.

3. Plates failing by cleavage fail with slightly lower nominal stress values than do similar plates which fail entirely by shear.

4. The chemical composition has a marked influence upon the transition temperature of steel. This is well demonstrated by the results of tests on the 3, percent nickel steel which was far superior to the mild steels both in transition temperature and in energy absorption. The effect of chemical composition was further demonstrated by the results of tests on steels A and C. These steels had essentially the same chemical composition with the exception of the nitrogen content. Steel A contained 0.004 percent nitrogen while steel C contained 0.009 percent. The difference in the behaviors of these two steels may be mainly due to the difference in the nitrogen content. However, the microstructures of these steels also differed slightly and part of the difference in properties was probably due to the difference in metallurgical structure. Apparently a higher rolling temperature had been used for steel C than for steel A. The

transition temperature and energy absorption are apparently affected as much by the metallurgical structure of the steel as they are by the chemical composition. Steel Q, which was quenched and drawn originally, was greatly improved by heat-treating. This treatment eliminated free ferrite from the microstructure.

5. For hull-quality steels of the semi-killed type, produced under ordinary conditions of present commercial practice, the temperatures at which the mode of failure of sharply notched plates changes from a ductile shear to a brittle cleavage type may vary from below freezing to well above room temperature.

6. In these tests it was found that on the basis of the transition temperatures, the steels could be more definitely rated by tests of 12-inch specimens than by tests of wider specimens.

7. With the same sharpness of notch and a fixed ratio of length of notch to width of plate, the nominal strength of plates of the same thickness decreased with increasing width. The decrease in strength is considerable as the plate width is increased from a few inches to one or two feet, but the decrease in strength is relatively small as the plate widths are increased beyond two feet. The nominal strength of steel B is only about 1000 psi less in 108-inch wide plates than it is in 72-inch wide plates.

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8. With a given notch geometry and a fixed plate width, the transition temperature was found to increase as the specimen thickness was increased. In specimens cut from plates rolled to different thicknesses from the same heat of steel, two factors influenced the transition temperatures; these were (1) specimen thickness, and (2) metallurgical conditions introduced by the additional rolling given to the thinner plates. Thin

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specimens machined from thicker plates had higher transition temperatures than did specimens of the same thickness made from as-rolled plates.

9. Steels can be arranged in the same order of notch sensitivity by tests of edge-notched 3-inch wide specimens as by tests of centrally-notched wider plates, although the actual transition temperature may differ for the two types of tests.

10. For a series of tests conducted on geometrically similar centrallynotched specimens 3, 6, and 12-inches wide it was demonstrated that the model laws apparently do not hold for fracture.

11. For tension tests made on cylindrical un-notched specimens at various temperatures down to liquid-air temperature, both yield and fracture strength were found to increase as the temperature was lowered. As the temperature approached liquid-air temperature, the mode of fracture changed from the shear to the cleavage type, and the fracture stress and ductility decreased. The cleavage strength at low temperatures was found to depend upon the strain history of the material. Bars strained at room temperature were found to have higher cleavage strength when subsequently broken at liquid-air temperature.

12. Tests of two additional tubular specimens, made to complete the research program originated as NDRC Project NRC-75, showed that welding with low hydrogen content electrodes apparently does not improve the ductility and that post heating to 1100°F after welding improves the ductility of the

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weld.

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#### Organization -

The investigations were conducted by the University of California in the Engineering Materials Laboratory. E. P. O'Brien, Dean of the College of Engineering, was the Technical Representative for the Project. The work was under the general direction of Raymond E. Davis, Director of the Engineering Materials Laboratory. G. E. Troxell, Professor of Civil mgineering, Harmer E. Davis, Associate Professor of Civil Engineering, Earl R. Parker, Associate Professor of Physical Metallurgy, and A. Boodberg, Research Engineer, were in charge of the technical phases of the investigation. Special studies were conducted by Charles H. Avery, Joseph D. DeVito, R. Páyne, and T. Robinson. The shop work, welding and rigging was under the supervision of Elvin L. Whittier. Other members of the project staff who have served either full or part-time included: P. R. Angell, G. Barringer, D. Behm, Mary E. Bennett, E. Berliner, D. Berner, E. Betts, R. Bousquet, F. Brezee, E. M. Cleave, Winifred Dunlop, C. Glassgow, David E. Gibbs, J. Hancock, Elsise Hornstein, R. Johnsen, Inez Meklak, Ruth Mimball, R. LaForge, S. Lever, J. Logan, E. McLaughlin, J. Mednick, M. Mullins, Jean Neilson, F. Ormsby, D. Peterson, K. T. Rains, Vera Rideout, A. D. Ring, R. F. Schord, Le. Seaborn, D. Unger, T. Yamamoto, and Phebe Zimmerman. Harry E. Kennedy, Research Associate in the College of Engineering, served as consultant on special problems,

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## APPENDIX A

## Residual Strain Distribution in Notched Flat Plate After Fracture

A system of rectangular grids described in a previous report<sup>1</sup> was applied to one face of all the wide notched flat plates that were tested. Readings reproducible to <sup>+</sup> 0.002 were taken by means of a special mechanical strain gage prior to the test and after fracture. Percent elongations were calculated for the different gage lengths and the results are presented in Figs. A-68 to A-153 of this report. Residual strain distributions for plates broken in the earlier part of the program were presented in Figs. A-1 to A-67 inclusive of the earlier report.<sup>1</sup> It is to be noted that the values given in the figures do not include elastic elongations nor the amount of separation of the parts of the plate along the fracture line. Also, since the residual elongations were measured only on one face of the plate, the effect of permanent bending of a plate during fracture may be included in the values shown in the figures. In most cases, however, very little bending and distortion occurred during fracture.

Lines of fracture are shown on the drawings for which the overall grid system is plotted. The temperature of test, the nominal stress and the mode of failure are indicated on the figures.

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#### APPENDIX B

## Additional Tests of Large Tubular Specimens of Kild Steel

To supply additional information, as a result of questions raised by a study of the data obtained from the tests on large tubular specimens included in the program of work of NDRC Project NRC-75,<sup>3</sup> tests were made on two additional tubular specimens at  $-40^{\circ}$ F with a stress ratio of 1:1.

The specimens were hollow cylinders 20-inches in outside diameter, 18½-inches in inside diameter and 10-feet long. The tubes were made by forming two 3/4-inch thick plates into half cylinders and welding them together along two longitudinal seams 180° apart. The same steel was used as for the tubes previously tested (steel A). The plates used in both specimens "L" and "O" were heat treated at 1100°F for about 8 hours after forming operations were completed. For detailed description of the apparatus used and the test procedure reference is made to the original report.<sup>3</sup> Specimen "O" was welded with NRC-2A electrodes<sup>5</sup> and was not stress relieved after welding. Insofar as the fabrication procedure was concerned, specimen "L" was a duplicate of specimen "I" and was welded with E-6020 electrodes and was given a socalled stress-relief heat treatment at 1100°F for 6 hours after the completion of the welding.

Figs. B-1 and B-2 show the nature of the fractures in the two tubes. Figs. B-3 and B-4 show the strain distribution in the fractured tubes as determined from grid measurements. Figs. B-5 and B-6 show the effectivestress: effective-strain<sup>6</sup> curves plotted for all of the tubular specimens

3,5 See Bibligraphy See Bibliography, Effective-strain and effective-stress are defined as follows: Effective-strain =  $\overline{\mathcal{E}} = \frac{2}{3} \sqrt{\frac{(\mathcal{E}_1 - \mathcal{E}_2)^2 + (\mathcal{E}_2 - \mathcal{E}_3)^2 + (\mathcal{E}_3 - \mathcal{E}_1)^2}{2}}$ as follows:  $E_{1} = \log_{e}(1+e_{1})^{2}; E_{2} = \log_{e}(1+e_{2}); E_{3} = -(E_{1}+E_{2})^{2}$ where (cont'd page 21)

for which load-strain readings were available. Figs. B-7 and B-8 show plots of the strain distributions in the tubes for various stress levels. Some of the results obtained on small tubes of the same steel, tested at Illinois Institute of Technology on NDRC Project NRC-77,<sup>4</sup> are plotted in Fig. B-9 for comparison with Figs. B-5 and B-6. Curves for results obtained from standard .505-inch diameter tension specimens cut from the weld and the plate material near the ends of the large tube and tested at the University of California are shown in Fig. B-10.

Specimen "O", welded with NRC-2A electrodes, did not show any appreciable improvement over tube "F", welded with E-6020 electrodes; both tubes were tested under similar conditions. The two tubes were also similar in method of fabrication with the exception of the electrodes that were used in welding. The same heat treatment prior to welding was used on each tubeplates being first formed, then stress relieved. Neither of the cylinders was preheated prior to welding and neither was stress relieved after welding. The welding of cylinder "O" was done with 1/4-inch diameter NRC-2A type electrodes preheated to 600°F prior to use and used while they were still hot. The longitudinal weld required quite a number of repairs near one of

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4 See Bibliography 6 Cont'd  $e_1 = \text{measured axial strain and}$   $e_2 = \text{measured circumferential strain}$ Effective-stress =  $\overline{U} = \sqrt{(\overline{U_1} - \overline{U_2})^2 + (\overline{U_2} - \overline{U_3})^2 + (\overline{U_3} - \overline{U_1})^2}$ where  $\overline{U_1}$  = average axial true stress, psi  $\overline{U_2}$  = average circumferential true stress, psi

G3 = average radial true stress, psi In these tests, effective-strains were computed from the average strain readings of the 2-in. clip gages located near the mid-section of the specimen away from the welds.

which the fracture originated. No preheat was used in rewelding the areas that were repaired. X-ray pictures of the weld taken after the repairs were made showed no indication of any defect near the origin of the break. Cleavage fracture originated at the longitudinal weld of specimen "O" about 22-inches below mid-section and proceeded in both directions parallel to the weld along the heat affected zone for about 12-inches and then propagated around the specimen in several directions.

Specimen "L" failed to show as good results from post heating to  $1100^{\circ}F$  as did its counterpart specimen "I". It was more ductile than specimen "F", which was not stress relieved after welding, but did not exhibit as much of a reduction in thickness, as great an elongation, or as large a true stress at fracture as did specimen "I".

The fracture in specimen "L" originated in the plate material well away from the weld, near the upper end of the tube. The fracture apparently started near a defect in the plate shown in Fig. B-ll. If it were not for this defect it is possible that somewhat higher strength may have been attained as well as greater elongation and reduction in thickness and thus the results from tube "L" would compare more favorably with those from tube "I". Examination of Fig. B-5 shows that the stress-strain curves for both tubes "L" and "I" do not differ greatly up to an effectivestrain of 0.09 at which point tube "L" fractured. The fracture occurred on the section perpendicular to the axis at a true stress of 62,000 psi, which is below the true stress at fracture in a simple tension test.

It may be noted in passing that in the effective-stress:effectivestrain curves there are discrepancies large enough to indicate that existing theories of plastic flow are either incomplete or inexact.
#### Conclusions

The following conclusions may be drawn from the results of large tubular specimen tests described in the final report of NDRC Project NRC-75<sup>3</sup> and the results obtained from the tests of the two additional specimens described in this report. Some of the conclusions are based on results from tests of pilot series on small tubular specimens.<sup>7</sup>

1. Welded 20-inch diameter tubes of hull-quality steel tested under various combinations of internal pressure and axial load exhibited strengths and ductilities considerably less than the tensile strengths and ductilities of standard coupons made of the plate material. This tendency was also exhibited in a number of the smaller, more homogeneous, tubes of the pilot series of tests.

2. The strengths of the tubes as calculated on the "conventional" basis did not vary as widely with different testing conditions as the socalled "true" stresses at failure. Also, for the purposes of interpretation of the phenomena observed in these tests, the true stresses at failure appear to be a more significant index of strength, even though they are computed as average stresses across an entire section rather than stresses at a point.

3. Under certain combinations of temperature, ratio of applied stresses, and conditions of tube as regards heat-treatment, it was possible to attain failures with very low ductilities, approaching those observed in fractured ships, even though there was no mechanical notch in the tubular specimens. The strengths attained under such conditions were correspondingly low as compared with the strengths of the most ductile specimens.

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4. All the tubes tested at 70°F, with the exception of those in which the fracture occurred near the ends due to complex stress conditions caused by end restraint and consequent excessive bending, exhibited appreciable ductility prior to fracture.

5. All the tubes tested at  $-40^{\circ}$ F, with the exception of one of the two which were heat-treated after welding, were relatively brittle, i.e., exhibited relatively low plastic strains prior to rupture.

6. Two types of fracture were observed to take place, depending upon the conditions leading up to failure: (a) shear fractures occurring approximately on planes of maximum shear stress, and (b) cleavage fractures occurring normal to the direction of the critical tensile stress.

7. In welded tubes, while the ratio of the principal stresses in a tube wall may have played some part in determining the overall strength and ductility, the orientation of the critical tensile stress with respect to the direction of the welded seam appeared to be a governing factor as regards initiation of failure. It is noteworthy that in the tests at room temperature, in those cases where the circumferential stresses were critical, failure occurred in the plate away from the weld, while in those cases where the longitudinal stresses became critical, the failures occurred in the weld or weld zone.

8. It is believed that the gross residual stresses due to welding contributed relatively little toward causing failure, at least within the range of temperatures at which these tests were conducted, because all tubes in which fracture initiated in the longitudinal weld stretched sufficiently (1.6 percent or more) prior to failure to minimize, if not to eliminate, the influence of residual stress.

9. In tubes in which fracture initiated in the region of a weld, a crack appeared to have started in the weld or weld zone, and then fracture propagated into the plate.

10. Small discontinuities, such as defects, gouges or nicks may be crack-starters, particularly at low temperatures (Tube G and Tube L). 11. In all the tests made in this investigation, wherever fracture started in the weld zone, failure occurred by cleavage and the specimen was brittle.

12. The beneficial results of heat-treatment of tubes after weld-. . . . . . . ing is attributed primarily to alteration of the metallurgical structure of the weld zone rather than to relief of residual stress. (See especially Tube I). The so-called "stress relieving" heat-treatment markedly improved the strength and ductility at low temperatures. This heat-treatment reduces the residual stresses and it alters the metallurgical structure of the weld zone, making the material in this region more ductile. The residual stress is also reduced by causing a small amount of plastic flow to occur parallel to the weld. This effect occurs at atmospheric temperatures; consequently, the metallurgical structure remains the same. The plastic flow is sufficient in all of the tubes tested in the "as-welded" condition to produce stress-relief by stretching. The tube "stress-relieved" by heat-treatment had much greater ductility than any of the as-welded tubes. Since stress-relief occurred in all tubes, either by heattreatment or by stretching, it appears that the main benefit derived from the heat-treatment is the beneficial alteration of the metallurgical structure. It is indicated that appropriate heat-treatments or pertinent changes in

welding technique are means of reducing or eliminating tendencies toward premature brittle cleavage fractures.

13. Bending stresses (such as those which can occur at the end of a closed tube due to radial restraint of the heads) or abrupt changes in wall thickness are likely causes of premature failure at both room and low temperatures. It was found necessary to take special care to provide a very gradual transition at the ends of the tubes in order to obtain failures near the mid-section.

14. A specimen welded with low hydrogen content, NRC-2A electrodes, was apparently no more ductile than similar specimens welded with E-6020 electrodes.

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#### APPENDIX C

# Results of Tests on Simple Tension Specimens

#### Tested at Various Temperatures

Tension tests were made on unnotched cylindrical specimens of steels A,  $B_n$ , and C at various temperatures ranging from 450°F to liquidair temperature. Yield strength, fracture stress and reduction of area were determined at each temperature. In addition, the effect of prestraining at various temperatures on the cleavage fracture stress at liquidair temperature was determined for steel A. These tests were conducted with the object of obtaining basic data on yield strength and fracture strength, and to determine the temperature of transition from shear to cleavage fracture for the case of simple tension loading.

The results of the tests have been plotted in Figs. C-1, C-2 and C-3. The yield strength increases rapidly as the testing temperature is lowered until it is essentially equal to the fracture stress at liquid-air temperature. The fracture stress (breaking load divided by final area) rises more slowly but continues to increase as the testing temperature is lowered until the cleavage-type fracture begins to occur. At this temperature, the transition temperature in simple tension, the fracture stress reaches a maximum and at lower temperatures drops to considerably lower values. The transition temperatures were found to be about  $-250^{\circ}$ F for all three steels. Thus it was indicated that the simple tension test apparently is not as suitable for rating steels in their relative order of brittleness as are notched-bar tests.

There are several results worthy of further discussion. Steels  $B_n$  and C tested at -300°F fractured at stresses lower than the yield stress. When the specimens yielded, the load dropped off as it normally does at room temperature for mild steel, and fracture occurred before the load increased again. This unusual effect was checked by tests on a number of additional specimens.

A series of specimens machined from steel A were strained to a 10, 20, 30, 40, 50 and 60 percent reduction of area at 212, 70, and  $-105^{\circ}$ F, and then the temperature was lowered immediately to  $-300^{\circ}$ F and the specimens broken with no additional plastic flow occurring. The cleavage fracture stress at  $-300^{\circ}$ F was found to increase as the amount of prior strain was increased. These results, shown in Fig. C-4, indicate for these steels how the fracture stress at a low temperature depends upon the strain history of the material. The temperature at which the prestraining was done, however, seems to have little influence upon the fracture stress.

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#### APPENDIX D

#### Results of Tests on Geometrically Similar Centrally Notched Flat Plate Specimens

Tests were made at several temperatures on a series of geometrically similar specimens. The type of the specimen and the dimensions of the three sizes of specimens are given in Fig. D-1. Table D-1 gives the principal data for each test, and Figs. D-3 and D-4 show the variation of longitudinal strain with distance from the notch of a 3-inch wide size-effect specimen.

Fig. D-2 gives nominal stress-strain curves for longitudinal elements at the base of the notch obtained on gage lengths of 0.01, 0.02, and 0.04 inches for the three sizes of specimens. The specimens do not behave similarly up to strains at which the first crack forms in the root of the notch. Consequently, it is questionable as to the extent to which model laws are valid in the plastic range. After cracks form, similarity in behavior no longer occurs because the specimens are thereafter no longer geometrically similar. The results of these tests contradict a previously reported<sup>2</sup> conclusion that similarly notched samples seem to unlergo similar strains within the plastic range.

The fact that the model laws do not hold within the plastic range is surprising, because theoretical considerations lead one to expect similarity in behavior. A possible contribution to the observed differences in behavior is the surface condition of the specimens. After annealing, all specimens were first carefully machined in a shaper, with the final cuts being very light. All specimens were finished in a surface grinder, with the final cuts again being light. Even with light cuts the surface layers of the specimens are cold worked and are consequently stronger than the base plate. The percentage of the total cross-section taken up by the coldworked surface layers is larger for the smaller specimens and consequently

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might conceivably explain the results. A rough estimate of the amount of strengthening which could result from such surface hardening indicates that the differences cannot be explained by this factor alone. Additional tests should be made on specimens from which the cold-worked surface layers have been removed completely. . 1. j. ii

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# TABLE 1. -- DESCRIPTION OF STEELS USED IN FLAT PLATE TESTS

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All steels were tested at temperatures selected so as to define the temperature transition range within reasonable limits.

Steels used in tests of 12-in. specimens (or wider) were furnished in plates 3/4 by 72 by 120 in.

Code Letter for Steel and Manufacturer	Approximate Chemical Analysis % C % M	Type of Steel and Condition .	Use in Test Program
A Carnegie-Illinois	0.25 0.47	Semi-killed as rolled	Large cylinders; 72,48,24,12 and 3-in. notched plates; Charpy impact tests; low tem- perature tensile bars
<sup>B</sup> ar Bethlehem	0.18 0.72	Semi-killed as rolled	72,48,24,12 and 3-in notched plates; Charpy impact tests
Bethlehem	0.18 0.72	Semi-killed normalized	72,48,24,12 and 3. in notched plates; Charpy impact tests; low temperature tensile bars
C Carnegie-Illinois	0.25 0.49	Semi-killed as rolled	72,48,24,12 and 3-in, notched plates; Charpy impact tests; low temperature tensile bars; size offect studies
D Lukens	0.19 0.52	Fully-killed normalized	One 72-in. plate and 3-in. notched plates
E Lukens	0.23 0.39	Rimmod as rolled	3-in. notched plates
H Bethlehem	0.16 0.85	Fully-killed as rolled	72,12 and 3-in. notched plates; Charpy impact tests
N Lukəns	0.13 0.49	3 1/4% Ni as rolled	72,12 and 3-in. notched plates; Charpy impact tests
Q Republic	0.23 1.05	Fully-killed water quen- ched from 1600°F. and drawn at 1300°F.	12 and 3-in. notched plates; Charpy impact tests
OS Republic	0.23 1.05	Fully-killed water quen- ched from 1600°F. and drawn at 1245°F.*	12 in. notched plates only

\*Six 12-in. specimens of Q steel were reheattreated.

TABLE 2. -- PROPERTIES OF STRELS USED IN THE INVESTIGATION.

Steel Code Letter and Manufacturer	Steel A Carnegie - Illinois	Steel B Bethlehem	Steel C Carnegie - Illinois	Steel H Bethlehem	Steel N Lukons	Steel Q Republic
Chemical Composition C Mn Si P S Ni Al Cu Cr Mo Sn N	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	a   b     0.16   0.18     0.74   0.73     0.03   0.07     0.011   0.008     0.030   0.030     -   0.05     -   0.015     -   0.03     -   0.03     -   0.015     -   0.02     -   0.006     -   0.012     -   0.005	a b   0.24 0.24   0.49 0.48   0.043 0.05   0.015 0.012   0.033 0.026   - 0.016   - 0.03   - 0.03   - 0.03   - 0.03   - 0.03   - 0.03   - 0.003   - 0.003   - 0.003   - 0.003	a   b     0.16   0.18     0.75   0.76     0.17   0.16     0.010   0.012     0.022   0.019     -   0.05     -   0.053     -   0.09     -   0.04     -   0.004	a     b       0.13     0.17       0.49     0.53       0.22     0.25       0.018     0.011       0.027     0.020       3.34     3.39       -     0.077       -     0.19       -     0.06       -     0.017       -     0.017	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
Type and Heat Treatment	Semi-killed As rolled	Semi-killed As rolled Normal- ized.	Semi-killed As rolled	Fully-killed As rolled	Alloy As rolled	Fully-killed Water Quenched from 1625°F Drawn at 1300°F for 1 3/4 hrs.
Physical Properties Yield Point, psi Ult. Strength, psi Elong.,% in 2 in. Elong.,% in 8 in.	37,950 59,910 33.5 —	35,800 34,800   59,600 58,900   26.0 32.0	39,000 67,400 25.5	39,800 63,100 27.0	49,800 78,300 25.5	46,600* 72,450* 49*
Deoxidation Practice	1-1/3 lb, ton in ladle 1/2 lb./ ton Al in the mold	8-1/2 lb./ton of ferro-manganese, 1- 1/8 lb/ton ferro- silicon and 2-1/2 lb/ton of Al-Si in Ladle; small amout cf Al added in mold	6 lb./ton of 80% ferro- manganese and 2.6 lb./ton of 50% ferro- silicon in ladle; 1/3 lb. per ton of Al in mold.	6.1 lb/ton at 80% ferro-man- ganese and 7.2 lb./ton of 50% ferro-silicon, 4.3 lb/ton of Alsifer and 2.6 lb/ton of Al in ladle	Not Reported	Not Reported

Notes: a -- Analysis furnished by the Steel Manufacturer \* Average values for the 10 plates furnished b -- Analysis performed by Dr. S. Eqstein(Bethlehem Steel Co.) for this investigation.

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TABLE 3 -- CHEMICAL ANALYSIS OF SAMPLES FROM INDIVIDUAL PLATES

Plate No.	Condition and Type	Chemical Analysis
A-1 A-2 A-3 A-4 A-5	As rolled, semi-killed """" """"""""	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
B-1 B-3 B-6 B-7 B-9	As rolled, semi-killed """" """" """"	0.17   0.71     0.18   0.70     0.17   0.73     0.17   0.68     0.17   0.71
B-2 B-4 B-5 B-8 B-10	Normalized, semi-killed """"""""""""""""""""""""""""""""""""	0.18 0.73   0.18 0.73   0.18 0.71   0.16 0.71   0.17 0.71
C-1 C-2 C-3 C-4 C-5 C-6	As rolled, semi-killed """"""""""""""""""""""""""""""""""""	0.25   0.47     0.26   0.49     0.23   0.50     0.25   0.48     0.26   0.46     0.25   0.48
D-1	Normalized, fully-killed	0.19 0.52
E-1	As rolled, rimmed	0.20 0.33
H-1 H-2	As rolled, fully-killed	0.18 0.76 0.18 0.75
N-1 N-2 N-3 N-4	As rolled 3.36% N: " 3.34% N: " 3.37% N: " 3.38% N:	0.18 0.48   0.17 0.48   0.15 0.50   0.17 0.50
ସ-1 ସ-2 ସ-3	Quenched and Drawn,fully-killed	0.22   1.11     0.21   1.13     0.22   1.12

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AND HARDNESS TESTS

#### (Sheet 1 of 3)

	., [	· · · · · · · · · · · · · · · · · · ·		anaya (ila ayan soora ayanaya a	Tensile Pro	perties		Hardness
Type of Steel	Plate No.	of Bar <sup>a</sup>	Orien- tation <sup>b</sup>	Yield Point, psi.	Tensile Strength, psi.	Elong. %°	Red. in Area,%	Rockwell B Numbers
	Al	.505 .505 Square Flat	T L L L	34,575 35,550 35,070 34,510	57,875 58,800 58,460 58,320	42.0 42.8 50.5 34.0	57.3 60.8 62.0 58.4	61
	A2	.505 .505 Square Flat	T L L L	35,890 33,200 34,380 32,950	55,700 57,630 58,190 57,860	43.3 44.7 53.2 32.4	59.7 62.4 64.0 61.6	60
A	A3	.505 .505 Square Flat	T L L L -	36,500 35,500 36,620 35,380	58,500 53,400 58,630 53,620	42.0 43.0 51.0 36.6	53.7 60.7 63.6 64.1	60 <b>-6</b> 2
	A4	.505 .505 Square Flat	T L L L	36,180 36,680 35,200 34,800	62,475 62,870 60,300 60,900	38.0 42.2 47.5 31.4	53.0 61.5 58.3 57.5	61
	A5	.505 .505 Square Flat	T L L L	35,100 35,000 35,100 32,800	57,100 57,400 57,800 57,500	43.2 43.0 50.0 32.4	54.5 53.0 60.0 61.5	58
	Bl	.505 .505 Square Flat	T L L L	34,600 32,200 32,460 32,210	56,950 57,050 57,680 56,460	44.3 44.8 48.8 35.0	63.0 65.0 67.2 65.5	60
В	B3	.505 .505 Square Flat	T L L L	31,230 32,050 32,700 31,960	55,640 55,850 56,350 57,680	44.3 42.8 54.8 32.8	57,9 67.5 66.8 64.3	58
As Rolled	- B6	.505 .505 Square Flat	T E L L	33,500 30,350 32,410 31,960	56,950 56,630 57,200 56,880	42.0 45.3 54.5 33.9	62.2 70.1 67.7 64.3	60
 	B7	.505 .505 Square Flat	T L L L	33,500 33,050 33,000 32,300	56,500 57,150 57,000 57,000	43.0 45.7 53.5 23.4	60.8 71.5 69.8 67.5	61-63

a - .505 = A.S.T.M. std. round 0.505-in. dia. bar; square = full thickness of square cross section; flat = A.S.T.M. std. full thickness flat bar.

b - L = axis of bar parallel with direction of rolling. T = " " " perpendicular to " " "

c - Elongations measured on 2-in. original gage length except on std.

flat bars for which gage length was 8 in.

# TABLE 4. -- RESULTS OF STANDARD TENSION

# AND HARDNESS TESTS

(Sheet 2 of 3)

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	Type		Type			Tensile Pro	porties		TT
	of	Plate	of	Orien-	Yield	Tensile	Elong	Red.	Background
	Stee1	No.	Bara	tation <sup>D</sup>	Point,	Strength,		. in	B Numbers
		-			psi	psi		Area, 🏸	D Trumoor b
1	В	, İ	.505	Т	34,600	67,400	43.5	62.0	ļ
		B9	<b>.</b> 505	L	32,400	58,600	43,5 ~	69.0	60
	As	1	Square	Ľ	30,600	57,000	54,0	- 70.0	. 00
2	Rolled		Flat	L	30,800	56,900		68,6	
			.505	Υ.	3 <b>6,37</b> 0	58,320	41,8	60.4	l l
		B2 -	<i>。</i> 505	$\cdot \mathbf{L}_{\perp}$	37,100	57,930	46.5	67.2	20
1			Square	L	34,140	57,440	. 54:0	65.5	60 1
			Flat	L	35,000	56,880	35 0	63.4	
			.505	т	33,480	56,710	41.8	62.7	
		R4	,505	L	33,410	57,260	45.5	65-4	5.0
			Square	L -	31,080	55,470	·54 .0	.66.0	59
			Flat	Ţ,:	30,900	55,140	35,1	64,9	
	•		,505	T	37,150	58,530	43.2	60.E	
		ਸ਼ਨ	,505	Ľ	35,650	58,700	<u>44</u> .8	66.0	
	В	μų	Square	L L	32,300	56,670	. 55 O	.66.8	60
	Norm.		Flat	Ţ	33,870	56,940	34.8	64.9	
			,505	T	33,600	57,500	43 5	61.0	
		ъя	.505	Ţ.,	38,800	56,700	49.0	64.0	
		υç	Square	· L : )	31,900	56,700	.52:8	68,7	60
	•		Flat	L.	32,200	56,200	34 1	67.4	
ł	•		.505	Ţ	31,800	56,000	44,5	62.5	
	, A	B10	,505	L	33,900	55,600	43.5	63.0	60
		DIO	Square	, T	32,400	55,850	54.5	68,0	0 <b>0</b>
	· · · ·		Flat	. L	31,800	55,300	33.4	67.9	
			.505	T	35,500	61,500	40.0	52.2	
1		C1	.505	L	36,330	61,810	41.5	59,6	66
			Square	tille ve	35,330	63,000.	. 49.0	59.5	00
ł			Flat	- L	35,300	64,600	31,6	57,4	152000
			.505	Τ.	36,000	68,130	35,6	50.1	<u>.</u>
		02	.505	L	37,130	68,500	38.0	57.0	60
		0.0	Square	Ľ	36,200	66 <b>,</b> 540	45.5	54,2	00
	4		Flat	L	35,650	66,170	30.0	53.0	141000
			.505	T	35,650	63,850	38.7	54.5	
	a l	03	505	L	34,550	63,850	42.2	60.8	67-74
	-		Square	Ţ	39,100	65,500	47.7	61.0	0 1 1
	ļ		Flat	<u>.</u> بل	36,260	64,500	31.7	60,1	16/ 500
			505	T	35,500	64,200	39.0	53.0	
		C4	<b>.</b> 505	Ľ	37,650	63,750	42.0	59.6	68
	× .	~~ [	Square	L				[	
			Flat	L					
			505	T	36,000	34,000	38.5	55.0	
1		C5	.505	L	34,700	64,200	42,5	61,5	69
			Square	L	36,250	66,000	47.0	58,7	
		i	Flat	L	34,800	65,700	28.0	61.7	171550

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#### TABLE 4, -- RESULTS OF STANDARD TENSION

#### AND HARDNESS TESTS

# (Sheet 3 of 3)

Tane	Plete	Tune			Tensile Pro	perties		Hardness
of Steel	No.	of Bar <sup>a</sup>	Orien- tation <sup>b</sup>	Yield Foint, psi.	Tensile Strength, psi.	Elong. %°	Red. in. Area, %	Rockwell B Numbers
. 17	H1	.505 .505 Square Flat	T L L L	33,900 37,000 34,500 34,500	63,200 63,700 62,600 62,100	41.5 43.0 52.0 29.6	59.0 68.6 68.7 68.7	70
	H2	.505 .505 Square Flat	T L L L	34,000 37,500 33,700 35,500	63,000 63,900 62,300 63,000	40.5 44.0 51.5 30.0	60.0 67.2 68.7 67.0	70
	NI	.505 .505 Sq <b>ua</b> re Flat	T L L L	61,000 63,000 59,000 60,100	76,850 77,100 75,600 74,700	37.8 37.5 46.8 26.1	62.0 69.7 70.8 69.1	83
TY	N2	.505 .505 Square Flat	Т L L L	61,500 59,000 53,800 59,700	77,600 78,100 77,500 77,100	38.2 38.0 45.3 25.7	61.0 62:1 69:5 66,3	83-84
N -	N3	.505 .505 Square Flat	T L L L	52,750 58,000 50,600 50,300	83,300 32,000 32,700 82,300	32.5 38.0 41.7 26.0	54.0 61.5 62.1 61.2	85
	N4	.505 .505 Square Flat	T L L L	61,300 60,100 60,600 59,800	30,000 80,100 78,650 78,000	33.5 36.0 44.0 27.0	59.0 65.4 66.1 64.3	84
۵	Ql	.505 .505 Square Flat	T L L L	49,000 48,300 53,100 51,900	71,800 72,500 73,800 71,900	42.5 45.0 42:0 23.5	61.2 65.0 74.4 70.9	82
Water Quenched and Drawn	<b>Q</b> .2	.505 .505 Square Flat	T: L L L	44,000 43,500 48,400 49,600	70,550 70,850 71,050 70,800	44.2 49.0 43.0 22.2	59:7 62.3 74:0 71.8	83
	Q.3	,505 ,505 Square Flat		45,200 44,800 53,000 50,700	73,800 74,250 74,000 71,600	42.8 47:0 41.0 23.0	58.3 60.2 73.8 71.3	31

	Т	123	6	Т	1	2	Ĵ	2	- i	-	Ţ,			4	-J	1	-	-	-	9	1	~	~	-	-		<u> </u>	1			_	_	_	-	<b></b>
¢,		ENERG	1034	2081	684	2222	513 (F)	2400			609	1449	10022	803 803	135 (1	100	1316	2 100	140	194(9	2050	2255 (c) 2255 (c) 225	1351 41 1351 2083	2/67 (b)	001	611		10 A A A	47.2	(i) <b>130</b>	(80)	110	248 142	290	310
1 OF	(A SIZE	GAGE FACTU	24	54	54	10 01	1 66 (6)	54 190 (s)			22	44	5 23	10 (4)	100 (0)	101	6 99	8/	24	54 24	*	170 (e) 24 34	181 (0)	(01 (0)	44	1004		24	22	167 (0)	-101 -	5	(o)	54	24
-ET	PLATE	TYPE	HS \$0	0% Burn	9% CL.	18 18 18 18	10%0	24 Bm			HS N	18 SH	HS %	10.60	120	DI ATE	HS &	\$ Burn	10 40	K SH.	K Bun.	1280	HS &		2201	HS H	HS%C	70%0		BULA.	PLATE	1	1997	207	
SHE	CH TESI	MINAL ENGTH CE	9 2 9	0.0	000	5	5.8 10	00			8.5 0	0.0	202	95 9	2	U 75CT	<u>, 175</u>	22	0	2 6 2 6	6 4	0 0	62 88	ù.	10	8	2 100	100	0		H TEST	<u>v</u>	2 *	00/	-
	DNI-22	MP NO	2 0 3		5	500	۳ د	45° 4			m N	4	510 41	- N		0w-a0		ñ		3 1	000	20 Z	36 36	-	3/° 37	÷.	04 43	2° 35	64 64		DNI - 80	200		EF.	
STS	$\vdash$	GY TE	<u>9</u>	(8)	5	(e) 48°	~	43.			ŝ	2	48-	9	8		<u> </u>	5	ľ	3 8	100	19	3/°	-	30°.	100	1:001	B058	152		2	ŝ		9 E	
ŤΕ	12E)	E ENER	93	(6) 346	196	(1) 1062							1160	241	20		╞					_	_			1521	717	55		46					
ŤΕ	4 <i>TE (B S</i>	646	36	<i>u</i> /32	9E 7	1351				_			36	9£	-								<u> </u>			36	36	36		36					
PLA	EST PL	TYPE	5 \$ 06	10 2 97	15 2 92	242 84							15 268	10200												10 \$001	13 K 5N	10%001		10 % 00					
t Lui	INCH T	NOMEN AL	204			4/.1							42.6	35.2					ŀ							37.2	44.9	37.2	-	37.0			-	1	ĺ
IOIM	48	TEMP F (b)	600	3	5	48,	T						5-460	ô											T	80°	.10	-6727		32°					
QN		ENERGY K-IN	100	336	367(e) 51	77 (8)				_	WELD. ESTED	566	4	-					405	107 (e/			Ì	-	19 13(e)	4/		N						1	
4	E (C SIZE	AGE E INGTH	4/	. 6	18	94 (e)	+				OKE AT 45 RET	18			+-		-	+	0	8 00	-			-	(e) /	8							-		
<u>-575</u>	T PLATI	PE 6	K SH	10.20	1	2					K SH BF	HS %		╞	$\left  \right $	-		+	Ъ,	HS N	-				6 70 5	2H 2H									
TE	SH TES	NAL T	6 72	2 2		20	+			_	3 88	3 100			-	-	╞	-	305	5 100	-	+			6001	1 992							-		
JLE	24-IN(	P NOW	° 43	4	on iou	07 30	-		_		46.	° 43						<u> </u>	3° 46	4		-		_	9.2E	40.4									
'ENS	<u> </u>	ST TEN	37	8	144	-1 / /-	â	2			32	22	>						32-3	6				_	27°31	.88	_		_						
۴ ا	5	LUERO	98	104	36	1 1801	22/	43 %	6	15	1946	115	11.4	21	36	144	158	61	134	133	121	22	116	53	134	20.3	85 1326		78 1196		93 1146	72	227		
0	E (D SIZI	CAGE	9	0	9.00	54 (e	9/(e) 9	89 (e)	6	6	49 (e)	54 (e)	9 46 (e)	43 (e.	9 6 2	9 62	9 62	9 2	9.9	9	9 23	47 (e)	9 76 (e)	7   (e)	0	6	9 45 (e)		9 44 (e)		9 83 (e)	77 (e)	9 62 (e)		
/LTS	ST PLAT	TYPE FRACTURE	HS \$11	26% SH	10 4 4 11	104001	0000		100207	100% CT	83 \$ SH.	94% SH	HS 2001	10 200	10200	20% SH	87 % SH	100801	18 X 81	94% SH	H5 %00)	00\$07	3% CL.	00%07	70%00	3\$ SH.	5/\$ SH 19\$ CL.		42 SH 62 CL		HSXOO	0 2 CL	12 CL.		
RESU	INCH TE	COMINAL STRENGTH (S.J. (c)	46.5	48.1	191	101			38.7	38.5	48.9	46.1	49.3	40.0	41.8	48.7	50.4	43.5	48.1	45.6	45.9	38.5	48.7	42.2	40.0	\$2.8	51.1		54.7		18.7 /	10.0	53.2 5		
17	- 21	FEMP N	86°	1.33°	500	0	100 / 100	10-11	0	<i>'9°</i>	32°	0-730	0=210	594347	746%	5-17-0	0=23°	6016	2:36	89°	0.510	10076	5/20	0/	2:33°	84° ,	•101		5412		7 <u>e</u> 123° 4	- <i>-06</i>	-9£/₅		
VCIP2	E BAR	r. s. i r. s. i	58.8	57.6 3	202	1.0	X	-	`		1.73	5.9 7	6.7 5	7.2 (3	8.6 47	2	<i>م</i> ر	E.	7.9 3	7.3	8.5 5	7.4 H2	5.6 10		1.8 32	8.8	3.9	_	9.9 141		150		132		
PRII	N TENSIL	5.1	5.6	2			+	-	+		6.)	21 5	0.4 5	31 5	3.1.5				1	5.5 5	0.0	5 23	5		5.3 6	50 6	16 6	-	30 6:	-				_	
£,	0.505-1	(b) K	9° 3.	•/ Jf		5 M	<u></u>	+		-	3.	0° 3.	4° 3(	е Э.	۳. ۳					R	m a	96 196	بخ		36	36	×,	-	ŝ					MALIZED	
0	STD STD	O. TEI	r 1-	2		) 4	: 		2	XZ	2	3 5	6 7	2 65	9 76	X	Xa	37	2	4	5 70	62 6	0 70	X	02	22	68	~	2/4	6	3	x	×	, NOR	
ARY	4.A Pr. 1	ee Tuee	₹ HS	HS ST	SH 1	C T SH	2H 3	: ::		4-4	SH B-	SH B- CT B-	5H. B-	SH B-	6	6-9	B-3	E-B	SH B-	-9 H	SH B-	B-1	B-I	B-2:	24 C-1	SH C-7	S. S.	5	5- 5- 5-	5- 5- 5-	5H C-5I	SH C-52	0-11	KILLED	
MM	NSILE B.	(a) FRAC	3 <u>5</u> 326 0	5.0	101	345	978	22 27	+	4	36	5 84%	5 39 <b>%</b>	\$ 1003					328	3/8	34%	100%			286	37	96 %	28	9440	36 <b>2</b> 64 <b>2</b> (	95.	100%		- הרדג	
ب ک	(u) (u)	STREN KS.L.	. 66	61.6	6/2	609	. 58	-			65.	65.	63.	59	-				64.1	62.7	60.5	58.6			64.9	644	63.2	62.2	63.8	61.9	63.5	61.5		9.52 , F	
<i>ч</i>	GE-NOTC	r.S.	9 45.9	43.4	42.5	42.3	43 /				9 38.7	40.5	37.8	37.7					1.64 (	42.8	4/8	41.5			42.9	42.5	41.6	40.7	40.7	40.2	42.1	42.1		; Mn - L	
BLE	3-IN ED	TEMP F (b)	6199415	30°	49°51	69°-73	80°				61402)	6°-9°	22	33°.39					62 HIG	(-0)-(-2-)	34°40°	55°			34°.35"	49°	750	04-108-	87°	96	128	1440		C-0.17	
77		27				C	רדונו דונס	14-1 108	W35 57	T			037 03	ו- אוק נסדו	W35 -57					ат 03	אורר ערר	- IW 3 1W401	s V				-03 03	אורדי ארדני	- //V ) H S	75 77				TEEL ;	
		S/E	, V.	900	V#11	ино,	ע 3-ורד	0 9 63 ( NEC	-499 7 - 0 1149,	۲.			N JI	9124 91 1974	- UN 10 - 3 11 36	, <sup>JO</sup> B.				w	2∉ 9 1913	0-4 9/0 7H13	v ? 9, <sup>4</sup> 9				77/-	* + 6 5 + . 3   E -	0-4 10- 3NH0	9 2	o.			0" 5	

<u> </u>	3-IN EDG	E - NOTCH	ED TEN	SILE BAR		STD. 0.505	5-IN. TENS	ULE BAR	I2-INCH	TEST	PLATE	- (D – SIZE	,		12-INCH	TE ST	PLATE	(D - SIZ	E)	PLATE	72 - INC	H TEST	PLATE	(A-SIZ)	ε)
STEEL	TEMP	Y.S. K.S.I	NOMINAL STRENGTH	TYPE FRACTURE	PLATE NO.	TEMP. *F (h)	Y.S. K.S.I.	T. S. K. S. I.	TEMP. *F (b)	NOMINAL STRENGTH K.S.I. (a)	TYPE FRACTURE	GAGE LENGTH	ENERGY (c <sup>l</sup> ) <sup>-IN</sup> (d)	NO.	TEMP. *F (b)	MOMINAL STRENGTH K.S.I. (0)	TYPE FRACTURE	GAGE LENGTH	ENERGY (c. <sup>K-IN</sup> .(d.)	NO.	ТЕМР. *F (b)	NOMINAL STRENGTH X.S.I. (Q)	TYPE FRACTURE	GAGE LENGTH	ENERGY (c) <sup>K-IN</sup> (d)
	( <u>5</u> / (39/ <u>(</u> 36/	640	83.5	5 X SH.	N-1	70*	63.0	77.1	(-30°H28¶	69.3	84%SH	9 53 (e)	111 208 (e)	N-42X	(-24%-22°)	68.1	100 <b>%</b> SH	9 89 (e)	116	N-1	f.559,651 9	64,2	475H 967CL	84 185 (1)	448 1913 (4)
	(3-)-(4-(-)	649	832	95 4 CL. 5 % SH	N-2	70°	59.0	78./	624599	759	6 % SH	57 (e)	338	N-21X	- 2°	68.4	100 % SH.	9 84 (e)	114 208 (e)	N-2	(357-(307	60.9	13 SH. 87 KCL.	54 192 (4)	ATT (1)
•	150	64.4	819	10 % SH	N-3		52.8	83.5	72°- 73°	66.4	100%SH.	9 49 (e)	94 139 (e)	N-22X	-60°	70.4	35 %SH 65 %CL	9 72 (e)	119   146 _(e)	N-3	2*	59.8	73 % SH 27 % BURN	24 54	2094
LEC States		67.0	795	98%SH	N.A	75°	60.4	BOI	434°44-329	70.4	100% SH	9	76 131 (e)	N-13X	46574639	71.1	17 %SH 83 %GL	9 74 (e)	95  3/ (e)						
N N N N N N N N N N N N N N N N N N N	23	05.0		11%SH.	NAV			1	(793/799	689	100% CI	9	71.7	N- 14X	43874-369	69.6	7 894	9 74 (a)	115						
AS - LL	· 6 <sup>-</sup>	65.0	85.5	89%cl.	14-47				LAPPLAN	699	81 % SH.	9	123 434 (e)	N-15X	-64°	66.7	100 %CL.	9 70 (e)	70 72 (e)						
ž					14-44.2		<u> </u>			00.0	13 4UL.	0.5 (67	404 (0)	N-16X	32°- 33°	66.0	100 % 54	9 69 (e	109 123 (e)					_	
				8%SH		708	40.4	77.0	710	573	100%01	9	33.9	0-218	57° - 59°	60.0	100 %54	9	114						
, and	-/ 3"	69.3	828	92%CL.	Q-/	70*	49.4	73.2	1749	- 51.0 - 61.0	100% CL.	77.5 (e) 9	825 (e) 112	0-22X	32 °	62.2	82 %SH.	9	117		<b> </b>				
2 ***	- 2*	686	83.4	95% CL.	42	- 75*	47.7	12.2	134	640	100% 04	<u>88 (e</u> ) 9	<u>402</u> (e) 124	0.137	0.0	584	18 XCL.	<u>9</u> 21 (2	32 52				<u>   </u>		
PUBL 0.21 103 11/1	29°	67.4	80.4	7 2 a.	Q-3			· · · ·	15-17-	64.0	100% SH	615 (e. 9	144 (e) 114	0-147	68*	6/9	100 % 54	9	131				<u> </u>		
DR C FE	/6°	65.3	80.5	94%CL	Q-IIX				100-101-	80.0	100% 511	74 (e)	1 <u>46 (e</u> )	0 714	(08)(009	600	100 % (1	9 9	52		<u> </u>		<u> </u>		
.°.	41°	62.2	80.9	74% CL.	Q-12 X		i	<u> </u>	85-87-	60.7	100%58	9	119.	0.704	15191509	507	100 201	<u>73 (a</u> 9	<u>85 (e)</u> 38		<b> </b>				
104	57°	64.3	81.2	4% CL			ļ	<u> </u>	<b> </b>		187 SH	4	126	Q-32X	(308(308	397	100 %01.	5 <u>2</u> (e 9	78 .	<b>}</b>	┟───				
HEAT HEAT					Q-IS				(-19(19)	69.0	82% CL	6 <u>2 (e</u> )	1 <u>58</u> (e) 152	4-45	-30AZ3A	68.0	ICO SOL	71 (e 9	70 116 (e)		<b>i</b> — —		{		
EPUB - 0.1 h- 10 h- 10 h					Q-25		ļ	<u> </u>	31°-34°	66.8	11% CL	<u>57</u> (e.	234 (e)	Q-55	14 7.157	55.7	100 %CL.	<u>58 (</u> 9	110 <u>(e</u> ) 144	1		<b>-</b> -			
C - H C - H					Q-35	L			63°-65°	66.8	100% SH	<u>58 (s</u>	216 (e) 91	Q-65	75*	<u> </u>	81 %CL.	<u>585 (</u>	<u>218 (a</u> 134				82 % SH.	H	1725
	71°	41.1	65.2	100% SH	H-I	75°	.37.0	63.2	(-1°H+27)	53.3	100%CL.	<u>69</u> (e,	1 57 (e)	H-7	98°	52.6	100 % SH	<u>58</u> (6	<u>) 216 (e</u> 927	H-1 H-1	6/-69	44.1	18% BURN 88% SH	101 (0) 24	<u>2072</u> (0) 1980
LED C	40°	41.6	66.2	12% GL.	H-2				23-27	53.2	26% CL.	6 <u>9.5</u> e	152 le.	H-9	(10°)(-11°)	530	100 ZCL.	<u>58 (i</u>	) /69 (e AR	<u> </u>	24-21	40.0	12%BURN	178 (4) 84	1010 (0) 102
KILE 11 12 12 12 12 12 12 12 12 12 12 12 12	32	42.2	65.1	3% SH 97% CL	H-3				40°-43°	53.4	34%CL	9 6 <u>2</u> .5 (e	197 (a)	H-10	(42)(-419	53.8	100 % CL.	54	139.6 (e	H-3	15-	38.5	NOZUL.	176 (s) N	408 (s) 134
1.0 2 20 2 20 7 20 7 20 7 20 7 20 7 20 7 2	25*	4/.4	66.4	95% SH. 5% CL.	H-4				60°-63°	52.7	92% S	. <u>72 (</u>	209 (e	н-віх	-64*	47.4	100% CL.	65 (6	468 (e	H- <b>4</b>	41974187	39.0	100 % CL	182 <u>(</u> 0)	540 (s)
90 <b>2</b> 42	25°	42.5	67.9	19% SH. 81% CL.	H-5		ļ		f207f229	51.9	100 201	65 (	101.3 le	H-82X	-40•	47.4	100%CL.	9	38	<b> </b>	<b> </b>		╡───		
-	15°	425	68.1	30% SH	н-6			1	10°-13°	55.0	44.% SH 56% CL	9 74 (i	116 1236 (e.	H-8	,-40°	57.6	97 % CL.	69 10	253 (0)				l		

TABLE 5- SUMMARY OF PRINCIPAL RESULTS OF TENSILE TESTS AND WIDE-PLATE TESTS

#### NOTE S:

(a) - NOMINAL STRESS IS COMPUTED ON THE BASIS OF NET SECTION AT THE NOTCH LINE.

(b) - TEMPERATURE RANGE IS THAT OBSERVED DURING THE INTERVAL FROM ZERO LOAD TO MAXIMUM LOAD.

(c) - ENERGY VALUES GIVE THE ENERGY ABSORBED BY THE PLATE UP TO MAXIMUM LOAD.

(d) - ENERGY VALUES ARE CORRECT TO WITHIN PLUS OR MINUS FIVE PERCENT UNLESS OTHERWISE NOTED.

(e)- BASED ON EXTENSION MEASURED BETWEEN PINS OF PULLING HEADS.

(1)- THE PERCENTAGE OF SHEAR AND CLEAVAGE NOTED IS PROBABLY DUE TO A TEARING ACTION CAUSED BY ONE SIDE OF THE PLATE FRACTURING BY SHEAR AND LEAVING THE OTHER TO BE TORN. IT HAS BEEN OBSERVED THAT OTHER TYPE SPECIMENS HAVING A NOTCH ON ONE EDGE ONLY FAIL BY CLEAVAGE AT MUCH HIGHER TEMPERATURES THAN DO SYMMETRICAL SPECIMENS WITH CENTRAL NOTCHES.

(g) - ENERGY ABSORBED IN 54-INCH GAGE LENGTH ESTIMATED FROM DATA FOR OTHER GAGE LENGTHS.

(h) - 3-INCH EDGE NOTCHED TENSILE BAR VALUES DO NOT CORRESPOND TO THE PARTICULAR PLATE NUMBERS. ALL 3-INCH BARS CUT FROM ONE PLATE OF EACH LOT OF STEEL.

SHEET 2 OF 2

						146	1.5-6				HICK	VESS	REDU	10110	44	- SNC	PACT.	URE L	INES			SHE	ET / (	7F 3		
1	2		TECTMC									5	STANCE	FRON	LON 1	CH INCH	ES.									Π
SIEEL	MIDTH	NO.	TEMP					TEF	SIDE	OF PI	ATE								RI	GHT SI	IDE OF	PLATE				
	N.		<b>ب</b> ر	26	91	00	4				~	1	8/1	1/16	0	0	1/16	8/j	1/4	1/2	1	2	4	8	16	26
			• 3 4	22.01	200	,   4 0	0 27	14	01 5 0	5 5 11	5513	0512	5 5	ľ	2.0 S	8.05		9.0.5	0.55	10.0 S	12 O S	13.5 S	16.0 S	19.0 5	20.55	
		4-14	48.50	17.555	20.02	21.05	0.0	5 18.5	5 15	5 5 14.	55/3	5512	0 5		4 O S			9.5 5 1	1.5 S	12.55	15.5 S	16.5 5	19.0 5	20.05	0	( 4 0
	.02	4-24	30-34	14.5 0 2	5.5 C	25.5 6		ري. دي	0 11	5 0 17.	05	14	0 S	<u>`</u>	1.5 S	6.05		5.5	1	18.05	10.00	200	- -	5 C 5 C 7 C	3 t 3 4 0 -	
		44-4	.01	2.50	3.00	200	2.5	05	0 2	) C J.	005	000	50	с о	202	6.00	2	2.00	9.0 C	3.00	2.0.0	20.7	20.0	200	200	2 U 2 U 4 O
		4-54	43-45		17.0 S	20.05	18.5	S 15.5	5 15.0	5 S 11.	5 S 11	5510	057	55	2.0 S	3.55	2	9.5 S /	2.5 5	12.0 3	10.0 0	0	3.00	0.0	2	2
	1	4-18	68		18.0 S	18.0	0.61	5 17 5	5 16.	5 5 14.	05/3	5510	5 S		505	5.55		0.5	50.	12.05	15.0 5	16.5 5	19.0 3	10.0		
	8	4-38	48.		18.0 S	17 5	5 16.0	S 12.0	.6 5 0	5 S 7.	557	.056	0.5	-	0.0 S	4.0 S		7.0 S	9.5 S	9.5 S	1205	10 0 0	( ) (	200	T	T
		20-1	. 20		ſ	19.5	5 2 5	S 15.5	515	5 S 12.	11 5 0	01 S S	5 S		4.5 S	4.5 S		0.051	0.55	12.0 5	13.0 S	16.05	18.0 S	8.0	+	I
٦	24	7-10	37.			306		16.5	S 14	5 S 12.	S C	8	05		5 0 S	3.5 S		7.0 S		9.0 S	10.5 5	13.5 5	15.5 5	18.5 5		
		4-30	(-2-1-6-1-			2.0 6	2.0	0 2	5 J.	0 C 4.	5 C 6	007	00	50	9.5 C	8.00	50	6.50	2.5	3.5 6	20	2.5 0	2	- - -	T	T
		4-10	.98					18.0	5 17.1	0 S 16.	2 S 14	.5 S 13	-5 S	-	8.5 S	9.05		1.551	502	13.0 5	15.0 5	17.05	2 4 6		İ	
_		4-30	50				4.5	5 14.0	5 17.1	0 S 14.	5 S 12	0510	5 S	-	5.5 51	1.55		5.05	0.0	(8.5 S	21.05	000	200			
		4-20	3/*- 33*				3.0	C 9.5	5 C 12.	5 S 10.	559	550	05	-	6.5 S	6.05		5.05	6.5 5	18.0 5	10.05		5 5 7 7		-	
	12"	0(24-4	.6/				1.0	0 2.0	200	502	5 C 4	00	8 0 0	50	1.5 0	2.00	1.5 0	4.00		0.0		200				
	!	4-40	• !!				2.0	0 2	502.	5 C 4.	005	000	505	50	6.0 C	6.50	0.0	5.50	4 1	4.5 C	2.9	202	5 0 			ſ
		0×19-4	7-8				0.5	0.7	100	502	003	.003	00	00	3.0 0	3.00.	0.0	3.0 0	2.50	2.0 0	000	5	24			
		4-50	68-1-6-5				1.5	°. 0	000	503	004	.0 C 4	5 C 4	00	25 C	3.00	15 C	5.0 C	4.5 C	3.0 C	202	202	2007	(   	T	T
		7 <u>7</u> 7	.62		24.5 S	22 5	521.0	5/16.0	5 /J.	55/4	0 5 12	EI S 0.	55		8 2 S	15.5 S	-	6.052	21.0 S	23.5 5	25.55	27.55	29.0 S	33.0 5	-	
			48.51	255	850	80.5	0 6 5	S 17.0	5 16.	0 S /3.	0 5 12	0.59	0 5		555	455		9.05	12.5 S	12.5 S	15.0 S	1755	21.55	22.05	8.00	000
	72*		30-32	0.00	2.50	30	50	~ ~	5 C 18.	05 20.	850	5.0			655	7.5S		6.0 S			18.0 5	7.5 C	4.0	3.5		
_		8-74	- <u>6</u> -8	200	200	151	20	ه ن	503.	506	00010	21 2 0.	0014	1.00	6.50	5.501	00.6	5.00	2.0 C	8.0 C	4.5 C	250	200	20.1	د د د	د د -
	ľ	89-8	48-51		22.05	23 5	5 20 5	5 19.	5 14.	5512	5511	150	5 S		0.55	1.55		8.05	10.0 S	15.05	19.5 S	19.05	23.0 5	23.05	0	
	48	8-78	-6		2.00	3.0	2.0	C 2.0	0 C 3.	004	507	5 C S	1001	00	7.0 0	2.50	0.0	9.00	7.5 C	5.00	3.0.5	2 2	2000	2	2	T
	'	B-3C	-22				25.0	5 25.0	5 23.	5 5 22	0 5 20	.0 S 14	5 S		20S	5.5S	-	3.5 5	17.0 5	18.55	20.5 5	20.02	22.0.2	000		
	54	8-16	•54				20.5	S 19.	5 S 19.	0516	5515	.0 S 12	.5 5		5.05	10.05		3.5 S	(3.5 S	13.5 S	10.05	0.61	C / 2	2.0	Ţ	
Bar		B-3D	70-73				 	25.0	5 24.	5 S 22	6150	.0 S 16	.0 S		755	8.05	-	5.0 S	18.0 S	20.0 S	23.05	20.5 5	13.0 5			
		B-60	46				0.61	S 18.	5 S 16.	05 13	5511	50.	.5 S		0.55	405		2.5 S	3.05	13.0 5	16.0 S	17.55	6.5 S			
		01-8	32				19.5	5 20.0	5 S 17.	5515	5513	.5 5 12	.5 S		5.0 S	10.05	-	20.2	15.55	15.5 5	17.5 5	19.55	200			
	1	B-32XD	20-23				18.5	5 19.0	0 S 16.	0 S 15	0513	.0 S 11	5 O.	1.0 S	3.5 S	6551	5.0 5	17.55	0.05	22.0 S	22.5 5	23.05	200			
	N	B-3IXO	0 12-15				3.5	08	5 0 20.	5 5 22	5 S 20	.5 5 17	.0 S /	1.0 S	3.0 S	305	9.9	1.55	16.05	18.5 5	19.5 C		5 5 7	Ì	I	
		B-33KD	1-37-(0%)				1.5	0 2	504.	005	8 0 0	5010	501	501	0.50	12.001	00	3.50	0.5	0.0	5.00	200	505			
		B-9D	1-7-1-69				05	C 2.	0 0	Э 0 С С	500	000	50	0.0	0.0 C	820	8.50	7.00	0 4 0 0	9 0 0 0 0		20	200			
		01-B	(35)+(34)				2.0	0 2.0	002	503	000	0 0	50	50	4 0 0	000	5 0 0	3	30.4	2.0	20.4		2 2 2 0	05 K C	Ī	
		B-4A	-22	25.05	20.05	25.5	5 22 5	5 21	0 S /8.	0 S 17	0517	.0 S /:	SS		3.5 5	12 0 2 1	7.5 S	18.0 5	18.0 5	0.0 2	10.0 5	0000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0000	00 E C	14 5 5
		B-54	49-52	20.03	22.0 S	80.0	521 O	S 20	5 S 17.	5515	5516	5514	1.0 S		655	3 2 2 9		13.0 5	10.05	0 0 0 1	5 5 5	20.00	0 4	20.02	2	2
	72*	8-24	33-35				3.5	63	5 C 4.	005	20	_			000	10.50			4	0.0	0.0	4 C	0 0 0 0 0	0 0 20	2 2 2 2 2	01 5 0
		B-104	3/33			24 0	5 21 5	S 26	55.24	05 20	55/8	.0 S 1	5.0514	1.6 5	605	2551	3.05	17.05	19.05	11.05	20.7	200	0 2 1	2 2 0	000	00
		8-84	16-18	1.00	2.50	0.0	C 3.0	C 3	504	005	508	1.0 0 10	0001	0.5 C 1	50C	10.01	3.0	12.00	200		34	2 2 2	040	2	>	2
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<i>.B</i> ,	*	B- 2C	32-33			20.5	S 21.0	S 19.	0 S 17.	0516	0515	.0 S 10	5 S		8.5 S	12.05	Ţ		00.00	0.02	2.2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 4 6			
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		B-50	50-51				15.5	S 21	5 5 23.	0523	5 521	.0 S /	.5 S		2.0	00		0 4 0 4				2 4				
	<b>0</b>	B-20	32-36				10.5	C 20	5 S 18.	05/6	0515	.5 5 1	2 O S	0	7.5 S	000	4	24	2 4 0	0.4	200		000			
	2	DOI-8	10-15				5.5	0 12	5515	05/4	0 5 12	.5 5 1	0.0	0.0	5.0 5	200	200	000	200		20	20	2 2 2			
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		8-80	(-15-)-(-10-)				0	N V	0 3	4	3	2	3							1910-0	1400					
*	NALU	ES IN	TABLE II	VDICATE	PERC.	ENT	REDUCI	ION.	ETTEN	FOLLG	DNING	NALUE	INUICAL	101	Ş T	NAPT	- JLO	5		5						

														,													a
					TAE	BLE –	6				THICK	WESS	RED OF N		N AL	ONG LAT	FRAC PLA	TURE	L/NE *	ES				SHEE	T 2 OF	: 3	
	1													TANCE	FROM	NOTCH	INCH	<u> </u>									
STEEL	PLATE	SPECIMEN	TESTING										DISI	AALE		1					IGHT S		PLATE				
	WIDTH	NUMBER	TEMR				+		EFT SID	EOF	PLATE	<del></del>				<del> </del>	1		4	4				A	16	26	39
	<i>IN</i> .		7	39	26	16	8	4	2	1	2	14	18	16	0.	0	*6	18	- 14	2	/		24.5	225	25.5 0		200 5
Ber	108	81-108	3/*			24.5 5	20.0	\$ 17.0	5 13.5 5	14.0	s 13.0 s	5 11.0 5	7.0 S	5.0 S	2.0 5	5.0	5 12.0	S 13.0	5 15.0	<u>5 17.0 .</u>	S 17.0	5 18.0 5	21.5	22.5 3	30 C		1.5 C
*C*	108	CI-108	26-28*	2.5 C		3.0 C	2.5	C 3.0	C 2.5 C	3.5	6.0 0	6.5 0	8.5 C	9.0 C	4.0 0	5.0	80	0 7.0	0.0	C 140	C 170	6 85 5	11.0 :	5 / 5.0 5	5 15.0 5	15.5 5	
_		C - 5A	152*			/3.5 5	15.0	S 12.5	5 9.5 5	6.5	5 6.5	5 5.5 5	5.0 5	6.5 S	3.0 5	2.0	9.5	C 70	6 100	5 120	5/30	5 140 5	160	5	1		- 1
		C - 3A	100-104	_		17.0 5	17.5	S 17.0	5 14.5 5	13.5	S 10.5	<u> </u>	5 <i>8.0</i> 5	5.5 5	30 5	5 2.0	5 0.5	7.0	c 70	C 85	6 135	C 80 C	12.5	9.5 0	6.0 0	4.0 0	1 -
	72*	C-4A	80"- 82			5.0 0	70	C 8.5	<u>c 5.0 c</u>	11.5	C 6.5 (	<u>6.0</u> 0	7.6 0		05 0			7.5	c 70	C 70	C 11.5	C 5.0 C	;		4.0 0	3.0 0	7
		C-2A	78*	_				_					75.0			00		35	ci	20	C 15	C 1.5 C	1.5	0 2.5 0	2.5 0	1.5 0	2
		C-IA	30°-31°		1.5 C	2.5 C	1.5	C 1.5	<u>c</u> 1.5 <u>c</u>	; 1.5	C 2.0		3.5 0	<u> </u>	40 0		- -	80	S RO	5 90	\$ 105	5 13.0 5	5 14.5	5 16.5 5	5		
		C - 3B	101*			16.0 5	190	\$ 17.0	5 16.5 5	/3.0	5 12.5	5 10.0 5	5 7.0 5		2.5 3	3.0	ci	60	0.0	C 8.5	C 6.0	C 7.0 0	5.5	C 6.5 C	4.0 0	.г	
	100	C-28	80°		<u>-</u>	4.0 0	5.5	<u>c 7.0</u>	C 4.0 C	9.0	C 6.0	C 6.5 C	5 60 0	60 0	4.5 0	45	6 55	c 50	C 4.0	C 35	C 2.5	C 25 0	20	C 20 C	25 0	/	
	40	C-68	32*			2.0 0	2.0	C 2.0	C 25 C	2.5	0 3.5	0 4.5 0	35 0	40 0	40 0	35	C 40	c 30	c 30	C 40	C 3.0	C 25 (	2.0	C 2.0 (	C 1.0 C	;	
-°C-	L	C-48	27-29	_	i <del> </del>	1.5 0	2.0	C 2.0	0 20 0	2.5	C 130				9.0	0 80	C.	11.0	C 11.5	C 110	C 15D	C 90 (	75	C 55 (	<i>c</i>	<u> </u>	
5	24	C-2C	88*			ļ	8.0	0 85	0 25 0	75.0	C 35	C 45 (	35 0	35 6	40	6 40	C 3.5	C 3.5	C 3.5	C 3.5	C 2.5	C 1.5 C	20	C 20 (	c	, 	<u> </u>
		0-10	27-31		<u> </u>	<u> </u>	2.0	0 20	C 2.5 C	0.5	c 75	<u>d 65 (</u>	5 60 5	2	2.5	5 1.0	<u>s</u>	10.0	\$ 12.0	\$ 14.5	\$ 155	5 160 5	5 12.5	c			
	İ	C-5D	141°- 145°		<u> </u>		+	125	5 11.5 3	5.5	c 95	5 75	5 80 5	50 S	20	5 7.5	\$ 7.0	S 7.5	5 8.5	5 11.5	5 11.0	S 12.0	s 1 8.0	5			<u> </u>
		C-IIXD	132-136	<b>—</b> —			<u> </u>	14.3	515.0	90.5	5 80	5 75 5	5 6.5 5	50 S	1.5	5 20	5 90	S 9.5	S 9.5	5 9.0	5 9.0	S 11.0	\$ 14.0	5		<u> </u>	<u> </u>
		C-5IXD	120-123					75	C 11.5 S	5 10.0	5 9.5	5 8.5 5	5 5.5 5	:	40	5 8.5	5	/ 3.5	S 15.5	5 /6.5	5 16.0	S 10.5	C 2.5	С		<u> </u>	
	12"	<u>c-30</u>	101		<u> </u>		+-	30	6 70 0	10.0	5 9.5	C 6.5 C	c 60 C	5.0 0	2.5	C 3.5	C 45	C 5.0	C 8.0	C 10.5	C / 5.5	\$ 7.0	0 3.5	C			<b></b>
		C-52XD	90		-		+-	1.5	C 45 (	10.5	C 6.5	C 60 0	0 60 0	;	4.5	C 5.5	C	6.0	C 7.0	C 8.5	C 11.5	C 4.5	2.5	<u> </u>		·	
	ļ	C-20	32- 33*			<u> </u>	+	1.5	C 1.0 C	2.0	C 20	C 3.0 C	5 3.5 C		3.5	C 3.5	C	3.5	C 2.5	C 2.5	C 20	C 2.0	C 1.0	<i>c</i>	60		- <del> </del>
101	70"	0-14	37-35	╉─────		5.5 (	6.0	C 10.0	C 7.5 (	8.5	C 14.0	C 17.0 C	0 11.5 C	2	3.5	C Q.5	C	14.5	C 185	C 15.5	C 90	C 6.5	C 65	0 070	50 0	. 20.6	
<u> </u>	12	H-IA	67.69	<u> </u>		20.0	5 23.5	5210	5 180 3	5 15.0	5 16.0	5 19.0	S 17.5 S	5 <i>120</i> S	5.0	5 4.5	S 8.5	5 9.0	511.0	\$ 12.0	S 14.0	\$ 17.0	5 20.5	5 23.0	5 23.5	, 20.5 S	
		H-24	24-27			19.0 :	5 21.5	S 18.5	5 18.5	5 14.0	S 11.5	5 12.0	s 11.5 S	<u>, 90</u> 5	1.0	5 9.5	S 9.5	5 11.5	S 12.5	\$ 12.5	S 14.0	S 165	5 19.0	5 20.5	5 18.5 3	·	<u> </u>
	72"	N-30	150	1	100	1.0	c 1.5	C 1.5	C 2.5 C	3.5	C 6.5	C 90 (	C 11.0 C	12.5 0	3.5	C 12.0	C 10.5	C 9.5	<u>C</u> 8.0	C 6.0	C 2.0	C 2.0	<u>c 1.0</u>	0.0.5	<u>c as a</u>	<u>, 1.0 </u>	<u>v</u>
1		H-44	4-19° H-18°	;	1.0 0	4.0	C 2.5	C 25	C 2.5	C 3.5	C 5.0	C 6.5	C 7.5 (	8.5 0	11.5	C 10.5	C 9.5	C 7.0	<u>C</u> 7.0	C 50	C 3.5	C 2.0	0 1.5	C 2.5	0 2.5	, 1.0	
		H-70	98*				1	7.0	C 18.5	5 15.5	5 14.0	s 11.0 .	5 9.5 3	5 8.5 5	2.5	<u>s</u> 4.0	5 8.0	\$ 11.5	S 12.5	5 /3.5	5 16.0	5 18.5	5.19.0	<u> </u>	,	·	
	1 ·	H-4D	60-63	-		1	-	90	5 21.5	5 15.5	5 13.5	5 13.0	5 120 3	5 <i>10.5</i> 5	6.5	5 3.5	5 14.0	\$ 16.0	5:17.5	5 200	5 220	5 17.5	5.10.0	<u> </u>		+	-+
		H- 3D	40-43	<u> </u>	_			5.5	C 230	<u>5 225</u>	<u>s 220</u>	<b>S</b> 17.0 .	s 8.0 s	5 0.5 5	5 0.0	<u>s 7.0</u>	\$ 11.0	5 100	511.0	5 130	5 10.5	5 195	C 55	<u></u>			+
	1	H-20	23.27					9.5	C17.0	5 150	\$ 130	\$ 10.5	5 10.0	5 60 5	3.5	5 6.5	S 7.5	5 9.5	511.5 C 12 F	5 130	5/50	5 205	5 45	c -		<u> </u>	- +
1 "	ļ	H-6D	10-130	1				4.5	C 18.5	0 225	5210	5 200	5 17.0 3	<u>s 15.5</u> S	2.5	5 50	5 8.5	5 10.5	5.12.5	5 13.3 C 8F	0 50	6 20	C 1.5	<i>c</i>			+
	.	H-ID	(-1°)++2°	1				20	C 2.5	c 4.0	C 50	C 12.5	C /4.5	C 65 (	3.5	G 3.5	0 60	0 13.0	C 0F	0.0.0	6 35	C 25	C 1.5	c		+	_ <del></del> =
l	12	H- 9D	410°H-11°					1.0	6 20	C 3.5	C 6.5	C 90	C 12.0	C 130 C	14.0	6 11.5	6 11.5	6/1.5	0 3.3	C 55	6 70	0 0 20	G 15	c	<u> </u>	<u>+</u>	+
1		H- 5D	1-201+22	7				1.0	C 2.0	C_35	C 60	C 10.5	C 11.0	C' 8.0 (	5 4.0 - 70	C 60	010.5	0 65	C 50	6 35	C 25	C 1.5	C 1.5	c	· ∔ · -	·+ ·-	
		H-82X	D -40°					1.0	C 1.5	C 2.0	C 30	C 4.0	C 55	C 6.0 (	0. 7.0	0 70	0 0.5	G 115	C 10.0	C 60	c 30	C 2.5	C 1.5	c			
1		H-10D	1427-41	1	<u> </u>			1.5	C 2.5	C 3.5	C 65	C 10.0	0 12.0	0 50	0 20	0 30	0 50	C 45	C 3.5	C 3.0	C 15	C 1.0	C 15	С			
		H-BIX	-64°		· 	<u> </u>	<u> </u>	0.5	<i>G 1.0</i>	<u>c 2.0</u>	C 2.5	0 4.0	C 115	5 95	5 75	5 3.5	5 55	5 18.0	5 18.5	C 13.5	C 7.5	C 4.5	C; 3.5	c			
		H-8D	(-419-1-39	"				2.5	C 4.0	6 7.0	0 12.5	010.0	0 11.0	0 0.0 C		BACT/		5 -	SHEAR		+ GLF	AVAGE.					
	*	VALUES	IN TABLE	INDICA	TE PEI	RCENT	REDUC	TION.	LETTEP	7 FOLL	OWING	VALUE I	NDICATE	SITTE	UF F	RAUIU							_	_			

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						TABLE	-6			7	HICKNE	ESS A	EDUCT	ON AL	LONG	FRAC	TURE	LINE	5			SHE	ET.	3 OF 3	,	
							·					OF	NOTC	HED F	LAT	PLATE	5	*								
STEEL	PLATE	SPECIMEN	TESTING										DISTANC	E FROM	NOTC	H, INCH	ES									
	IN.	NUNICER	12.mr. •F.					LI	eft side	OF PL	ATE								,	RIGHT SI	DE OF	PLATE				
				26	16	8	4	2	1	1/2	4	1/8	¥6	0	0	16	¥8	4	1/2	.   /	2		4	8	16	26
		N-3A	2*	21.0 5	5 19.0 5	150 \$	12.5	5 10.5 5	9.5 S	80 S	5 8.5 5	9.0 5	5 8.5 S	3.0 S	3.0	5 12.0	S /3.5	S 17.0	S 19.0	S 200	S 19.5	5 21.0	5	260 S		
1	72"	Ń-2A	435°H-30°)		3.5 0	5.0 C	9.0 (	C 13.0 S	5 13.5 S	150 S	5 16.5 S	10.5	5 14.0 5	5.5 S	2.0	S 6.5	\$ 6.0	5 10.0	5 9.5	S 120	5 14.0	S 17.5	C	6.5 C	3.5 C	4.0 C
		N-IA	(-55°)+-51 * )	2.5 (	0 5.5 0	6.0 C	6.5 (	C 8.5 C	15.0 C	20.5 5	5 18.5 S	16.0 5	5 <i>16.5 S</i>	4.5 S	6.0	S 7.0	5 8.0	5 8.5	\$ 11.0	S 13.5	C 7.5	C 4.5	C	4.0 C	2.5 0	<u>20</u> C
		N-3D	72-73				200	5 8.5 5	9.0 5	8.0 S	655	6.0 5	5 <i>6.0</i> S	25 S	1.5	s 55	S 6.5	5 7.5	5 8.5	5 10.0	S 13.0	S 14.5	5			
		N-IEXD	32-33				8.0	5/3.5 5	11.5 5	9.5 5	5 9.0 S	8.0	5 65 5	3.5 5	40	5 55	S 8.5	5 8.0	\$ 9.5	\$ 11.0	5 12.5	S 12.5	5			
-		N-2IXD	-2		-	+	6.0	5 14.5 5	12.5 5	11.5 S	10.0 5	7.5 5	5 65 5	30 5	25	5 25	5 7.5	5 95	5 10.0	\$ 12.5	5 13.5	5 /6.5	5			+
		N-2XD	(-247(-227				21.5	5 / 3.5 5	12.0 5	10.5 S	9.0 5	85 3	5 7.5 5	2.0 5	35	5 80	5 85	<u>s 90</u>	5 9.0	S 9.5	5 10.0	\$ 13.0	5			
"N"		N=70	(-30)+287		+	+	10.0	0 14.0 S	12.5 5	11.0 5	9.5 5	7.0 3		2.5 5	2.0	S C C E	5 3.5	5 90	5 9.5	5 11.0	5 14.0	5 0.5	6			-
	10"		17091707		+	÷	12.5	3 70.0 3	60 0	05.0	0.0 3	150 0	5 25 3 5 150 5	20 5	2.5	5 0.3	5 7.5	5 0.0	5 85	5 90	5 10.5	5 5.5	->			
	12	14-1420	F307F307		· ·		2.5	5 0.5 C	0.0 0	0.0 0	95 0	70 0	65 0	20 5	25	c 70	s 90	5 95	5 100	\$ 110	\$ 180	6 70	~			
		N-20	-40/+44/ L6294-5991				79.0	CU75 0	350 5	245 5	180 5	155 \$	6 /45 5	20 5	20	5 50	5 65	5 80	5 70	S 245	5 125	6 55				+
		N-2XD	(-62)(-60")			+ ·	30	2 75 0	IRO C	205 S	185 5	190 5	185 S	15 5	35	5 60	5 75	5 85	5 90	5 110	S 13.5	5 45	C			
		N-15XD	-64°		·	+•	35	65 0	50 G	75 G	95 0	11.5 0	120 0	12.5 G	2.5	011.5	C 115	6 110	C 75	C 55	C 5.0	C 30	c			
		N-13XD	(-659 <u>+</u> 637		+	+	3.5 (	C 6.5 C	9.5 C	120 5	10.0 5	6.5 5	5 4.5 S	3.5 S	1.5	5 7.5	5 9.5	\$ 10.0	5 /30	5 8.5	C 6.0	C 3.0	C			
		N-4XD	6799 <del>7</del> 787		++		3.0	5.5 0	60 C	8.5 C	11.0 C	12.0 0	: 12.5 C	10.5 C	14.0	0 14.0	C 13.0	c 11.0	c 8.0	C 6.5	C 4.5	C 30	C			1
•		Q-2D	134°			1	21.0	5 41.5 5	355 S	285 S	15.5 5	13.0 5	5 9.0 S	3.5 S	1.0	5 14.5	5 19.5	5 25.5	\$ 355	S_385	S 40.5	5 17.5	s			
		Q-IIXD	100 <u>=</u> 101°			!	16.5 :	s 225 s	25.5 S	16.5 S	5 16.0 S	12.5 3	5 11.5 S	25 S	1.0 :	5 9.5	S 13.5	S 17.5	s 20.5	S 22.5	S 19.5	\$ 10.5	5			
		Q-12XD	85° 87°			+	21.0	s 32.0 s	17.5 S	16.0 S	14.0 S	10.5 5	5 7.0 S	1.0 S	1.5 3	5 12.0	S 15.0	S 19.5	\$ 230	5 26.0	S 335	5 / 5.5	5			
		Q-1D	71°		:	?	1.5 (	55 0	7.0 C	7.5 C	7.5 C	7.0 0	7.5 C	5.5 C	9.0	8.5	C 80	C 7.5	C 6.0	C 4.5	C 3.5	C 2.0	C			
		Q-14XD	68°				11.5 :	5 300 S	23.0 S	27.0 S	220 S	17.0 S	14.0 S	2.5 S	2.5	5 7.0	s 10.0	5 14.0	S /6.5	s 18.0	S 30.5	5 18.5	5			
"a"	12"	Q-21 XD	56°-59°		İ		7.5	5 27.5 5	19.5 5	190 S	15.0 S	1.0 5	13.5 5	3D 5	2.5 3	5 7.5	5 11.0	S 15.0	5 17.0	5 17.0	S 18D	5 22.0	s			
		Q-22XD	32°		1		17.5	5 21.0 5	20.5 S	18.0 S	17.0 S	12.0 S	7.5 5	20 5	30	5 9.0	s 13.0	5 17.5	S 19.5	S 19.5	5 240	5 11.0	\$			{ +
		Q-3D	15°-17°				9.0	5 17 5 9	20.5 S	19.0 5	6.5 S	/3.5 5	: 11.0 S	1.0 S	1.5	5 60	5 9.0	5 10.5	S 12.0	s 130	S 15.5	S 17.5	5			
		Q-13XD	0°				1.5 (	5 1.5 0	2.5 C	3.5 0	50 C	55 0	6.5 C	70 C	5.5	6.5	C 60	C 5.0	C 3.0	C 35	C 1.5	C 1.0	c			
		Q-31XD	1-2194-20				3.0 0	3.5 0	5.0 C	5.5 C	5.5 C	9.0 0	5.5 C	2.5 C	4.0	7.0	C 9.5	C 7.0	6.0	c 3.5	C 2.5	C 2.0	C			
		Q32XD	(-51° )+509				3.0 0	55 0	5.0 C	5.0 C	5.5 C	7.0 0	7.0 C	6.0 C	4.5	c 7.0	C 6.5	C	4.5	C_35	C 20	C 1.5	0			ļ
		Q-35D	63°-65°				24.0 5	5 1 <b>8</b> .0 S	18.5 S	17.0 S	5 14.0 5	9.5 9	5 <b>8</b> 0 S	1.5 5	35	5 95	S /1.5	5 16.0	5.18.0	5 18.0	\$ 18.0	S 8.5	5			
		Q-25D	3/°-34°				1 <b>3.5</b> (	c 20.0 s	16.5 S	155 5	5 1 <b>3</b> .0 S	10.5 S	6.0 S	1.5 S	7.0	5 7.5	5 12.0	S 16.5	S 27.5	5 27.0	\$ 20.5	S 18.0	5			
·0."	12"	Q-65D	15*				4.5 (	6.5 (	155 5	140 5	6 14.0 S	13.0 S	11.0 5	3.0 S	3.5	\$ 10.0	s 11.0	s 13.0	5 15.0	S 1 <b>3.5</b>	C 6.0	C 3.0	c			L
	<u>، د</u>	Q-15D	(-1°)-(+1°)				5.0 0	6.5 0	14.0 C	14.0 S	5 14.0 S	11.0 5	10.5 5	9 <u>0</u> 5	7.0	5 11.5	5 /4.5	\$ 15.0	S <sub>1</sub> 7.5	5 145	C 6.0	C 3.5	C	1		<u> </u>
		Q-55D	(-14°H-139		·		3.0 0	3.0 0	3.5 C	6.0 0	9.5 C	12.5 0	12.0 C	4.0 C	2.5	2 12.5	C 12.0	C 10.0	C 6.5	C 50	C 20	C 20	C			
		Q-45D	(-30°H-297				2.0 0	3.0 0	3.5 C	6.5 C	8.5 C	10.0 0	10.0 C	100 C	7.5	: 11.0	C 11.5	C 9.5	C 6.0	C <sub>j</sub> 3.5	C. 2.5	C 1.5	C			<u> </u>
		* 1/4	LUES IN	TABL	E INDIC	ATE PE	RCENT	REDUCT	7/ON.	LETTER	FOLLO	WING	VALUE	INDICATE	ES TY	PE OF	FRACTU	RE:	5 = 51	YEAR,	C = CLE	AVAGE.				

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Stee	1			Descrip	tion of te	st plate		Temperature	Energy Ab-	Tield	Tominal	Ireitere	Type of
Oods letter, type & Manufacture	<b>\$0</b>	<b>**</b> *	Type	Width in.	fhickness in.	Bepth in.	width in.	of Test o <sub>F</sub> .	sorbed to Maxim. Load in1b.	Peint Pei	Stress (Max.) Pei	Stress P#1	Frasture % Shear
A As rolled Carnegie-Illinoid	0.25	0.47	Nachined Bige	3	3/4	none	none	67 27 9 - 9	Not Recorded	58,200 40,900 37,100 42,900	64,500 65,600 65,000 68,000	55,200 58,200 56,100 58,700	100 80 37 37
A As rolled Carnegis-Illinois	0.25	0.47	Sheared. Bága	3	3/4	none	none	-68 51 41 28	n	49,300 33,570 58,010 37,500	72,900 61,440 59,720 65,100	61,400 7,870 5,770 68,300	53 100 100 15
A As rolled Carnegie-Illinois	0.25	0.47	No tohed. Rigns	3	3/4	1/4	0.042	7 95 80 80 71	14,690	38,300 34,200 55,590 43,100 42,300	65,900 55,500 57,380 58,100 60,200	65,900 14,900 19,125 26,400 27,800	1 100 100 95 95
					·			70 62 51 45 30 21	13,600 13,570 15,180	37,000 37,070 48,500 37,490 43,400 38,500	51,400 56,760 61,500 57,920 61,600 59,700	19,100 19,200 60,300 50,280 61,600 59,700	97 100 17 29 8 4
3 As rolled Bethlehem	0.18	0.72	Notohed Båges	1	3/4	1/4	0.042	-15 70 49 38 36	21,800	45,900 36,600 37,220 37,700 38,200	66,000 59,600 60,800 59,400 65,200	66,000 15,200 19,810 21,500 17,500	6 100 100 100 92
								22 20 6 0 19 25	16,790 22,850	37,880 36,100 40,500 40,800 38,700 39,950	45,500 60,000 45,500 65,600 65,600 65,750	49,000 53,300 61,200 65,500 65,600 65,400 66,730	17 15 21 6 12 4
B Normalised Bothlehem	0.18	0.72	Notched Edges	3	3/4	1/4	0.042	60 38 16 5 - 1 - <b>16</b> -21 -37	20,330 16,580 11,850 18,800	41,500 41,800 40,700 41,205 48,800 43,100 40,000 43,500	56,600 60,500 60,000 60,600 62,700 64,800 57,000	16,500 25,600 20,600 19,180 51,400 64,800 57,690 63,100	100 92 100 100 31 5 2
C As rolled Carnegie-Illinois	0.25	0.49	Mahined Riges	3	3/4	nshe	none	106 76 55 37 22 -43	Fot Recorded	34,800 35,800 36,760 38,600 37,800	65,400 65,000 66,050 66,050 68,060 70,400	59,500 58,500 55,800 61,600 60,100	100 100 58 48 45
C As rolled Carnele-Illincis	0 <b>.2</b> 5	0.49	Sheared Rdge	2-1/8	3/4	none	Lone	152 135 282 119 110 100 99 98 90 74 67	Not Recorded	34,020 34,710 34,530 38,490 35,510 36,510 34,950 34,950 34,550	64,360 65,760 66,850 66,990 65,590 60,180 64,210 66,380 67,180 65,900 50,500	5,210 4,130 5,840 64,990 65,590 60,180 64,210 8,705 62,680 63,680 50,300	100 100 20 3 0 0 100 11 0 0
C As rolled Carnegie-Illincis	0.25	0.49	Notched Diges	3	3/2	2/4	0.042	94 81 74 55 35 25 14 1	Not Recorded	45,700 47,200 46,300 48,700 47,300 49,600 48,300 50,100	61,800 63,400 62,800 65,000 64,100 66,500 67,000 67,500	16,000 21,600 17,200 19,200 25,600 66,500 67,000 67,500	100 100 100 97 8 8 8 8
C As rolled Carnegie-Illinois	0.25	0.49	Notohed Edges	3	5/8	1/4	0.042	110 102 98 89 73 60 39	12,000 10,100 9,990 10,220	43,510 42,500 48,750 41,600 45,100 44,250 44,000	66,850 62,800 64,880 63,300 65,100 65,880 63,900	26,320 21,300 25,730 35,600 65,100 65,880 63,900	100 94 100 98 3 6 9
C As rolled Carnegis-Illineis	0.25	0,49	Notahed Mgus	8	3/4	1/4	0.042	149 129 115 107 101 91 90 87 80 75 71 61 49 54	Not Recorded 15,090 12,760 16,080 9,710 11,080 10,050	42,100 42,100 59,200 40,700 40,200 40,200 40,700 41,220 41,220 41,500 41,500 41,500 43,500	61,500 63,500 62,800 62,800 63,900 63,900 63,900 63,490 63,490 64,900 64,900	19,300 35,400 85,000 38,800 87,560 44,800 44,800 45,900 45,800 63,490 63,490 63,400 64,400	100 95 96 40 6 15 2 3 4 2 6 4

#### TABLE 7 SUMMARY OF 3 INCH WIDE PLATE RESULTS Page 2 of 5

Steel			1	Descrit						1			1	
Gode letter, type			Contrat	August billing br Test			Temper.	EDergy	Yield	Mominal	Fractore	Type of		
and Marmifacturer	40	404	-	24.443	m tomana	201		OT Test	Absorbed	Point	Stress	Stress	Fracture	
	~		TATA	1 4 S		Depter	Wiath	°¥•	to Marin.	Psi	(max.)	Psi	% Shear	
C As rolled Carnegie-Illinois	0.25	0.49	Notched Edges	3	1	<u>174</u>	0.042	159	Hot Recorded	40 960	Pei	76 000	100	
						-/*		146 143 137 135	16,100	40,980 39,200 40,800 36,800 36,640	62,800 61,800 60,400 62,080	36,000 39,500 33,600 60,400 62,080	100 94 96 22 21	
C 4s willet	-							100 80 41	<b>18,400</b> 3,810	37,600 42,400 38,890 42,400	62,000 57,800 49,960 63,500	61,500 57,800 49,960 63,500	16 11 0 4	
Carnegie-Illinois	0.25	0.49	Biges	3	1 1/8	2/4	0.042	161 151 139 135 187 118 111 77	17,000 20,554	34,600 38,200 39,100 39,600 34,300 40,000 35,140 38,900	62,500 56,100 57,200 58,200 58,100 59,300 59,460 55,800	45,800 29,000 29,800 32,900 34,600 59,300 59,460 55,800	100 94 92 93 98 11 11 0	
0 As rolled Carnegie-Illinois	0.25	0.49	Canter Notchei	3	3/4	1/2	0.048	111 89	12,000 11,700	<b>38,640</b> 44,230	68,490 72,010	18,110 16,925	100 100	
0 As rolled			Center					<b>6</b> 0	11,500 12,975	<b>43,</b> 760 <b>41,00</b> 0	70,490 β6,000	70,490 55,000	8	
Oarnegie-Illinois	0.25	0.49	Notahed	3	1 1/8	1/2	0.042	139 100 89 74 60	18,850 19,320 21,500 21,810	38,800 40,000 39,160 40,400 41,380	61,500 63,800 64,690 64,500 66,030	26,200 24,700 61,400 63,800 66,030	100 100 14 7 4	
C As rolled Carnegie-Illinois	0.25	0.49	Notched Edges, Machined from 1-1/8 stock	3	1/2	1/4	0.042	110 93 75	9,000 9,000 8,200	33,840 33,880 33,600	57,860 59,360 59,520	19,580 15,200 59,520	100 100 2	
C As rolled Carnegie-Illinois	0.25	0.49	Notched Edges, Machined from 1-1/8 stock	8	5/0	1/4	0.042	130 118 111 105 98 90	10,900 11,500 11,160 12,220 10,550 11,770	32,600 30,860 33,000 31,480 31,930 32,900	59,200 58,030 56,700 60,000 58,710 58,700	22,300 16,825 40,700 50,000 57,420 56,500	100 100 38 9 8	
Carnegio-Illinois	0.25	0.49	Notched Edges, Mashined from 1-1/8 stook	3	3/4	1/4	0.042	151 140 132 125 121 108 91	9,000 13,170 13,660 14,620 11,180 17,350 11,640	52,800 30,670 31,730 31,610 31,900 31,130 33,600	58,500 59,630 59,310 58,630 57,800 59,360 59,980	28,800 17,070 20,210 20,790 27,200 58,150 59,980	100 100 96 100 96 19 5	
C As rolled Carnegie-Illinois	0.25	0.49	Notched Edges, Machined from 1-1/8 stock	3	1	1/4	0.042	160 142 130 105	14,020 14,640 15,240 14,800	32,550 34,460 33,800 33,500 33,900	60,440 58,370 57,600 59,600 59,900	58,100 29,460 56,500 49,300 59,900	12 92 22 15 2	
0 As rolled Carnegie-Illinois	<b>0.2</b> 5	0.49	Notched Edges	2	1/2	5/32	0.027	63 55 40 33 25	4,470 10,080 5,015 6,430 4,770	48,300 49,100 49,900 50,100 47,900	67,600 64,700 67,400 68,000 68,000	50,690 50,000 68,000 68,000	100 100 100 5 5	
C As rolled Carnegie-Illinois	0 <b>.2</b> 5	0.49	Notohed Edges	2 1/2	5/8	7/32	0.054	10 93 80 66 55	5,900 7,520 8,640 5,300 7,360 3,970	49,100 42,290 44,770 44,580 45,410 44,600	<b>64,070</b> 66,920 64,750 67,420 61,220	69,100 35,440 25,080 64,730 67,420 61,220	5 97 100 1 0	
Garnegie-Illinois	0.25	0.49	Rotched Edges	4	1	5/16	0.058	170 161 153 152 145 154 120	16,390 13,920 14,030 21, <b>360</b> 17,250 19,310 13, <b>3</b> 00	35,740 36,150 37,020 36,690 36,300 36,600	57,980 60,180 59,740 61,020 58,010 61,200 57,060	28,400 34,190 50,230 47,400 40,360 61,110 57,080	95 95 29 21 51 3	

Steel		<del>ر</del>	Descrip	tion of Te	st Plates	st Plates		Energy	Yield Nominal	Nominal	Fracture	Type of	
Code letter, type		de-	<b>m</b> -c	1	håalman	Not	ch.	of Test	Absorbed to Mavim	Point Pei	Stress (mar.)	Stress Psi	Fracture % Shear
and Manufacturer	%0	(%))(in	TADe	in. 1	in.	in.	in.	~	Lord in-1b	- 81	Psi		· سمين بر
C As rolled			Notched	/ .	/ .			161	27 460	83 910	58 620	29 760	96
Oarnegie-Illinois	0.25	0.49	Edges	4-1/2	1-1/8	13/32	0.068	139	35,470	014,00	56,190	23,920	94
								131	26.350	33.570	55.640	26.860	95
								125	24,790	33,630	56,100	56,100	3
			ļ					119	24, 540		57,790	57,790	4
			1					109	28,410	33,509	57,560	57,560	3
D Normalized		0.50	Notched		714	1/4	0.049	66		43.500	65.000	21.200	100
Lukens	0.19	0.52	mges	3	3/4	1/4	0.042	58		44.700	64,000	21.000	100
								47		41,000	64,500	22,700	100
								36	15,770	37,310	59,100	26,260	97
								28		40,000	63,400	63,400	6
					-			15	21,750	41,550	65,890	65,470	7
-								20	17,160	45,700	67,000	69 760	39 7
			Netshad					- 20	13,000	40,000	03,100	0.100	•
AS FOLLED	0.23	0.39	No coneo.	3	3/4	1/4	0.042	160	7_680	34,330	53,950	21,800	100
244-0419	1.10	1.00		"	-,-	-,-		151	-	36,000	55,600	24,700	96
1		1	1	1				141	10,740	35,560	56,080	32,340	100
	1		1	1				132	9,520	35,400	53,430	24,860	100
	1	1	1					128	12,160	35,675	56,430	29,730	200
	1						Į <b>I</b>	126		36,300	56,500	56,500	13
	Į	1	}		1		j l	110		37 200	57.300	57.300	ĩ
	1	1	1					50 67		37.700	56,300	56 300	3
		1		1		1	!!!	44		39,300	59,700	59,700	2
E As rolled		ļ	Sheared	1.									
Lukens	0.23	0.39	Edge	3	3/4	none	none	62		30,400	60,100	6,390	100
			1 -					65		31,900	57,100	7,990	100
	1					1		53		35,800	49 760	47,000	~* 0
	i							47		33,600	63,200	54,000	8
							1				,		
H is rolled	0.16	0.85	Notched				1	55		41,100	65,300	19,750	100
Bethlehem			Edges	3	3/4	1/4	0.042	71	18,960	41,080	65,180	20,270	100
	Ì		1					40	19,630	41,610	66,200	25,160	88
							1	33	15,630	42,820	66,960	64,080	14
								32	12,850	40 550	67,050	59,100	10
		i i	Į		1			20	18,000	42,550	67,500	83 600	26
								15	20,910	42,530	58.120	53,330	30
							1 1	1	20,210	43,400	70,600	68,500	15
							1	- 11	20,200	42,820	70,120	69,200	12
							1	- 19	18,640	43,640	69,440	64,420	18
			ł		i i			- 33	15,220	44,440	68,260	68,280	1
H As rolled			Sheared				1	-50		45,100	66,800	66,800	100
Bethlehem	0,16	0.85	5 Edge	3	3/4	none	n <b>one</b>	55		40,000	67 450	1,600	100
							1	28		38 770	67,100	50-620	27
						ļ		<i>⊷</i> ∧		••••	57,080	1.070	100
						1		_ 4		40,000	67.750	_	2
								- 20		39,470	67,110	67,110	0
	1				1			20		42,100	65,900	3,800	100
N As rolled			Notched	· 1	1 .	1				CT 000	-	44 700	96
lakens	0.13	0.49	Bdges	3	3/4	1/4	0.042	29	10 500	66,000	79,500	29 :140	96
Nickel Alloy						1		24	TA*200	64 400	B1 900	79,200	12
1	i	ļ	1			1		10		64.900	83 200	83,200	6
t			1			1		- 6		65,000	85,500	84,300	8
			1					- 19	22,200	69,850	85,400	57,100	96
-	1		1				1	- 20	16,410	69,540	64,080	49,310	98
								- 39	19,690	68,690	84,800	29,330	96
			1		1			- 39	1	64,000	83,500	46 540	4
0.000			1104-L-3	.			· ·	- 63	17,500	11,000	03,000		
4 Quenched	0.97	1 1	NOTCHED	-   - <del>-</del> -	R/A	1/4	0.042	57	18,120	64.320	81,180	36,040	96
Bernhlin	1.000	11.0			1 3/4	1 1/3		50	18_520	56,720	78,720	33,510	100
TOTADITO					1			42		62,200	80,900	76,600	26
							1	40	22,430	62,160	79,370	34,590	100
	1							34	15,925	60,000	79,130	79,130	4
								31	19,785	63,800	81,130	42,870	4
	ł							30	20,680	06,900	78,170	30,090	100
							1	29	1	07,000	00,000	00,000	100
				1		4		16	17 000	00,000	80,500	82 040	2
	- ]				1			, <b>, ,</b>	10,080	68 700	83 500	82,300	9
						1	1	- 13		69_400	82.800	82,400	10
		ł	1			1	1	- 37	15.560	64.000	63.570	83,570	3
			1										

# TABLE 8 - COMPARISON OF ESTIMATED TRANSITION TEMPERATURES FOR THE VARIOUS TYPES OF SPECIMENS USED IN THE INVESTIGATION, °F.

	Charp	y Bars	3-in. Te	ension	Notched Flat Plate Specimens						
Steel Code Letter	Long.	Trans.	Edge Notched	Sheared Edge	- 12-in	24-in,	48-in	.72-in	108-in		
A	17	20	45	35	25	-7 to 37	below 48 <sup>b</sup>	35			
Bar		-8	5	••••••••••••••••••••••••••••••••••••••	5	below 32 <sup>a</sup>	9 to 45	33	below 32 <sup>a</sup>		
Bn	-17	8	-5		15	below .32	i .	31			
	22.	20	90	120	.90 .	about 	80 to 100	90	above 32		
Н	-10	-10	about 20	10	15	· • • • • • • • • • • • • • • • • • • •	• ar %	20	<b></b>		
N	-120 <sup>c</sup>	-170 <sup>c</sup>	F	ан сараан 	~64						
Q	-60	80	35		10	-		·			
QS				•	-5		fite mound				

a.- Coldest test at 32°F, resulted in 100 percent shear. b.- Coldest test at 48°F, resulted in 100 percent shear. c.- No definite transition temperature.

Note: Transition temperatures for Charpy bars were taken as a point corresponding to a temperature halfway between the maximum and the minimum energy values in Fig. 7 for the particular steel.

Transition temperatures for the 12-in. and 72-in. wide specimens were taken as the value of temperature corresponding to an energy value on the steeply sloping part of the energy-temperature curve approximately one-half way between the maximum and minimum in Figs. 8, 9 and 10.

Transition temperatures for 3-in. wide specimens were taken as the temperature corresponding to a point halfway between a O percent and a 100 percent shear fracture in Fig. 13 for the particular steel.

Ship	Distance in from Frac- tured Sur-	Percent Reduction in Thickness Measur at Several Locations Along Fracture							
	face, inches	1	2	: 3	4	5	6	7	
	0	3 16	2 93	3:09	2 61			··· •• •• ••	
	1/16	2,45	2.37	2,29	1.82				
	1/8	1.11	1:11	1.27	0.79			~~~~~	
S.S.Sea Bass	1/4	0.32	0:55	0.40	0.47				
	1/2	0.08	80.0	0.24	0,00				
$\mathcal{T}_{i}$	3/4	0,08	0,00	0.00	0.00		,		
۵۰۰۰ موجوع می اور در معالی می موجوع می موجوع می موجوع می موجوع می موجوع می موجوع می موجوع می موجوع می موجوع می مربو		0.20	<u>יי</u> ז <i>ו</i> ה	<u>.</u> 3. Δ.8.	3.10	2:03	1.16	2:03	
,	1 . 1 /1e	0.20	0.58	2.61	2.32	2.03	0.87	1.74	
7 - 14 per	1/20	0.00	0.20	1.42	1 45	2.03	0:87	1,16	
S.S.Russell H.	1/4	0.00	0.00	1,16	1,16	1.74	0:58	0.87	
Chittenden	1/2	0.00	0.00	0.87	0.87	1.16	0.58	0.58	
	3/4	****		0.29				0.29	
	0	2: 33	2.04	0,58			1999 - 1997 -	alalah yere a araya (b <sup>ara</sup>	
	1/16	1.46	0.58	0.00					
S.S. James Gunn	1/8	0.29	0.29	0;00	*	· · · · ·	· • ·		
	1/4	0.29	0.00	0:00	÷ .		•		
	1/2	0.00	0:00	0.00		* 15 S	- · • • • •		
	3/4	0.00	0,00	0.00	•••				

TABLE 9. -- REDUCTIONS IN THICKNESS OF PLATE OBTAINED FROM SAPPLES OF FRACTURED PLATES OF SHIPS THAT FAILED IN SERVICE

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All above values were obtained at or near fractures of cleavage type.

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# DURING TESTS OF LARGE FLAT PLATES

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	Devel	opment of Ci		**************************************	
Specimen Number	Temp. F.	Load, Kips	Nominal Stress ksi	Max. Nominal Stress ksi	Break % Shear
A3A	49	1320	32.6	40.3	100
A4A	10	1300	32.1	35.8	0
A5A	45	1400	34.6	40.0	90
A1B	68	910	33.7	40.7	100
A3B	48	950	35.2	41.1	100
A3C	-6	505	37.4	38.1	0
A3D	50	250	38.0	48.1	100
A5D	-8	220	32.6	39.9	0
B-108 B7A B8A B6B B5D B6D B7D B9D B10D	32 9 16 45 50 -34 -7 12	1750 1250 1150 900 240 325 270 240 265	28.8 30.8 28.4 33.3 35.6 48.1 40.0 35.6 39.3	36.7 34.6 33.3 42.6 45.9 49.3 40.0 41.8 48.7	100 0 100 100 100 0 87
C-108 C4A C5A C1D C3D C5D C51XD C52XD	32 81 152 32 101 143 121 90	1900 1320 1350 257 270 275 290 270	31.4 32.6 33.3 38.1 40.0 40.8 43.0 40.0	38.4 35.7 43.0 40.0 51.1 54.7 48.7 46.6	0 98 0 51 91 100 10
Hla	68	1640	40.5	44•7	82
H2A	25	1500	37.0	45•6	88
H4A	-18	1450	35.8	39•0	0
NIA	-53	1650	40.7	64.2	4
N2A	-32	2250	55.5	60.9	13
N3A	2	2000	49.4	59.8	73
N1D	-29	385	55.6	69.3	84
N2D	-60	435	64.4	75.9	6
N3D	72	360	53.3	66.4	100
N41XD	-45	430	63.7	69.9	81
Q2D	134	390	57.8	61.0	100
Q12XD	86	385	57.0	60.7	100

TUBE	
DIANETER	
20-IN.	
- 1	
RESULTS	
TEST	
6	
SUDAA BY	
H	
TABLE	

		Mature of Fracture		Initiated by shear in plate about 4 in. from and parallel to weld usar midsection; after shearing for about 5 in., ersk propagated over considerable lameth of the hv. law	age. Practically same as for tuba A.	Clearing fronting anti	cumferential end weld.	Shear for 6 in. (premature); <sup>f</sup> after re- pair by welding, shear for 4 in., then cleavage.g	Olearage fraoture originating in weld about 48 in. from mid-soction and prop- agating spirally around tube.	Gleavage fracture originating in wold 2 in. from mid-section and propagating completely around tube. No shattering.	Cleavage fracture originating in weld 24 in: from mid-sociiton. Specimen shat- tared from control of the sociated of the sociation of the soci	orou and press. Clearage fracture originating in weld the from mid-section. Specimen stat-	our succession wanty precess. Clearwage fracture originating in weld 28 in from mid-soction. Specimen	watered into many pieces. Gleavage fracture originating at defect in plate 90° from weid 44 in. from mid- section and propagating around specimen. No shitterter	Unerwage fracture originatiag at longi- utinul well 22-in. from add-section proceeding along the heat affected come parallel to the weld and them around	the tube at both eads. Leavage fracture originating near top of the tube at the defect in the plate ropediating around upper portion and ownmard parallel to the weld. Seesian	hattered into many pieces.
Potontial	Frergy	Fracture,	ft1b.h	133,000	148,500		000,011	109,500	102,000	145,000	86, 500	201,000	60, 500	38,000	98,000	0000 22	•
Reduction	ui	Thi ckness.	be.	30.0	32.0	6		Q 8	2	20.0	3 <b>.</b> 5	31.0	6.7	5.0	0.9	<b>10.6</b>	
mun	tent ettor	н. Н	Trans	15.0Ĵ	21.0			4.4	4.0	10.6	2.0	18.7	3.0	0.3 8.0	3. 13	6.3	
Maxi	Perc	i i	Long.		Ч	Ċ		4.4	5°2	ର ଜ	1.6	17.4	3.0	2.0	5 <b>.</b> 4	5.7	
verage	e Stress Tacture, <sup>c</sup>	psi.	Iranc.	85,000	<u>\$0,000</u>	60 - 00De		59 <b>,</b> 500e	56,000*	72,000	45,500	88,500	64, 500	25,000	0,600	006*6	-
-	ь т т т т т		•9mn	42,500	45,000	30.000		000	60 <b>,</b> 500 <sup>e</sup>	000 69	15,500	15, 500	1,000	000	,100 t	000	
1	۰	utti- ™ta	5	000 65	62,000	54,000		55,000	26, 500	1,500	<sup>14</sup> 500	- 1000 e	9 000 <b>*</b> 6	, 200 9, 500	000°	000	
Homin	Stree pei	Prop.		30,000	30,000	40,000		30,000		000,00	000'0	0,000	s, 000 5	*****	2000	000	-
tional	328	Tans-		52,500	49,800	51, 300		51,300		000	4,500 4	1,400 4	9,300 2	40	600	300 37	+
U9AU00	19d	Longi- tudinal		26,250	24,900	25,650		001,66		56,800	45,400 4	62,500 5	59, 700	0,800 24	8,760 48	8,500	88⊄. bîchnece }
Hoat	Treatment	(J_00TT)		Before Welding	After Welding	Before	Before	Welding		F	Before Welding	Before and after Welding	None	Before Walding	Before Welding	Before and Si wfter welding	ongitudinal stre original wali t
Test	Temp.			ç	22	- 45	2	02		2	-44	62 -	8	÷44	64		L = l
Tooding	Conditions			Pressure	£	E	Axial load,	int.press.		,	4		r	Axial load, int. press.	Axial load, int. press.	Arial load, ' int. press.	ential stress; computed on b
Stress	Batio, a	•		N	~	N		н					1	3/1			dircumfer 1 stress
Sneoi-			•	<	Ħ	77 181	рŋ	 B					ъ		, k		- T = c - Nomina

ed at the designated load condition.

c - Computed as load on a given section divided by actual oross-sectional area, except as noted in footnote e for specimens failing prematurely. Underlined values indicate direction of stress presumed to govern failure.

d - Failure occurred at or near ands or and connections, prosumably due to high complex stresses caused by bending induced by end restraint. However, results are significant in that they indicate average stress levels attained before localized conditions caused failure.

e - Values given are those for mid-section of tube at instant of failure.

f - Shear fracture 6 in. long, crossing lougitudinal weld at 1/6 in. from circumfercutial and weld. Fracture started inside of tubs, in circumferential weld.

g. Fracture 4 in. long (apparently shear) at root of oircumferential weld, starting about 8 in. from nearest longitudinal weld; than cleavage fracture extending completely around speci-non at angle of about 70° from axis. h - Compression emergy in liquid and concrete plugs, and elastic onergy in specimen.

i - Computed on basis of original diameter and original thickness. k - Welded with NBC-2A electroise.

J - Computed from thickness measurements at 1/2 in. intervals over 5 in. length across fracture at point of origin.

#### TABLE D-1

# SUMMARY OF RESULTS OF TESTS ON GEOMETRICALLY-SIMILAR SPECIMENS

Note:	A11	specimens	made	from a	single	annealed	plate	containing	25%	carbon
-------	-----	-----------	------	--------	--------	----------	-------	------------	-----	--------

Size	Temp. of Test °r.	Type of	Stress at formation of first crack Ksi	Nominal Stress at Max. Lœd Ksi	Reduction in Thickness % Maximum Minimum		
3-in. wide 9-im. long 0.180" thick	75 75 32 * 0 * -20 -30 -40	100% Shear 100% Shear 100% Shear 100% Shear 100% Shear 94% Shear 1% Shear 0% Shear	40.3 42.5 x x x x x x x	45.7 45.7 45.2 47.9 45.2 47.9 45.2 47.2 50.3	29.8 28.4 26.7 30.0 25.1 21.0 26.2	19.8 20.0 15.6 18.9 17.3 0 1.2	
6-in. wide 18-in. long 0.360" thick	90 * 70 68 50 * 32 *	100% Shear 100% Shear 100% Shear Shear and Cleavage 0% Shear	x 37.5 37.5 x x	44•4 44•5 42•8 44•2 45•5	25.6 25.7 20.5 23.1 22.3	17.7 15.1 6.9 7.8 9.0	
l2-in.wide 36-in.long 0.720" thick	125 102 * 70 * 70 32 *	60% Shear 0% Shear 0% Shear 0% Shear 0% Shear	32.3 x xx 27.5 x	34.4 39.1 35.2 39.9 40.9	19.5 19.7 14.8 17.9 16.2	2.9 1.7 0.9 1.4 1.4	

\* Test results reported in previous report (Bibliography 2)
x Observations not possible in these tests because of type of temperature control housing used.

xx Not observed



FIG. I VIEW OF IO8-INCH SPECIMEN READY FOR TESTING AT 32 °F



DWG. 44E44

F16. 2



FIG. 3



F1G.4



DW9.44E38

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FIG. 5



F10. 6



3,500,000 VALUES NEAR POINTS INDICATE PERCENT SHEAR -Bor-STEEL AS ROLLED ÷ -BA-STEEL AS MOLLED -BR-STEEL NORMALIZED C - STEEL AS ROLLED N - STEEL AS ROLLED H - STEEL AS ROLLED 3000,000 2,500,000 Γiο φ 00 100 00  $\overline{n}$ 2,000,000 180 ENERGY, IN-LB N - STEEL B. - STEEL 1,500,000 B. - STEEL --A-STEEL 100 1,000,000 H - STEEL: C-STEEL 98 500,000 о --<del>0</del>-0 ğ 0 0 100 120 -80 -60 - 40 -20 20 40 50 80 140 160 TEMPERATURE , "F VARIATION WITH TEMPERATURE OF ENERGY TO MAXIMUM LOAD FIGURE 8 FOR 72-INCH WIDE SPECIMENS . DWG. 44E62

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57

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DWG. 44E6 6







F/G.13

DNG

100 . SHEAR INCH \* 100 THICK SHEAP I- INCH \* 100 INCH THICK SHEAR \* 0 n ha 100 INCH THICK - INCH THICK % SHEAR 0 100 SHEAR ×. 0 120 160 180 200 MO 100 40 60 80 20 - 60 -40 -20 0 TEMPERATURE, \*F FIG.14 - TRANSITION TEMPERATURE RANGE, 3-INCH WIDE EDGE NOTCHED SPECIMENS, C-STEEL, CUT THICKNESSES. FROM PLATES OF VARIOUS

DWG. 44E269

FI Q





FIG. 16

FIG. 17 - TRANSITION TEMPERATURE RANGES FOR 3-INCH WIDE SPECIMENS

FIG. 17











DWG. 44E263

FIG. 20





FIG.22-RESIDUAL ELONGATION AFTER RUPTURE ILLUSTRATING INFLUENCE OF PLATE WIDTH ON DUCTILITY AT FAILURE.

> ELONGATIONS MEASURED ON ONE FAGE ONLY GAGE LENGTH-34 PLATE WIDTH

SPECIMENSBI-108ANDCI-108AREIO8-INCHESWIDESPECIMENSB-5AANDC-2AARE72-INCHESWIDESPECIMENSB-6BANDC-2BARE48-INCHESWIDESPECIMENSB-4CANDC-2CARE24-INCHESWIDESPECIMENSB-4DANDC-2DARE12-INCHESWIDE

DWG 44E267

71

FIG. 22



MACHINED EDGES

CENTER NOTCHED

FIG. 23-FOUR DIFFERENT TYPES OF 3-INCH WIDE SPECIMENS USED IN THE INVESTIGATION.





FIGURE 25D (Section DD in Fig. 25A) SPECIMEN H-8D CUT ACROSS THICKNESS OF SPECIMEN SHOWING OPENNINGS ALONG SEAMS OF NONMETALLIC INCLUSIONS. UNETCHED (50x)



SPECIMEN H-10D VIEW OF FRACTURE AT NOTCH (5x)



FIGURE 25 E (Section EE in Fig. 25B) SPECIMEN H-10D CUT ACROSS THICKNESS OF SPECIMEN SHOWING OPENNINGS ALONG SEAMS OF NONMETALLIC INCLUSIONS. UNETCHED (50x)







FIGURE 25 F (Section FF in Fig. 25C) SPECIMEN H-82xD CUT ACROSS THICKNESS OF SPECIMEN SHOWING OPENNING ALONG SEAMS OF NONMETALLIC INCLUSIONS. UNETCHED (50x)



FIGURE 26 PHOTOMICROGRAPHS OF SPECIMENS OF STEEL Q (Etched for 15 seconds in 2% Nital, 250x )



Steel C



Steel H





Steel N ( 100x )



Steel QS ( 250x )

Steel Q (250x)



8.8 8.2 8.E ₽'E ₽'E 0'E 0'E 8'9 £'9 3'S 0'S 8'9 0'9 19 63 9.9 8.9 8.E E.E 2°£ 9`£ \*\* 8"\* 1 1 6.6 6 T.S. °, 41. Pa 5.7 4.1.5 o 6.9 £28 8.2. £-6 ٠ £ 9 0 9.1-9.9 -2.3 .... -1.7 9) 9 ~ ~ ~ 5 9 4 ٠ • ٠ . • ٠ 8.8 . 0.1 ٠ 2.8 8.4 9'E 9.5 3"\$ 8.1 -0.2-4.2- 4 4 5.4-6.2.9 N. 7 9.7ņ -• 8° £ • 3.E ٠ ٠ 8 °E ٠ • 3°E 8.0 . 89 6'8 ē.2- o 0.2- o . -1.3 -1.6 1.2- 0 5 **1** \* 1. • 0.1--2.9 9.9-.1.8 -1.1 0-1.5 • 8.8 • 8.8 5 E 57 . 1.9 • • s . 2.8 ÷'3 1.2 5.5 6.5 - 2.7 2 7 -2.8 5.5 5 3 5 7 . 1.8 0.3 0 1'8 \$°£ 1.5 ç 4--2.6 9.2 0 0 1.1 • -1.3 0.0 5.1.0 6.1-2 • - 2:3 • -2.I ٠ • £'1 ٠ 0 ٠ 2'£ ۰ 6'# ۰ . 8'E 6'3 8.8 . 97 8.0 ۰ 9.0 . 01 \$1 9'8 15 6. 7 • -0.9 -0.*0* 0.2. 0 5.7--1.7 -P. B - 2.9 - 6.7 5 9-2-0 ÷,0 ۰. ۱. 9.0 36.7 KSI 0 -0.4 GRID ) • ٠ • £'# ٠ ٠ . 0.5 67 **\$**7 ٠ 8.1 £'0 • 5.0 ٠ • • 11 27 9.8 27 . 8.0 10 2.9 . -0.3 9 2.7 -10 -0.1 a.o. + -0.6 9.7--0.2 1.1--8-• ò 0.3 BI-108 (5-INCH STRENGTH 9 SHEAR • 1 • ٠ -7.2 . ٠ 8.0 1.0. ٠ ۰ ٠ 01 • **9**7 60.Jo - 0.B o 6'8 27 -0.5 0 8'1 e0.10 - 0.5 o \*0 £ 0 \$ 0 10-10 10 8'/- e 0 0 10- 0100 6010 -0.5 10- -109 604e -0.J 0.4+ -0.2 0 0 2.0 \$.0-₽ 0 ₽ 0 0 0 0 0 £ 0 **s** 0 27 6<sup>05</sup>6 ro • 0 • • 0 • 1.0o 60.lo 1.0-<del>6</del>0.3<sub>0</sub> e0.4e 1001 8.0 · ٠ 07 1.0-10-8.0-£'0-10. 1.0-10-VOMINAL 0.1 9.0 6 0 1.0 0 0 0 0.1 6 0 0 0 0 0 ٠ • 8.0-٠ 10-٠ 8.0- 0 1.0-. 0 . . • \*·0-0 £'0-8.0-PLATE 5 6 0 4 6 0 0 0 ۰ • . 80. 8.0 10-10-8.0-£ 0 3.0-1:0-10-<u>,</u> هر 0 0 0.1 0 0 0 6 0 0 0 0 • 0 • 80-#'0- º 3.0-• £.0- • 8.0- o • ٠ 3.0-٠ £ 0-11 0 1:0-0.3 0 0.3 0 0 9 0 • . . ۰ 10-8.0-8.0 0 10-10 1:0-1.0-8.0-STEEL, 108-INCH WIDE PLATE 0 0 9 9 0 0 Ø 6 è ò 0 FIG. A-69 PERCENT ELONGATION £'0 \$'0 10. 0 • 0 • 0 0 1.0 8.0 8.0 8.0 ۰ • 2.0 505 10 1.0 °, 70 1.0-0 • • 1.0 eQ/e 10--0.6 00.30 .00 • 0 • 500 0.7 100 e//e ġ 1.0 0 0.1 £ 0 0 Υ, 0 0 £ 0 10 • . 8.1 2 0 1.7 0 • -/ / • 01 0 0 0.0 31 9 0 ۰ £'0-6'8 9'1 01 0 ٠ 10 91 \$.0 2.0 .0 Z:0. \*0 8:0 -0.P TEMPERATURE , 0 4 0 -2.B -1.6 1.0---0.5 9.0 -0.2 17- 0 1.0-P .... ÷ 0 • • ٠ 0 £°0 ٠ 0'8 ٠ • \*'8 • ٠ . 3.8 91 6.0 ٠ £ 0 10 . 10 ٠ 91 6'8 6'8 9'\$ -0.2 -2.2 07--0.2 -2.9 -0.J K. 7 -0.6 -0.8 -1.2 - 2.5 - 3.0 -2.6 **1** 7 Ņ • • \$'1 • • • 9'E • ¥ E ٠. • 8.3 • 8'8 ٠ 0.5 • 18 • 8.1 • 81 ٠ •0 . 8.0 0.8 18 ٠ # O -0.3 - 5 - 2.3 -2.6 6. 7 - 6 -5.9. ------0.8 ş 9 -0.2 -1.5 9) 7 ò o -1.6 1.1-• • 0.8 27 . **\***1 1.8 £`£ 0.4 £'# • \* 8 11 • -0.7 -3.0 -2.3 1.1 - 0 51-6 /-- 5.1 2 2.9 ų. 1 0 0 • ٠ • • ¢ 9.9 ٠ 18 9°£ 0.8 11 . • £'8 ۰ 8.4 -0.9 -1.5 0.0 -1.3 -1.5 2.6 2.8 a -2.2 ò è. e -2.9 e -2.8 1 4.1- + -1.1 907700 ٠ e • ⊊'≱ • 8.5 9'# 2.8 0.5 2.8 \* '8 ٠ <u>6'8</u> 9.8 • 6'> . 0.2 . 0'8 6.5 5.5 2 -2.5 2.2 -20 -1.0 5.1 -1.7 -1.8 ÷ - 5.7 **6** T -1.5 -1.1 ò e 6° E 1.0 a 0.5 ٠ . £ '£ 0.4 ٠ · 9.4 1.5 1.3 £'7 -1.7 -2.0 Ċ -1.8 e.) --1.6 -1.7 0 • - 1 - . **.** 10 9.7-6.0 77 -1.3 ø'.J. 8 0'r 2°£ 2°£ 0'5 #'5 1'E 7'E 5 9'E 9'\$ 9'} 5°1 5'0 1.4 1°8 1°8 6°£ /¥ 4210 9'E #'E 8'¥ e'!.7.o 1.1 o*€*.1₀ 5'\$ 5'\$ 2.4 6200 67.0 1.70 5

82

FIG. A-4



80 10 20 20 30 30 0 10 1.0 0 ro io 10 10 #0 #0 57 57 0 0 80 83 ø ą ş ą ą q ş ş **}**. 5 ş ģ 10- . è 0 0 ò 1.0 10 in **z**:0 • 6 9 0 10 ro 20 1.0 10 ġ ģ ġ ٥ 1.0 ģ 0 0 1.0 £'0 10 38.4 KSI. 90 9 à 3 è 0 CI-108 ( 5 - INCH GRID) . 10 £ 0 . 20 80 0.0 3 0 -0 - - 0.8 ġ 9 STRENGTH SHEAR 0 20 \$0 10 r:a -0. -0.2 -• /• -0/0- -0/E 0 0 10- 10-٩ 10 0 ş 10 0 0 104 -20 0 ro 0 10 50 9 9 ro 0 ro Ó 10 NONINAL 80 -0.1 0 -0.E 10- • 9.0 6 0 0 0 0 . ro . 2.0 -0.4 PLATE -0.8 ò ø 0 0 • 10 ٠ ro 1.0 -0.6 -05 0 1.0 80 -0.1 ò ò 0 . 0 "C" STEEL, IOB-INCH WIDE PLATE -0+ 90 9 0 FIG A-71 PERCENT ELONGATION 1.0 0 1.0 10 10 10 0 +05 ÷, TEMPERATURE, 26-28"F. 10 0 10 0 1 0 10 10-0 / 0-+ 0 0 20 10 . 0 1.0 10 11 - - 01 9 ro 0 + -0.1 1.0. 2 Ġ 50 10 1.0 0 10 -0.2 90 9. 0 õ 0 10 ro 0 0 0 0 ò 10 0 0 0 0 0 • 10 10 10 • 0 • 0 0 -10 10 •67• 10 10 10 10 10 0 1.0 0 0 0 0 0 0 0 • 63 • 9 10 •d/• 01 -00 10 0 ą ġ -05 ş ą ġ • 10 10 0

FIG. A - 7/



ľ£ ø O'Z <del>ا</del>. ا -16 -0.7 5 Ņ 04 20-5 7 0 25 ¢ •• OE-8 -03 5 2 8 3-- 1.2 1.1 Ŧ G 22 2.1 <u>9</u>'2 ø ø 0.4 6.0 6'/ 12 . BOTTOM PLATE A-JA (5-INCH GRID) STRENGTH 41.3 KSI 03 -2.6 \$ -0di. 2 -0.2 -05 -1-2:ø 60 10 1:5 81 ø ٥ 0 6.E 0 2:0 90 SHEAR -02 ģ - 2 4 35ð 7 8 ġ 17-9 • 0 • 100 X 10 **3**.0 0-020 o [7-0 9'/ e05 e n 2.0 -010 • 10-0 **\$**1 0700 •20• 0 0-020 e-0.5e 0 **JANNAN** ro ю ю ro **9**0 10 0 90 -03 96 <u>-</u> 01 ò Ó ġ å ģ 0 9 10 0 o ro 20 ro 0 ø -0.2 å 20-Ş ġ ġ 9-0 ELONGATION 0 • 0 0 10 0 • 10 r0 0 ø 0 0 ş , b -03 -0 0 0 ġ. - 02 0 0 e-04e 0-13 0 30 0700 • ; ; • **5**Ð 20 0-050 - 50 0450 0 ٥ 90 10 é o "A" STEEL, 72-INCH WIDE PLATE 20ç PERCENT 10 **£**0 ro 0 97 **\$**7 80 n 48-30 F -07 -3.2 -03 -63 -1.3 -04 0 -02 -05 7-30 ø 61 20 67 TEMPERATURE 3.E 0 Q 10 10 8.1 ø ٥ o -02 ģ \*\*--6.3 2 \* - 05 -0.8 -1.6 7 4 - 73 0 σι 22 0 o ø 91 12 o /\* ø ø 9'8 o 27 07 - 94 TOP -1.8 -2.5 с, q 7 45 -17 -10 -1.3 8 F1G. ø £.2 0.6 *05* ۶É ٥ Z\* ø 0 G **₽£** 61 -08 -2.2 ٩  $\overline{\gamma}$ 50 -1.9 9 -0.8 -1.2 -1.6 ¢ *r* # 28 65 9 8

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FIG. A-73

<u>DWG 44E 20</u>



$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2	0.0	٥	0'0	۰	0.0	٥	10-	۰		٥	0'0	٥	10	٥	10	٥	1.0	۰		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2		-0.1		0.0		0.0		0.0	[ *	0.0		-0.1		0.0		1.0-		0.0		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	•	1.0-	۰	0.0	٥	0.0	٥	10-	o	1101	٥	10-	o	<u>s.</u> 0	۰	10	٥	0.0	•		
0       01       0       01       0       01       0       01       0       01 </td <td>2</td> <td></td> <td>-0.1</td> <td></td> <td>-0.1</td> <td></td> <td>0.0</td> <td></td> <td>0.0</td> <td>BO</td> <td>0.1</td> <td></td> <td>-0.2</td> <td></td> <td>-0.2</td> <td></td> <td>-0.2</td> <td></td> <td>-0.1</td> <td>~</td> <td></td>	2		-0.1		-0.1		0.0		0.0	BO	0.1		-0.2		-0.2		-0.2		-0.1	~	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	•	10	۰	10	٥	2.0-	٥	10-	٥		٥	1.0	0	1.0-	0	10	۰	00	0	SRID	15
0       0	2		-0.2		-0.2		1.0-		0.0		0.1		10-		-0.2		-0.2		-0.1	VCH (	35.8 K
0       0	1	1.0-	٥	0.0	٥	10	0.	1.0	٥		٥	<b>\$</b> '0	o	10	•	10	۰	1.0-	a	12-11	
0       0	5		-0.2		0.0		1.0-		-0.2		-0.3		1.0-		0.0		10-		1.0 -	44	ENGTH
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	- 34	0'0 1'0-	0-0 <b>40</b>	1:0- 1:0-	00:60	5°0- 1'0-	6-040	0°0	0-0:40	T	0-0.40	1.0 0.0	o ().30	1.0- 0.0	0./0	0'0 1'0-	o.().o	0'0 0'0	or <i>0.2</i> 0	E 4-	STRE
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ŝ		-0.1		10-		0.0		0.0		0.1		0.0		0.1		0.0		0.0	2,47	TENIN
0       01	,	8.0-	o	0.0	٥	0.0	o	0'0	o		o	0.0	o	0.0	٥	00	٥	10-	0	4	ION
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Š		-0.1		10-		0.0		10-		0.1		0.1		0.0		0.0		0.0	N	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2	2'0-	٥	10	0	2'0-	0	10-	٥		0	0.0	٥	0.0	o	1.0-	. 0	0.0	ò	17/0	ТЕ Г
0       -01       0       -01       0       01       01       01       01         0       -01       0       -01       0       01       01       01       01         0       01       01       01       01       01       01       01       01         0       01       01       01       01       01       01       01       01         0       03       03       03       03       03       03       01       01       01         0       03       03       03       03       03       03       04       01	Ņ		-0.1		-0.1		0.0		-0.2		0.0		1.0-		-0.2		0.0		1.0-	'9NC	PLA
0 $0$		0:0 1:0	o-04 o	0°0 1°0-	0-0:2 o	1.0 1.0-	00:40	0'0 1'0	0-0.4 o	Ŷ	o-0.20	0'0 1'0-	o//0-0	10- 10-	o <i>0:0</i> o	0:0 1:0-	0-0.2a	0'0 0'0	0.020	ELI	HIDE
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Ś		-0.2		-0.1		-0.2		<b>-</b> 0. <b>4</b>		0.2		0.2		0.0		0.0		0.0	EW7	INCH
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	9	1.0	٥	0.0	ø	2.0	0	<b>\$</b> `0	٥		°	2.0	•	1.0	o ·	0.0	•	00	٥	- BCI	72-
<ul> <li>0.1 0</li> <li>0.2 0</li> <li>0.1 0</li> <li>0.2 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> <li>0.1 0</li> &lt;</ul>	5		-0		- O.3		-0.2		-0.2		0.1		-0.1		0.0		0.1		-0.1	đ	5 <i>E</i> L,
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	Š		-0.1		10-		-0.J		-0.2		0.0		-0.1		1.0-		-0.2		1.0-	9 9	দু য
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FIG. A-75

44E 216

OWG.



o <u>۲</u>.2 <u>Ζ'</u>Ε 0.2 0'8 9 - **2** 8 -3.8 90 5 -0.9 -0 47 01 6'/-BOTTOM a oa 83. 0 ٥ o ¢ • 9.8 ø /`**£** 9.9 9.51 2 <sup>.</sup>S 6°.Z 8.1 PLATE A-5A (5-INCH GRID) 5 00-0 - <u>2</u> 7 07-5 <u>o</u> 17------27. NOMINAL STRENGTH 40.0 KSI 0 0 **8** 0 0 ø 8.8 8.4 5.3 ٥ 0 6'0 æ 1 Б. О. -a2 -30 å - 2.1 -0.5 0 - 2.5 - 1.6 47-17-·100% SHEAR ٥ 8.0 0 57 0 £'£ <u>s</u> / <u>6</u>.0 ø <u>8</u>.0 0 \$°0 27 -0.2 - 03 -09 -01 -01 - 2.1 -03 -0.1 -0 ۰ 0 ( ) O O 0*0*.00 • 1.0 0 0 00.20 0/100 0 0*2*,00 £ '/ o€ Ø0 1.0 1.0 **\*** 1 0010 0/100 0 0 0 ro 0 0 ¥ 0 1.0 + 0 0 -0ġ -01 è. 0 ø 0 -0' 0 0 0 0 1.0-۰ • 10 10 0 1.0 00--05 - 0/ 0 PERCENT ELONGATION 0 0 0 0 0 r. 0 0 0 n 0 a 0 1.0 0 0 "A" STEEL, 72-INCH WIDE PLATE 0 è. ģ 0 ٥ -0. 0 0 0 0 TEMPERATURE 43-45°F. •0/• **\***9 0 030 1.0 0 0 **3**:0 ° /0° 1.0 0 0*2* 00 o£⊘o 00 **1**0 • 0 • 00.00 ro ro **3**'0 10 10 1.0 • £ '7 **2** '/ ٥ -0 -1.0 <u>6</u> 0 à 5.2 ŝ -1.1 8 0 ٥ 10 ٥ ro <u>e</u> .0 s'1 £ '+ 3.8 27 £ 0 • ì 1.1 FIG. A-77 -03 - 2 -02 -0 11-0 ġ 57-• • 0 1.0 • 0.8 Z'÷ é v 2.0 17 6°5 OE--03 9.5 --07 07--15 8-2- e -16 -a -09 ø . • 1.03 /'£ . £ '6 24 £.5 c'7 £'/ - 700 03-• 7 -06 -13 0.7 - 0 • 1-1.0 2 07- • 97- . -a7 £ c **c** 19 • 6 27

DING. 4 - E.B.

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27 ° + 7 ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °	-56515/ -66515/	670 97	0 /10 £10 6 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		0 // 0 5/ 0 0 5/ 0 0 0 7/ 0 5/ 0 0 7/ 0 5/ 0	210 £1 0 6 500 200		
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SI

FIG. 4-78

2'9 2'9 ٥ 94 8.5 ° 29 66 96 Ó シ᠈⁰ - 2.4 2 0 1'2 ° 2, 69 0 <u>5</u> <u>6</u> 9'\$ £'9 <u>0</u>1 0 0 0 8.5 0 1.5 ¢ \$ 2 2 - 0.2 9.1ņ Q Ŷ ò 9'**\* 0,0** £'9--0 8.5 0 £7 0 0 0 # 9 0 6'£ o 0 o 1.8 o 1'£ 17 (5- INCH GRID) 39.5 KSI - 4.2 BOTTOM - 2.8 - 2.8 - 2.1 - 0.2 ò • • <u>• • •</u> • • \*'E\_\_\_\_\_ 81 0 5.0 0 67 0 O 6 0 0 0 10 NOMINAL STRENGTH -3./ ē. B-54 4 -07 E.I.-SHEAR 27 23 12 20 02 10 02 10 Q 10 0-0-0 2.0 0-0:80 +0 0.40 1.0 2.0 10 0-0 PL ATE o 0 1.0-0 10 10 10 10 -3.5 5.0 0 0 ò 0 • <u>•</u> 3.0-• 2.0-0 10 ° - 0'5 0 2.0-8.0-0 o ø • 10-10--2.5 ₩.E 1 6 ò -0.1 0 ELONGATION 8'I-2'0 - 2'0 -0.5 0-0 0 0 2.0-Q 10 2.0 ٥ 10-0 10-- 3.2 - 30 0 0 -0.1 97 57 57 57 57 57 57 57 PLATE 0//0-0 9.0 0.0 7.1 2 7.2 7.2 7.2 7.2 o 0-050 10 £`0 10 •-a3• 10 0 8 0 0 PERCENT 2.0 0 o 0 10 ø 2.0 0 -0.2 72-INCH WIDE -30 - 0.2 44. -/3 4.1 -+E 1+ ° + ° • • • • • • 11 o £`0 o 1.5 0 o 0 0 10 ø 6'0 0 .0.0 45 -0.3 - 3.0 - 2.6 Ň STEEL, FIG A-79 0 1.2 did ° <mark>° 3 5</mark> 9 ø o 0 6E o ÷7 81 0 8'E £7 - 30 - 1.8 -2.0 **.** 8 0 - 0.6 700 2 • <u>• - 52</u> 7175 • • 5 E 97 19 29 000 ٥ 8.4 o 0 <u>,</u>Σ.Σ 67 0 2.5 0 30 0.5 ° ° 8'S 13'9' 5.4 ۰ 8.8 ۰ 9'9 9'8 °\_ ° 5.5

FIG. <u>A</u>-79

100 %

TEMPERATURE 49-52°F

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FIG. A-80

1.5 o 9.4 o ø 1.5 1.9 8.4 Q Ġ 11 11 - 2.3 - 1.6 - / 9 4 4 12-5 0 s s 0 2.5 o 8 E 5.5 0 8 E 2.5 0 12 ٥ -2.9 -2.0 - 0.6 -2.1 2.2 -0.9 0 \$`S rz 91 0 ¥'S 9'£ 6 E ø a 9.5 2.5 o c BOTTOM (S-INCH GRID) - 3.0 40.2 KSI - 3.0 - 0. i -2.0 ₽.0ŝ 5.Þ 0 o 0.4 ٥ 0 0 5.5 9'/ 12 0 £'0 57 1.5 NOMINAL STRENGTH - 2.5 8.2-- 0.1 -0.1 - / 3 + / -*B-6*4 0-/*.*0 o-/30 87 0.5 11 0.50 •70 0-0.50 0 0 0-080 11 £7 2.0 PLATE 1.0 °C - 0.2 -0.7 4.0--1.2 -1.0 0 0 1.0 o 0 £ 0 10 2.0 1.0 1.0 £ '0 0 10 -0.1 - 0.3 -0.5 - 0.1 PERCENT ELONGATION 0 S.0 0 • 1.0 10 10 o 1.0 10 o o 10 ro - 0.9 - 0.2 -0.2 -0.2 - 0.6 - 0.2 ●-2:0e 0-/-40 0-0.30 0.1 17 <del>0</del>0;90 000 1.0 ç 0 0 1.0 "B" STEEL, 72-INCH WIDE PLATE 0.08 81 87 20 2.0 5.0 8.0 ø -0.2 9.5 -2.3 -3.1 -1.2 -1.2

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FIG. A- 81

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FIG. A-81


F/G. A-82

0 ο 4.0 ¢ 9 0.6 0.5 ø. -0.1 0 ò ò BOTTOM o ro 0 0 (5-INCH GRID) 8.0 ¢ 0 o 0 0 -0.2 9.0 90 0.5 0 0 10 0.6 0.7 0 0 2.0 0 <u>s o</u> 0 8.0 ٥ \$°0 ç 1.0 10-1.0 1:0 -0.3 -0.7 **4** 4 -0.5 -0.6 0 4 0.0 ò PLATE B-74 • 0 • 8 0 0 0'1 0 o 8 0 8.0 0 n 2.0 n 0 -0.2 0.4 -0 2 0 -0.2 - 0.2 9 9 -0.7 -0.2 ġ, 1:0 1:0-<u>0.3</u>0 1.0-1.0-1.0-0-0.B 0 0-040 <u>~07</u>0 0-<u>0.</u>30 о 2.0-0-040 ro-0-020 0-030 0-030 10-10-10 5.0. 10о 10-90 9 -0.1 -01 -0.1 9.0 -0 90 ò 8.0. 0 8°0o ø 10 10 3.0 c 10 0 ò -0.1 -0.1 -07 9 0 -0ò ò  $\dot{\phi}$ 0 ٥ 1.0 10 0 FIG. A-83 PERCENT ELONGATION ٥ 10 0 1.0 1.0 -0.1 -0.2 -0' ò -0.2 ò  $\tilde{o}$ ò 0 0-0.50 0-030

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NOMINAL STRENGTH

"B" STEEL , 72-INCH WIDE PLATE

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35.028.01       0.09.09       08.07       07.06       0.01       01       01         0.028.01       0.028.01       0.07       0.01       0.01       01       01         0.028.01       0.01       0.01       0.01       0.01       0.01       01       01         0.018.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01         0.019.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01         0.01       0.	1       •.04.01       •.04.01       •.04.01       •.04.01       •.04.01         1       •.04.01       •.02       •.04.01       •.04.01       •.04.01       •.01         1       •.03       •.02       •.04       •.04       •.04       •.01       •.01         1       •.03       •.02       •.04       •.04       •.04       •.01       •.01       •.01         1       •.03       •.02       •.06       •.04       •.04       •.04       •.01 <td></td> <td>PLATE B-8A (1-INCH GRID) NOMINAL STRENGTH 33.3KSI 0% SHEAR</td>		PLATE B-8A (1-INCH GRID) NOMINAL STRENGTH 33.3KSI 0% SHEAR
			FIG A-84 PERCENT ELONGATION "B" STEEL, 72-INCH WIDE PLATE TEMPERATURE 16-18 "F.
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FIG. A-84

-0.3 -0.2 ò 0 9 õ BOTTON 0 .0 9 0 6'0 10 å ò 0 ò 4 9 0 0 ò ò B-84 (5 INCH GRID) 6'0 . 0.1 1.0 <u>9</u> 0 0 6.0 20 NOMINAL STRENGTH 33.3 KSI •<u></u> -0.3 ÷ 0 9 9 9 -0 0 9 ø OX SHEAR 11 0  $\boldsymbol{n}$ 6 0 0 £ '0 • ¢ £ 0 1.0 1.0 -0.7 -0.7 ò 10ģ ò 0 0-0<del>0</del>0 -030 00.80 0.1.00 0 10 €.**0** 10 • 7.00 £ 0 **\*** 0 004 o 0.10 0 ro 0.30 10 0 0 ro 10 0 1:0 10 10 10 0 PLATE **9** 0 -0.2 -0. 0.1 -0.P -0.1 o ro e . 0 0 0 9 • 10 1:0 FIG. A-85 PERCENT ELONGATION ٥ 0 0 0 1.0 0 10 "B" STEEL, 72-INCH WIDE PLATE -0 16 - 18 °F. ò 0 0.1 9 0 Q 00.30 <del>0</del>0-0 0-0./0 00.50 0 0.00 1.0 0./ o 0 0 1.0 00.*P* 0 0'?o 0 10 0030 0.20 £ '0 3.0 0 0 0 ro 0 TEMPERATURE -0.5 -0.3 6.3 -0' 0 0 0 0 + Q ø 0 1.0 ø **\*** 0 -0.2 9.0-- 0.3 -0.3 <u>0</u> 0 0 0 0 0 ro **3**.0 2.0 8 £ .0 **3** 0 10 -0.3 - O -01 9.0 ò Ó 0 2 ø ø 3.0 0 3.0 ø 1.0 • 10 ø **8**10 ø 8.0 0 0 92 --0.1 -0 9 -0.1 0 0 6 0 • 0 0 10 1.0 **z**:0 ė 10 e ø 0 £ 2

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FIG. A-85

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-0.7		<u>e.</u> 0-		-1.3	,	-2.0		-2.9			1		-1.6		11-		-0.8		ν C	"В	-
•	1.8	•	8'8	•	9 E	•	5.2	۰	ο <sup>0</sup> .	, ,	9 0	14	•	٤.5	e	8.3	0		L.		
-0.7		-1.3		-1.6		-2.1		<b>√</b> -2.2	0	4	4	i	-1.9		-1.5		-0.6				
٠	8.5	٠	<b>₹</b> .₹	9	8 🌶	٠	2 1	•	ν.	0	9 0	i'g	• •	1.4	9	0`£	• •				

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DWG.

FIG. A-87

1.0 -6.1 0 1.9 - 2 1.5 1.9 - 2 1.5 1.9 - 1.4 0 1.5 0 1.4 0 1.5 0 1 4.1 **8**0 9.1 9.1-7.307.30\*3 6.9 0 7.8 0 02 +E 0 EE 0 63 0 6 6 6 7 6 - 1.9 6 - 1.5 6 - 1.4 6 - 1.4 - - 1.8 6 - 1.8 6 - 1.5 6 - 1 10 0 9 0 0 8 1 0 8 1 0 0000 M000 6.5 ° 7 1. 0.0 6 E 000100 0.7-0.7-PLATE C-34 (1-INCH GRID 2.2 -2.6 2.3 05+0++ 6606176#1 9 9 9 7 0*0'5* NOMINAL STRENGTH 43.2 KSI SIDE 100 % SHEAR LEFT 679 0 1905-906-9 10 10 6 0 Z 2 02 0'E' 2.2 -2.7 

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٥	27	0	7.8	٥	₹.₹	0	0'\$	₽.		0	<b>S.E</b>	٥	07	0	E.E.	۰	0.9	0				
- 0.6						- 1.8		-1.8		+1-		- J. 6						-0.7				
o	<b>≯</b> 7	0	67	0	8.9	o	05	÷ o		٥	5.4	0	*2	o	¥ 3	٥	27	0				
¥0-						-17		1 0		-2.2		-2.1						- O. G				
o	20	o	81	o	0° <b>8</b>	0	97	• •		0	5.2	o	8.9	٥	91	o	60	o	6	15		
L   -						-1.3		ſ	<u>807.70</u>			6.1-						-1.2	NCH GRI	43.2 K		
٥	10	0	50	٥	17	o	8.5	\$		0	8.5	٥	<b>#</b> 'l	o	20	¢	8.0	٥	(S - II			
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ŏ	10	0	0	o	0	ò	<b>#</b> 0	<b>0</b> 2		•	<b>5</b> 0	0	10	0	10	٥	ro	0	TE	NINAL	× 00	
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0	<b>£</b> 7	٥	81	0	5.3	٥	0 €	٥	۲ ۱	o	<b>3</b> T	٥	678	٥	£.3	Ö	97	o	Ĩ			
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FIG. A-90

DWG

a, o	80	o 10-	60	- <i>0.2</i> o	60	- 0.5 o	<b>S</b> '1	- 0.6 o	Γ	-08	<b>£</b> 7	-0.5 0	01	ہ - 2	90	- 0.2 0	20	-1.7 0				
o	0	¢	0.2	0	<b>\$</b> 0	0	<b>3</b> 7	o	- NO	0	8.1	o	20	o	<b>\$</b> '0	0	ro	٥	_			
0		a		0		-02		-0.6	8077	г <b>О</b> .		- 0.6		-02		0		-0.1	CH GRID)	. 15		
0	-01	0	30	0	10-	•	10	0		0	6.0	0	30	0	0	•	0	0	(S- IN	5.7 K.		
<b>.</b>		0		0'		0		+0-		-08		-0.1		0		-01		-01	44	й Я		
0-030	1:0- 1:0	000	0 0	0 0. <b>2</b> 0	0 80-	0020	0 0	000	ŧ	00./ 0	1:0 0	0 0 0	30 30-	00.80	0.2 1.0-	0-0.2 0	0 #0	00.20	5 Lu	STRENGT	SHEAR	
ā		01		0		01		-0.	$\int$	0		0	-	0		ġ		-0.8	PLATE	JAINAL	0 <b>X</b>	
<b>.</b> 0	1.0	0	30-	•	10-	o	0	•		0	<b>\$</b> 7-	Ø	10	٥	10	0	1.0-	• •		Ň		
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-0.6		0.1		à		0		0.2	Y	0.1		0.1		-01		6		0	LONGA			
0020	0 0	000	0 10-	000	10 0	000	1:0 1:0	0 <b>0.2</b> 0	I	000	01 8:0	o // O	10 10-	000	0 0	000	£0- 10-	00.20	IT EI	PLATE		
0.1		0		0		0.1		-0.5		0.7		1.0-		02		0.2		-02	ERCEN	NIDE	0- 82°F	
٥	0	0	1.0	0	10-	0	8.0	<b>O</b>		0	6.0	ø	<b>£</b> :0	0	80	0	3.0-	0	٩	INCH	IRE 8	
1.5		0		-0.1		-04		-0.6		- 0.4		- 0.6		E0-		-0'		-0.		72	PERATI	
۰ ۵	0	0	20	0	<b>\$</b> `0	o	17	٥		o	60	•	9.0	0	<b>\$</b> 0	0	10	o	16	S T EEL	TEMI	
1.6		1.5		67		6./		1.8	100	1.7		£'i		£7		1.5		1.5	י ד נו	ېن		
٥	30	٥	<b>#</b> 0	0	60	0	60	°		٥	<b>9</b> 7	0	ri.	o	<b>\$</b> 0	0	60	0	FI.			
-0.2		-02		¥.0 -		-0.2		-0.2		0.1		0		-0.5		-03		0				
o	6.0	O	30	0	90	0	80	0		<b>o</b> .	0	ø	8.0	0	60	0	ED	0				WG 44E 210

FIG. A-91

		• 21 • 21 • 81 • 67 • 71 • £3 • £7 • £3 • 13 • 27 • 80 •	
• 00	• • • • • • • •	1-0 8-1-0 8-1-0 	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		• 210 030 510 530 120 050 010 610 210 210 • 20 030 010 610 210 210 • 0 00 010 610 210 210	
(3)       (	222 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 01 0 1, 0 01 0 02 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E N-1A (1-INCH GRID) IL STRENGTH 64.2 KSI 4% SHEAR
14 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	68 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0, -0, -1, -0, -0, -0, -0, -0, -0, -0, -0, -0, -0	CENT ELONGATION PLA) NCH WIDE PLATE NOMIN (55)-(-51) °F
• 1/ • • 50 • 00 • 10 • 50 • 50 • 50 • 00 • 10 • 50 • 50 • 50 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 10 • 50 • 50 • 50 • 50 • 50 • 50 • 50 • 5	BE 6 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	00000000000000000000000000000000000000	FIG. A-92 PEF. "N* STEEL, 72-1. TEMPERATURE
€ 60 ° €/ ° €/ ° €/ ° €/ ° €/ ° €/ ° €/ ° €	LE 0 E 2 0 F/ 0 L/ 0 60 0 5/ 0	° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °	<del>.</del>

FIG.

	٥	-0.3	0	0	٥	0	Ο.	-01	• 0 •	- 0.1	٥	0	o	0	• 0 •	0	•	0	o	0	0	0	۰
	80		03		0		0		00		0		0		00		0		0		٥.		0
	٥	- 0.4	0	-0.3	٥	0	٥	0	o-0.20	- 0.1	o	0	0	0	• <i>0</i> •	0	0	0	0	-1.7	0	0	٠
	97		8.0		0.1		0		0 0		0		0		0 0		0		0		0		ö
	•	-1.1	Ð	-0.7	o	-03	9	0	0 <i>-0.2</i> 0	-01	•	0	o	0	0-2/0	- 0.1	0	0	o	0	0	0	o
	5		8.1		0		0		0 0		0		0		0 0		0		0		a,		و
	ø	-0.1	0	-1.3	0	-0.9	٥	- 0.1	000	0	0	0	o	0	000	- 0.1	0	- 0.1	o	0	•	-1.0	0
			<b>6</b> 1				~										5						
	Q		0		<b>9</b> .,		0		00		0		0		00		0		1.1		6.1		57
	¢	0	۶°	-0.2	ø	- 0.6	o	- 1. <b>6</b>	o 0 o	0	0	0	0	0	000	- 0.5	0	- 0.8	o	- 0. <b>8</b>	0	- 0. <b>B</b>	e
	_	-01	<u> </u>	- TOP				10		$- \subset$				$\sum_{i=1}^{n}$				<b>B</b> 07	TOM				
	0	- 0.7	0	-1.2	o	-2.0	o	-7.0	0-0.7 0	U	0	0.7	0		0-10 0	-/.0	¢	-1.1	0	-0.8	o	-0.6	0
	8		<b>9</b> .0		0.9		0		00		0		0		0.6		2.4		5		17		
	0	- <b>0</b> . /	٥	-1.6	o	- 0. 3	0	0	. 00	0	0	о	۰.	0	o <i>0</i> o	- 0.4	0	- 1.1	0	-0.9	0	-0.7	0
	0.0		1.0		01		0		00		0		0		0 0		20		97		9		*
	0	- 0. 4	٥	-02	• 0	- <b>0</b> .1 <sup>°</sup>	o	-01	o- 0./o	0	o	0	0	-0.1		0	o	-0.5	0	-0.8	0	-0.8	0
	07		0.3		0		0		0 0		0		0		0 0		0		<b>9</b> .0		9'		8
	o	-01	0	0	٥	0	0	- 0.1	.0.	- 0.1	o	0	o	о	000	0	0	0	0	-0.4	0	-0.7	0
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			FIC	5. A-s	93		PE	RCEN	T ELC	NGAT	ION		1	PLATE	N-1A	l r	5 - IN	CH G <b>RID</b>	v				
				"N" S	TEEL,	, 72-11	NCH	WIDE	PLATE					NOMIN	AL STR	ENGTH	64	1.2 KSI					
					TEMP	PERATUR	E (-	-55)-(-	-51) •F					4 %	SHEAF	7		-					
•13 nwe					•																÷		

FIG. A-93

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FIG. A-94

۰ o 1.5 0.5 0.1 ,4 , 0.1--1.0 11-5 BOTTOM ġ ÷ 0 0 ٥ 01 6'/ 6.5 c 0.5 8.5 σ o <u>5</u>.5 1.5 1.5 0 Q (5-INCH GRID) -0.3 0 - 1 --0.7 -1.6 -1.5 4 -12 0 60.9 KSI o **\*** 0 \$ '0 0 2°1 <u>5.</u>5 ø \$`\$ o ٥ 2.2 0 £'/ ٥ 1.0 o ь. О. -2.0 8.0 -2.1 -1.6 -0 9 4.1-0 -0.1 0 ٥ a <u>s.o</u> 0 01 8.S 0 <u>ς</u> ε 0 9'0 0 0 10 o ٥ 13 % SHEAR PLATE N-2A NOMINAL STRENGTH ¢ ₽ -0.5 -2.5 ģ Ģ -0--2.4  $\tilde{o}$ 0 0.30 00.100 000 **S**.0 0 <u>8</u>.0 000 10 00.20 0*10*-0 0/00 <u>s.</u>0 0-020 0 1.0 1.0 000 0 000 1.0 1.0ro 0 о 0 0 1.0 -0.2 õ 0 0 0 0 0 0 0 ٥ 0 1.0roo a 10-0 2.0 0 ¢ 0 1:0 c 0 1.0- $\dot{o}$ 9 -0. 0 0 0  $\hat{\mathbf{q}}$ .0.1 20 PERCENT ELONGATION 0 о о ٥ 0 o 10-¢ o С o ø 0 o 10-1.0-0 10-1.7 ò TEMPERATURE (-35)-(-30) % õ -0.1 "N" STEEL, 72-INCH WIDE PLATE õ 0 0 -0.1 -0 000 0/*0*-0/ 0*0*.2 o 0 0 ro ro-0 //00 0 000 0.0.0 ° / ? ~ 0070 0 000 о 0.2.00 0 ro σ 0 1.0 1.0 ro ı o <u>s.</u>0 -0.2 -2.0 -07 -0.1 ò 9.6 - 0 -0-1.3 ò -07 ٥ 0 ø 3.0 6.5 o 81 1.0 r:o 0 o r:p c 0 o 0 9.9 1 ₹ 0 ю. О-5.7 5.1-5 -0.3 9 0 -1.5 0 FIG. A-95 ٥ 1.0 8.S 0 5.0 51 8° ¢ o 0 ø 2.0 ¢ £ '0 0 o -0.1 9 8. 9 9.6 ю. 10 -1.2 0 4 0- 0' 0 ٥ 2.0 0 01 o 0.9 0 £.0 0 1.0 **z**., ¢ ÷'2 0 C 7 o -10P 4.0 9°. ò 2 9.0  $\tilde{o}$ 0- 0 ~ -0-Ŧ 0 ۰ • <u>9</u>1 ٥ 9.0 <u>6.5</u> ٥ 6.0 ٥ 0 £ 0 **2**.0 0 **3**.0 0 **3**.0 44E 2 N.

FIG. A-95

/09

FIG. A-96

**s** 'i - 0.8 -0 0 -1.4 ÷ BOTTOM 0 8 °E 6 ° E 0 1.0 0 12 1.0 2 -9 0 PLATE N-3A (1-INCH GRID) -0.3 - 2.3 -0.3 07-- - ~ 2 NOMINAL STRENGTH 59.8 KSI 0 ø 5.5 \$°5 6 ' £ £ '0 £ .0 **\*** N -0.2 ŝ - 6.1 -0.2 -1.3 0 100 % SHEAR 0 0.2 0 9 <sup>.</sup> 8 c 2.0 ro 0 -0--1.8 0 9 9.0 -0.7 0.6.0 -3.0 0 <u>~0.3</u>0 °*1*.0-0 #:0 1:0 0.0-0 1.0 ٥ 0'1 0 0 2°0 °, ' ° 1:0 0.0.0 000 200 0 0 ro **#** '0 0 0 £ 0 1.0 0 0 0 0 0.3 ٥ 0 10 o ٥ 10 0 1.0 1.0 10, , o õ 0 PERCENT ELONGATION 2°0 ۰ ¢ 1.0 0 "N" STEEL, 72-INCH WIDE PLATE 0.2 - 0 8 0 0 0 0 C 0 2°F 0 *01* 0 <u>ç</u>.0 סו 0 1.00 1.0 8.0 0*80*0 0.000 <u>5.0</u> 80 0700 0 1:0 202 e-0.20 000 000 0 2.0 17 10 £ '0 1.0 1.0 • • -0.5 -1.5 - 0.2 101 -0.1 -1.6 0 TEMPERATURE <u>6'8</u> 2.5 ٠, -1.2 5 0.0 9 - 1.8 0 ŝ -0 0- 0.1 FIG. A-97 0.1 0 8.0 67 0.0 9.0 0 -0.2 -0.6 -0.9 0.1-¥ 15j 9.7 7 15-9 0- 0 -0.5 o 2 <sup>.</sup> 5 £7 0 6'1 n • 🗲 -100 -0.9 -0.5 -0.5 1-1.6 -0.9 ŝ 2.5 2 0 o 12 0'8 0

445231

FIG.

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	۰	2.5	0	55	o	0.6	۰	$\sim$	•	8.8	٥	2.8	•	٤.5	۰	9.2	•			
	1.1-		-1.7		-2.5		-4.6	-wo	4 ~ 4-		-2.6		6.1-		3 1-		- 0.6			
97	0	9' 7	0	8.5	٥	0.7	٥	BOTT	٥	<b>*</b> '9	0	07	o	5.5	•	9'l	•	2		
	-0.8		-1.3		-2.2		. 3.8		-4.1	1	-2,4		-1.5		6.0-		•0.4	GRIL	KSI	0-
9.0	۰	<b>5</b> 7	۰	9.5	o	6'9	o		۰	0.2	٥	7.5	۰	97	•	20	٩.	INCH	44.7	HEAF
	-0. <b>4</b>		-1.0		-1.7		- 3.2		- 3.6		-1.8		-1.0		+0-		-0.2	( 5-1	ЮТН	94 2
1.0	o	£'0	G	91	۰	01	0		o	° 0'£	•	<b>5</b> 7	۰	3.0	ð	10	0	7	TREN	90
	0		-0.2		<del>.</del> 0.9		E.3-		- 2.4		07-		-0.2		-0		-0.1	- H	4 <b>L</b> S	
0	o	10	٥	0	0	9'1	o	1	0	20	٥	0	٥	0	٥	0	0	1 <i>7</i> E	NIMO	
	0		0		0		-0.5		<b>0</b> -		-0.1		0		-0.1		-0.1	PLA	2	
0 1'0	• <i>0</i> •	0 0	• 0 •	0 0	o-01 o	6.0 5.0	0-0.20		0- <i>02</i> 0	8'0- 5'0	o-0.9e	0 0	• 0 •	0 0	• 0 •	0 0	°//0~		·	
	0		-0.1		0		-0.1		0		0		0		0		-0.1	NO		
o ro	• 0 •	10 0	• 0 •	0 0	o / Oo	0 70	000		• 0 •	0.5 0	0 0 o	0 0	• 0 •	0 0	• 0 •	0 0	• 0 •	NGAT	LATE	
	0		0		-0.1		9.0-	T	-0.5		0		0		0		-0.1	ELC	DE P	9 °r
10	۰	0	۰	10	۰	9.0	0		۰	2.2	۰	0	0	0	۰	10	•	NT NT	Г <b>М</b> Н	57-6.
	-0.1		-0.4		0'1-		-2.5		4.7		17-		-0. <b>3</b>		-0.1		-0.3	RCE	- INCI	'RE (
1.0	0	<u>9</u> .0	0	<b>9</b> 7	۰	2.8	۰		o	6.5	0	51	٥	9'0	°,	1.0	•	Ъ	. 72	RATU
	4 4		-1.0		-1.7		-3.2		4		-1.7		1.1-	~	-0.5		-0.2	- 66	STEEL	EMPE
2.0	•	5'1	o	9.5	٥	G. 4	•			2.8	0	8.5	0	<b>9</b> 7	•	8.0	•	بر م	μ,	L
	-0.6		-1.3		-2.1		- 3.2		<b>3</b> .4		-2.3		- <i>0.8</i>		-0.B		-0.4	FIC		
<b>9</b> 7	٥	\$`₹	0	<u>7</u> .8	9	8.8 .	~ 0	100	•	1.3	o	8.E	. 0	9.2	٥	9'1	0			
	17-		-1.7		0		1-2-1		4		-2.5		-1.7		-1.2		-0.5			
5.5	٥	8.E	0	15	0	9'#	Q.	7	0	8.2	0	5.2	¢	7.E	0	9.5	0			
	9'1 9'0 0'0 0'0 1'0 1'0 1'0 1'0 2'0 2'7 2'7 2'7	1-       0	<ul> <li>5.2</li> <li>6</li> <li>7.2</li> <li>6</li> <li>7.2</li> <li>7.3</li> <li>7.4</li> <li>7.5</li> <li>7.6</li> <li>7.6</li> <li>7.6</li> <li>7.7</li> <li>7.6</li> <li>7.6</li> <li>7.7</li> <li>7.7</li> <li>7.8</li> <li>7.9</li> <li>7.9</li> <li>7.1</li> <li>7.1</li> <li>7.1</li> <li>7.2</li> <li>7.2</li> <li>7.2</li> <li>7.2</li> <li>7.4</li> <li>7.4</li> <li>7.5</li> <li>7.5</li> <li>7.6</li> <li>7.6</li> <li>7.7</li> <li>7.7</li> <li>7.7</li> <li>7.8</li> <li>7.8</li> <li>7.9</li> <li>7.9</li> <li>7.9</li> <li>7.1</li> <li>7.1</li> <li>7.1</li> <li>7.1</li> <li>7.2</li> <li>7.2</li> <li>7.4</li> <li>7.4</li> <li>7.5</li> <li>7.5</li> <li>7.5</li> <li>7.6</li> <li>7.6</li> <li>7.7</li> <li></li></ul>	2       2       0	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$   \begin{array}{ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$				

ہ و:ع یہ 0 -0.P. • - 0. **2** • 00 ő 9 0 50 • 50 • 10 • ( 01 • 20 • 50 • 0 11 • 11 • 01 • 57 11 • 11 • 01 • 57 5 • 7 230 .3.0 . -30 10 . - 0'F' • 10 10 -17 --2.9--2.0 0.00 - **-** - -10-0-010 -2.6 - 3.3 0 3.2 10 - 30 - 90 -06 -181 -N 901° 8 60 ° 6//68-00E-0EF ŀ -2.6 0 1 PLATE H-2A (I-INCH GRID) 1 31 -23 .-13 23 EE 2 - 2.5 0 NOMINAL STRENGTH 45.6 KSI 12 0 21 8.5 3.5 . -6.9 0 LEFT SIDE - 5.4 --8.8-ţ 12/65-025-026-0 12/65-025-024-0 100 % SHEAR 5 . 521 · 505 · 891 · 301 · 91 591 · 565 · 251 · 501 · 38 961 · 533 · 351 · 011 · 68 +91 · 153 · 6+1 · 601 · 46 - 533 · 553 · 51 · 601 · 56 5 Į -3.6 .... 4 16 0 9 16 0 31 0. 3.2 52 }• £7/•; ₹ ₹ 02 0 /9 0 N N X 0 F9 X 0 F9 9 9 0 10 10 19 ° M • 09 1 .3.5 0 4 • /F-\$ 9 0 - 8 - 0 22/ 0 2/ 2 0 52/ 0 2/ 2 0 59/ 0 2/ 2 0 50 - \$0 - - 3 B 553 0 +5/ 0 00 80 18 , i the FIG A-100 PERCENT ELONGATION -3.5 -36 5 ₩38/° ₩ 128 0 121 0 871 121 0 121 0 824 3.9. -3.5 0-J.9 "H" STEEL, 72-INCH WIDE PLATE 520 221 0 F1 591 0 71 591 0 71 221 -3.7 -3.5 0 -1.7 2.5 . 3.3 ų, 100 TEMPERATURE 24° 27° -3.5 . 20 /° #1 6.6-0.1 s11 • 4 12 2 4 4 19 4 19 -3.60 -3.2 0 1 9828 0 1 5 £.81 0 SIDE 3.5 Ņ 3.3 0 - 34 -2.9 0 E3-0 67-128 021 021 5'81 ° . 9 44 0-5.3 92 ° 5 -23 • 55 -270 04 √ å *8*≯/ 01 3.2 2'S 5.5--2.3 -2.9 0 -2.8 0 -24 4.6 0-3.0 3.0 8:510 8.8 53 \*2 0.3 .-5.80 -2.20 9 6 563 0 82/ 0 95/ 0 8 83 0 59/ 0 59/ 0 8 83 5 82/ 0 59/ 0 9.9 0.6 -0.7 - /.3 . 0.8 -08 - -1.0 ° 5'0 01 0.60 0 -1.5 0. 05 · 5 01 • 15 5 50 · 50 · 10 · 00 20 20 °60-10-191 0 5 503 0 291 9 5 5 6 0 3 1 6 9 5 6 0 3 1 6 9 6 6 0 3 1 6 9 6 6 0 3 90 . 60 • *3* 0 - 5.6 0 0 120 0 503 0 219 0 0 0 503 0 219 0 0 0 0 0 233 0 0 0 233 0 0 0 0 233 é 503-\*

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A-100

-0.6 - 1.2 2.2 -2.6 ŝ ŝ <u>9</u> 9 (2-INCH GRID) 9'9 - 0.4 - 0.9 . 1.5 36 2 - 3.6 -0.5 Ň 2 45.6 KSI BOTTOM 0 05 • 112 6'0 - 0.2 55--3.5 - 1.8 -0.3 ģ - 1,8 0.5 17 2 PLATE H-2A NOMINAL STRENGTH 100 % SHEAR **≯`£** 9'2 10 -0.2 9 -0.3 +2-4 - 1.0 -07 -0.3 0 0 0-1**2** 0 0-0.10 0/1/-0 £7 \$0 8.0 17 ro ro 10 0-0.20 10 °0.50 0200 。 *0* 。 0.50 0 1.0 8-0-8 0-020 10 ro £ 0 0 r0 0 0.2 0.2 0 0 0 0 £ 0 0 **#**0 ۰ -0.1 0 0 0 Q 10-0 ٥ 10 FIG. A-101 PERCENT ELONGATION "H" STEEL, 72-INCH WIDE PLATE -0.1 -0.1 -0-0 6 0 0 0.1 0 9 000 020 · 0-1.20 <u>~03</u>° ro £ 0 **#**'0 °-0'/° 0-2-0 £ 0 2.0 0.20 -020-0 0 °0.4° 0<u>.</u>30 TEMPERATURE 24°-27° 10 11 £7 0 2.0 8°Q 22 60--2.8 -02 10-0.2 -0.2 -1.2 -0.1 0 ۰ ľ£ 17 o 2.0 81 \$0 -40 -0.1 0.0 -20 -0.2 15 -1.0 2 --1.6 <u>,</u> • 20 g p 12 £9 10 14.5 - 3.4 - 0.4 --2.0 -1.0 -2.6 . 1 2 9 -17 TOP o 82 99 05 - 3.8 - 0, 8 - 5.4 -20 00 -/.5 -3.0 - 1.6 ¢, -- 12 nn 62 FIG. A-IOI

DWG. 44E25

<b>Market State Market State           <b>Marke</b></b>			
<b>1 1</b> <th></th> <th></th> <th>GRID)</th>			GRID)
Processor       Processor			PLATE H-3A (1-INCH NOMINAL STRENGTH 38.3KSI 0% SHEAR
	0 • 50 • 60 • 0 • 60 • 0 • 60 • 0 • 60 • 0 •	\$1       \$1 <td< td=""><td>FIG. A-102 PERCENT ELONGATION "H" STEEL, 72-INCH WIDE PLATE TEMPERATURE 15" F.</td></td<>	FIG. A-102 PERCENT ELONGATION "H" STEEL, 72-INCH WIDE PLATE TEMPERATURE 15" F.

- S

*10* •

NOMINAL STRENGTH 38.3 KSI

"H" STEEL, 72-INCH WIDE PLATE TEMPERATURE 15 °F

O & SHEAR

a, a, O, O, /O = #O = 60		04 0 0 80 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	• <b>•</b> 0	FU 60		° -0.8	10	• -0.1	-0.2 v	£.0	° - 0.3	9.0	° -0.3	ro	0	0	•	SRID )
		1:0-		-0.2		-0.6		1.0-	-0.2		-0.2		- 0.1		-01		-01	-INCH
0	ł	۰	10	۰	50	0	20	۰	۰	9.0	٥	£.0	•	8.0	٥	ro	۰	15
		-0.1		-0.1		-0.3		- 0.3	-0.4		•0-		- 0.3		-0.2		-0.2	Z
	0	۰	0	. <b>°</b>	10	۰	20	۰	٥	<b>5</b> .0	۰	3.0	۰	10	٥	0	•	н-5
		- 0.1		-0.1		-0.1		- 0.7	- 0.6		-0.2		-0.2		-0.2		-07	1E
	0 0	° 1.0 °	0 0	0 <b>0.3</b> 0	0 0	o <i>0.</i> 3 o	0 0	° /:0°	63°	10 0	° 0.1 °	10 0	• 0 •	0 0	• 0 •	0 10	0.3°	PLA
		0.1		-0.2		0		1.0-	ļ Ģ Ģ		0		-01		-0.1		-0.3	
	0	•	0	۰	0	۰	0	•	•	0	ø	0	۰	0	•	0	0	
		0.1		0		10		0	10-		-01		-0.1		-0.2		-0.8	
	0	, 0	0	•	0	•	0	0	0	0	۰	0	۰	r <b>o</b>	٥	1:0-	•	NO
		- 0.3		-0.2		- 0.3		•0-	$\bigcup_{i=1}^{n}$		0		0		-0.1		10-	VGATI
	1:0 0	°0.3°	0 0	°0.2°	ro ro	° 0.5 °	ro ro	•0•	- <del>3</del> 0-	0 10	°/.0~	0 0	• 0 •	0 0	• 0 •	0 10	0-0 <b>2</b> 0	ELOI
		1.0		-0.2		- 0.3		- O.B	-0.6		-0.2		-0.1		-0.2		-0.2	CENT
	0	•	.0	۰	80	ø	80	۰	0	60	0	10	۰	0	۰	10	۰	ER
		-0.2		-0.2		- 0.6		-0.5	-0.2		- 0.5		-0.2		-0.2		- 0.1	4
	10	۰	£.0	) o	9'0	0	<b>G</b> .0	۰	۰	6.0	0	<b>8</b> .0	•	£ 0	0	10	۰	:0 -
		-0.2		-0.J		-0.3		-0.2	1.0 -		-0.3		-0.6		-01		-0.2	ש <u></u> ש
	0	¢	9.0	) 0	90	٥	8.0	o	rop .	ro	٥	£.0	0	9'0	۰	0	۰	F
		-0.2		+0.4		-0.2		£.0-1	-01		0		- 0.3		-0.3		0	
د	<b>#</b> '0	•	20	, . , .	9.0	o	10	•	$\checkmark$ .	10	۰	10	o	50	0	8.0	o	

FIG. A-103

DWG. 44E260

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FIG. A-104

-BOTTOM 1.0-10.2 -03 50-0 0 Ó • (5 INCH GRID) 10 <u>6</u>.0 - 01 9 -0-9 è 0 0 ş 390 KSI 1.0 £:0 0 9'0 9 6 0 -03 -0.1 a t 10à ģ å -0 -92 0 PLATE H-4A NOMINAL STRENGTH OX SHEAR 0 8'0 ٥ 10 .0 ra 9.0 1 -0--0.6 10--01 **9** 0 1 -07 -0. Ì -0 o-0/o •/0• 0 0 40 0 1.0 10 10 **4**07 d d 1:0-1:0-• 0 • 0 10 o-0% ą -96ğ 10 0 10-0 201 ģ 1.01 0 0 <u>a</u>/ ø 0 0 ø 1.0 ¢ . 10 . 10 0 10 -0.1 - 0. ġ -0-0 0 0 0 ø 0 ro. ø 0 • a 10 0 FIG. A-105 PERCENT ELONGATION đ 10 "H" STEEL, 72 INCH WIDE PLATE 0.7 -0.1 -9 -01 0 0. 9 0 0 0 TEMPERATURE (-199)-(-189) F 0 80--0-0 ģ 0 °,0,-0 ° 0 ° 10 °0./ ° ••• 1.0 °-0% 。 。 ą • 0./• ð 0 10 8.0 10 10 -0.3 -03 -0-**₩**.0 1 101 0 0 0 0 0 • • .• 50 1:0-8.0 1.0 0 10 80 - 0.2 10-<u> 00-</u> -0.1 -0.3 ş Ş 0 -0.1 0 1.0 0 ¢ ç 0 10 10 1.0 75 Þ10 ò -01 ð 1.0- + 0 0 ò ò \$ -07 0 . 1.0 0 80 rø 1'0 1.0 1.0 -02 10 6 • 0.4 0 • -0.1 100 0 10 1.0 10 1.0 o

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FIG. A-100

44E262

0 0 100 00 ø 0 8'0-0 110 010 210 PLATE B -78 (1-INCH GRID, 0 Z'0-0 NOMINAL STRENGTH 35.2 KSI 000 80 2 10010 10-0 21-0 SHEAR 100 100 60 80 . 60 . 0.0.5 0.15 0.1 0.0.1 0.0.1 0.0.30.0.3 0.0.1 -1.0 0.1-£7 -1.0 0 LEFT SIDE 80 0-1-0 ò -0.70-0.5 0-1.1 s 0.8 .. 0.8 -0.80-1.0 6 FIG. 4-106 PERCENT ELONGATION "B" STEEL, 48-INCH WIDE PLATE 17 -0.9 0-0.5 0-0.6 0 97 0 0 97 0 0-0.7 0-0.3 6.0 ļĽ, 5'3 0 0.5 0.5 0.5 0 ġ, 076 ₹7 0°0 0° 67 
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 1. P 0-1.P 9 SIDE TEMPERATURE \$ 0-0.9 9 110 23 110 23 10° 10° Å 57 27 RIGHT 9 -0.70 0 -0.5 0-1.4 300 a 0020-0 200 010 0 070 100 5 0 à 10-0 10 0 F.O-0 0 ΩQ. 0.7 0-0.2 10 \$ 2.0 10 0 0 0 0 0 0 0 0 0 00 1.0-0 2.0-0 0 200 0 • 3'0 0 010-0 0 0 100 001 0-03001 1000 0.00 20010-0 0 . 300

||9

FIG. A - 106

• 0 • -0.1 • -0.2 • -0.1 • 0 • -0.2 • -0.2 • -0.2 • 1.2 • -0.1 • -0.2 • -0.2 • -0.1 • 0 • -0.2 • -0.1 • -0.3 • -0.1 • 0 • -0.1 • -0.1 • -0.2 • 0 • -0.1 • -0.2 • -0.1 • -0.3 • **6** 6 7 0 0 0 0 7 7 6 6 0 • -0.5 • -0.5 • -0.2 • -0.1 • 0 • -0.1 • -0.1 • -0.1 • 0 • -0.1 • -0.3 • -0.4 • -0.5 • 0 • Q • -0.1 • -0.6 • -0.5 • 0 • 0 • 0 • 0 • 0 • 0 • 0.4 • -0.7 • -0.2 • -0.2 • -TOP BOTTOM-0 0 0 -0.4 0 -0.4 0 -0.4 00.60 0 0 0 0 -0.1 0-0.10 -0.3 0 -0.4 0 -0.2 0 -0.4 0 8 0 -0.2 0 -0.4 0 -0.1 0-0.1 00.50 -0.1 0 0 0 -0.2 0 0 0 0 -0.2 0 -0.4 0 -0.3 0 0.5 o -0.1 o -0.4 o -0.1 o -0.1 o0.5 o -0.2 o 0 o -0.3 o-0.2 o 0.1 o -0.2 o 0.1 o -0.1 o o -0.1 o -0.2 o -0.1 o -0.2 o -0.2 o -0.1 o 0 o0.1 o 0.1 o -0.1 o -0.2 o 0.2 o FIG. A-107 PERCENT ELONGATION PLATE B-7B (4-INCH GRID) "B" STEEL, 48-INCH WIDE PLATE NOMINAL STRENGTH 35.2 KSI TEMPERATURE 9°F. OX SHEAR DWG. 44E219

 $\leq 1$ 

FIG. A-108

0 0 0 0 0 PLATE C-4B (4-INCH GRID 0 1.0 0 1.0 0 0 ø 0 STRENGTH 37.2 KSI 0 BOTTOM 0.20 0 0 0 - 0.20 - 2.7 0 - 0.1 0 0 0 0 0 - 0 0.1 0 0 1.0 0 **S**.0 0 0 1.0 0 0 SHEAR 0 -0.1 1.0 - 0 1.0 - 0.0 0 0 0 0 0.2 0-0.10-0.1 0 <u> 7</u>0 1.0-0 <u>s.</u>0 00.20-0.3 0 0.0 0.20 -0.20 0 0 0 000-0050 0 0 % 0 0 0 0 0 <u>2</u>.0 <u>0-0./0</u> 。 0 0 1.0-0 NOMINAL 0 0 0 0 0 0-0.1 0-0.1 0 0 0 0 0 0 0 0 ٥ 0 0 1.0. 0 0 0 0 o 0 0 0 0 0 0 0 FIG. A-109 PERCENT ELONGATION 1.0-0 10-0 1.0-0 0 0 0 0 Ľ o 0 0 "C" STEEL , 48-INCH WIDE PLATE 0-0.20 00 -01 27-29° 0 0 0-01000-01 0 0 0 1.0-0.0-010-0 1.0-010 0 0 -0.2 0-0.1 00.20 0 0 -0.2 0 -0.1 00.10 0 1.0-0 - 0<del>4</del>0 - 0 0 - 0.30 0 0 o -0.3 0-0.10 0 0 2:0-1.0-1.0ľO TEMPERATURE 0 0 0 0 **S**.0 <u>s</u>.0 0-010-0 0-0.2 0 - 0.2 0- 0 0 -0.2 0 1.0 0 0 1.0 1.0 0 0 0- 0 0 - 0.**e** • - 0.4 0-0,2 0-01 0-0.2 0-0.2 1.0 - 700 0 0 1.0 0 0 0 0- 01 ° -0./ ہ '-*0*/ 0- 0./ 0 0 0 0 010 1.0 0 0 0 0

FIG. A - 109

DWG. 44E215



F/G.A-110

	0 - <i>0.2</i>	0 - <i>0</i> .3	0-0- 4-0-	o	0 0	€.O-	0- 0.J	0	-0.3	o	o	0-01	0	0	0	0	0
	£.0		£.0		1.0					0			0.2				1.0
	0 - <i>0.2</i>	o -0.2	0-0.1	0-0.2	0-0./0	-0.2	0- 0-0	0	-0.2	0-07	0.2	0 - 0.	ò	-0.1	ې ٥	9	0
	¢.0	£.0	£.0	1.0	1:0 1:0-		0	0	-	0	1.0	1.0	£.0		0		1.0
	0 -0.4	0 -0. <i>3</i>	o -0.3	0-0.1	0 <b>0.2</b> 0	- 0.2	0-0.2	0	-0.2	00	0-0'	0-0	0	0	ہ ہ	2	0
	<u>s</u> :0	<b>#</b> .0	<u>0</u> .5	<b>\$</b> `0	o 1:0		0	0	-	0	ro	£.0	1.0-		1.0		1.0
	1.0- 0	0-01	o −0. 4	0-0'S	o /'Oo	-0.5	0	ໍ່ໃ	-0.1	10-0	0-0.3	0 0	0	-01	° 0	ġ	0
		-T0P			•					1			Ð,	0770	X		
	0 - 0.1	0 <b>-0.2</b>	0 - <b>0</b> .1	0 <b>-0.4</b>	0 <b>.0</b> 0	0	0- <i>0</i> .	0	0	0-0	0-0.5	0 0	0	0	0	≁0	0
	¢.0	<b>\$</b> 0	<b>\$</b> `0	£.0	0 1.0	-	0	0		1.0	<b>S</b> .0	<b>\$</b> 0	1.0		1.0		1.0
	0-0.1	0-01	0 - 0.2	1.000	0/10-0	0	0- o	0	0	00	0-0.2	° -0.2	0	0	0	0	0
	• £'0	5.0	2.0	0	· 1'0-		1:0-	10		ro-	<i>5.0</i> -	1:0-	5.0		S.O		1.0
	0-01	0-01	0 - <del>0</del> .2	0-0.1	0-0 <i>B</i>	0	0- 0	0	0	00	0-0.6	0.7	0	-0.3	ې ٥	27	0
	£.0		1.0		10				٠	1.0-			£.0				1.0
	0	o	o	, 0	0 0		0	0	-	o	o	o	Ø		0		0
	FΚ	3. A - 111	PER	CEN	r El	ONG	4 <i>T1</i> 01	-	4	LAT	C Lu	- 68	4	- INCI	I GRI	10	
		"C" 5]	TEEL , •	18- IN	CH W	IDE P	LATE		ž	ANIMC	5 7	TRENG	ТН	37.0	KSI		
			TEMPE	RATUR	E	32	لر: ه				80	SHEA	Ø				
DWG 44E217																	

0.9 0 0.8 0 50 0 0.6 0 0.9 0 0.3 0 0.5 0 1.1 0 o 0.5 -0. <del>3</del> -0.5 ò Ó Ó Ó 0.6 0 Č. . ~ ġ, Ъ 0-0.4 0 0.9 0 1.1 0 1.0 0 4.6 0 0.6 0 1.4 0 0.5 0 0.0 0  $\boldsymbol{P}_{s}$ 20 0.2 ġ. ġ. 0.2 0. V 0 0 ġ. 0 Ġ Qn. Ň STEEL TEMPERATURE PERCENT 0 / / 0 5 7 0 / 3 0 / 2 0 0.4 0 0.2 0.0 º 1.1 0.2 0 0.0 ... 6 -1.0 0.7 0 0 Ó Ó. 0. Ň N 0 Ø0 12 0-0.2 0-1.8 0 0 1 0 1.5 0 7.4 0 1.2 0 0.4 0 0.1 0-0.2 0 INCH -1.4 0 --0.1 6 0.3 0 Ó 0 3 na l ELONGATION o-1.1 o 0.0 o-0.1 o 0.0 o 7,6 o 0.4 o 0.2 o 0.1 o 0.0 WIDE N 0.0 0.0 • 0.5 Ó 0 0 0 0 0 ö Ň. 0 Ø <u>Cu</u> PLATE o -0.3 o -0.2 o 0.2 o -0.2 o ( **"** ) 0 0.3 0 0.2 0 0.3 0 0.6 ο -0.4 0 0 0.0 0.0 0 io l ò Ň. ō • -0.3 • -0.2 • 0.0 • -0.2 • Y <sup>J</sup> 0 0.2 0 0.3 0 0.3 0 0.2 0 PLATE NOMINAL -0.7 0.1 0.0 Ó Ö. 0.1 0 0 9 in. Ň N 0-0.2 0-0.4 0-0.5 0 0.0 0 6 5 0 0.3 0 0.0 0 0.2 0 0.1 ο **%** 0 0 1 0.0 0 0,0 0 Ó 01 Ó 0 0 SHEAR Ň Ъ No. N STRENGTH Ġ 9 1-4 IX0 0 0.0 0 0.0 0 0.2 0 0.8 0 5 9 0 1.3 0 0.5 0.0.3 0 0.3 0 0.0 0.0 .0. 0 ġ. 0 0.4 20 N 0 Ġ Ġ, • 0.0 • 0.0 • 0.4 • 0.5 • 5.6 • 0.6 • 1.1 • 0.5 • 0.3 • ( I-INCH GRID ) -0.5 0 38.7KSI . . . Ó 0 Ó 0.2 0.4 ò Ň. i, 0 0.7 0 0.4 0 0.3 0 0.3 0 4 1 0 0.5 0 0.6 0 0.9 0 0.4 0 -0.2 -0.4 *o* . О. З 0 ġ. 0. 0 Ö S N o 0.2 o 0.4 o 1.2 o 0.5 o o 0.2 o 0,1 o 0.2 o 0.6 o 4.4

ſ

126

a =01	_	00		01	_	00	-	~ /	_	00		00	_	~	_	~ ~	-	09	_	~ /	
5 U.I	0	-0.2	Q1	-0.7	۳.	0.0	~	-0.7	•	0.0	~	0,0	~	- 0.7	/	0.0	° 0	-0.2	°	-0.1	0 60
0	<u>o</u>		o.		0		0.		0		ò.		ò.		0		0		0		Ö
• - <i>0.8</i>	0	-0.3	0	-0.3	• /	0.0	• •	- 0.4	•	- 0.2	•	- 0.1	•	- 0. 4	•	-0.3	0	-0.3	٥	- 0.7	0
0.	1.0		0.7		0		-0	•	-0.		0.0		0.0		0.0		0.7		1.1		0.9
o - <i>0.7</i>	0	- 0. 8	٥	-0.3	٥	-0.2	0	- 0. I	۰	0.0	۰	- 0.2	٥	-0.2	0	- 0.2	٥	-1.0	•	-0.5	0
<b>8</b> .0	0.9		1.1		9.6		0.1		00		0.2		0.0		0.3		6.0		0.5		4
o -0.5	0	- 0.7	٥	- 1.0	•	-0.4	•	- 0.1	0	-0.2	•	-0.3	0	- 0.4	o	-1. <b>2</b>	0	-0. <b>2</b>	0	- 0. 2	0
9.5	2.0		4		0.		9		2.2		2.1		9.6		~		N N		Ð.		4
• - <i>0.7</i>	•	-0.2	0	- O. 8	•	-1.5	•	0.0	0	0.2	•	- <b>0</b> .1	•	-1.3	。	-0.4	•	- 0.4	°	- O. 4	°.
	مرجعة	<b>6</b>	•	· ••••	_ہو_	、 ← щ - «	<u>م</u> د.		_(	-	>_		<u>_</u> @	<b></b>	. اکم	er -ei	<u>_</u> 0_	<b>*-*</b> -4	<u>_</u> م_		0
v o - 0.5	ю 0	0.2	• •	0.2	0j 0	-1.1	نې ه	0.1	•	0.2	<i>_</i>	0.0	N No	-1.4	с) o	-0.4	م ہ	- 0.3	mj ₀	- 0.3	<b>0</b> .
0	5		4		*		6	••••			5		4		0		m		4		6
0	0	~ ~ ~	0	<i>,,</i>	~	~ ~	õ	~	0	~ ~	.0	~ /	0	<u> </u>	Q,	<i>,,</i>	-	0 F	0		0
8 U.U 8	ہ ک	-0.1	0	- 1.1	ہ م	0.0	0	- 0.7	°	0.0	•	-0.1	0	-0.3	•	- 7.7	o	-0.5	0	-0.3	٥
Ö	0		9.1		0		0.1		0.0		ò		0.1		0		1.3		0.0		1.1
• - <i>0,</i> <b>4</b>	0	-0.8	٥	0.0	0	0.0	•	- 0.1	0	-0.2	•	- 0.3	c	0.0	0	- 0. 1	0	- 0.7	•	-1.3	0
6.0	1.1		0.1		0.0		9.0		<b>0</b> .4		0.0		0.3		0.2		9.0		0.0		1.3
∘ <i>- 0. 6</i>	٥	0. O	٥	0.0	۰.	0.0	o	0.3	0	-0.5	0	- 0. 2	•	-0.1	0	- 0.2	0	- 0.3	٥	-0.7	۰
2.2	0.0		0.0		0.0		0.1		<b>6</b>		0.1		0.2		5.1		0.2		0.2		a.
· <i>0.0</i>	•	0.0	0	0.0	•	0.1	י ס	- 0.1	0	0.0	•	0.0	0	- 0.2	•	-0.2	1 0	- 0.1	•	- 0. 2	0
										•											
													•								
FIG. A	-//	13 F	PE	RCE	N7	E	LC	NG	47	ION		PLA	TE	- A-	42	2XD	(	l - INC	H	GRID	1
	*4	1" 57	TE E	ΞL, /	21	NCH	W	DE .	PL.	ATE		NOMI	NA	L Si	TR	ENGT	Ή	38.5	5K.	S/	
		TE	E MI	PERA	ти	RE	1	7 ° F.					0	<b>%</b> SH	IEA	R					
																-		•			

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F16. A-//3

• -0.8 • -0.5 • -0.2 • 0 • 0 • -0.1 • 0 • -0.2 • -0.1 • -0.7 • -0.8 • 0 0 10 0 õ ~ õ ٩, 0-0.8 0-1.0 0-0.7 0 0 0 0-0.1 0 0 0 0-0.7 0-1.0 0 -1.0 0 2.1 õ 0 00 .3 N, ∿i <u>م</u>ن <u>م</u>ن 0 -0.8 0 -1.1 0 -1.4 0 -1.1 0 0.1 0 -0.1 0 -0.1 0 -0.1 0 -1.4 0 -0.2 0 -0.3 0 8.9 2.5 2.9 1.8 .5 4 2 6. 0 0 ٩i ٩i 0-0.7 0-1.1 0-1.5 0-1.3 0-0.5 0 0.2 0-0.6 0-1.6 0-1.1 0-0.6 0 2.9 0,3 QЗ 2 2 **N** А. ◦ -0.5 ◦ -0.7 ◦ -0.9 ◦ -2.6 ◦ -0.7 ◦ -0.7 ◦ -1.0 ◦ -2.8 ◦ -0.9 ◦ -0.7 ◦ -0.7 ◦ o -0.7 o -0.8 o -1.0 o -2.7 o -0.8 o -0.9 o -0.7 o -2.9 o -1.2 o -0.7 o -0.5 o 6,2 20 6 5 2 õ 0 0-0.8 0-1.2 0-1.7 0-1.6 0-0.6 0 0.2 0-0.8 0-1.6 0-1.8 0-0.9 0-0.7 0 2.3 2.7 2.8 6) 67 õ ŝ 0 Q 0-0.9 0-1.3 0-1.3 0-1.0 0 0 0 0 0 0 0 0 -1.1 0-1.3 0-1.3 0-1.0 0 2 0. 2 10 1.5 01 20 0.3 1.8 Ň ٩j <u>م</u> 61 0-0.9 0-1,1 0-0.9 0 0 0.5 0-0.1 0 0 0.1 0-1.2 0-1.0 0-0.8 0 1.6 , 0 0 2 õ 0 2 0 2 ۹ĩ. o -0.8 o -0.7 o -0.1 o 0.1 o 0 o 0 o 0 o -0.1 o -0.1 o -0.7 o -0.9 ● FIG. A-1/4 PERCENT ELONGATION PLATE B-2IXD (I-INCH GRID) "B" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 42.2 KSI TEMPERATURE IO °F. 0% SHEAR

DWG. 44E195

FIG. A - 114

o -1.5	o -1.4	o - 1.1 Au	o 0.2	• - 0.4	<b>9</b> - 0.4	o -0.2	• -0.7	• -0.6	0 -1.4	• -1.6	0
4.1	Mj	¢vi	2	0.0		1	1.1	2.1	2.4	Э.6 С	с К
0 - 2,1 00	o _1.7	• -/.3	o -0.7	• -0.2	• - 0.1	o - <i>0.4</i>	• -0.7	0 - 1.4	o -1.3	o 2.2	٥
Ö	<b>4</b> 0	tr)	27	<u>cv</u> :	0 4	0.3	1:2	0 V	40	5.4	6.9
• - <b>3</b> .0	o - 2.6	o - 2.3	o - <i>1.2</i>	o -0.1	• 0	• -0.4	o <i>- 1.</i> 4	o -2.3	o - 3.6	o - 3.2	0
<b>8</b> 7	73	6.0	б. Б	0 N	-07	0	сі Сі	42	7.5	18	74 2
o -3.9	o -4.3	o -3.3	o - 2.2	o -0.7	• -0.1	o -08	• - 2.2	o - 4.7	o - 4.6	o - <i>3.2</i>	0
6.9	1.6	6.01	Ð.9	¢ ¢	0.9	0.8	3.1	13.7	4.11	8.1	5.7
o - 2.8	o - 3.5	o -5.2	0 -4.9	o - 0.7	o -2.7	o - 0.8	o - 6.4	o - 4.1	o -2,4	o - 2.5	٥
<del>8</del> <del></del>	9.0	<b>13</b> .3	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			)		23.8 *	13.0	₩ <u>0</u>	► <u>~</u>
o -2.5	o - 2.9	o - 5.6	o - 6.0	o -1.0	• - 2.0	• <i>- 1.0</i>	o - 4.7	o <i>-5.2</i>	o - 3.7	• - <i>2.8</i>	0
6.0	8.4	120	6.11	3.1	0.7	0.8	r) N	a v	1.0	89 19	6.8
• - <b>3</b> .7	o <u>- 4.</u> 7	• - 4.5	• - <i>2.2</i>	• -0.9	• 0.1	o _1.1	o -2./	o -3.4	o -4.0	o - 3.5	٥
92	81	7.4	N.C.	2.1	0	1.0	6.1	3	5.5	6.7	8.0
o - 3.3	o -3./	o -2.3	o -1.5	o -0.4	o -0.1	• - 0.I	o -1.4	o -20	o -2.4	o <i>- 2.8</i>	٥
6.8	5.3	S S	2.4	0.1	0.5	0.5	1.2	22	5	4.7	5.3
o - 2.3	• <i>-2.0</i>	o - 1.4	• <i>-0</i> .9	o - 0.2	• -0.2	• -0.4	o - 0.5	o -1.5	o - 19	o -1.3	٥
4.5	<b>4</b> .6	0.3	1.6	6.0	<b>6</b> .0	<b>6</b> .0	<u>6</u> .0	1.7	6. 10	3.0	€ O
o - 1.7	o -1.3	o - 0.8	o - 0.6	o -0.3	o - 0.4	o -0.6	o -0.4	o -0.8	• - 1.1	• - <i>l.</i> 5	٥
FIG					NC AT		DI AT				
<i>F10</i> ,	A-115			ELU	WGAI	101	PLAIL	- 83	ΙΧΟ (Ι	INCH G	irid)
	<b>"8</b> " s	STEEL,	12 IN	CH WID	E PLAT	ΓE	NOMINA	L STRE	NGTH	48.7 KS	51
	7	EMPER	ATURE	12-17	°F		20	0% SHE	AR		

DWG. 44E /94

FIG. A-115

0	-1.5	0	-1.4	¢	-0.9	a	-0.5	0	-0.5	0	- 0.4		-0.5	o	-0.8	•	-0.9	.0	-17	0	-17	
3.8		2.9		0		4		6.0		0		0		6	••••	6		5		ŋ		Ŋ
1 0	-2.0	0	-1.7	- <b>-</b>	-1.6	0	-0.8	0	-0.7	<u> </u>	-0.7	` . ` .	-04	0	-16	° °	-17	~	.17	رس م	-26	4
00		4		Ņ		0		~	••••	Ŋ	0.1	4	-0.0		<i>1.</i> <b>C</b>	თ	-7.7	ب ا	-1.7	ы С	-2.0	õ
•	. 7 6	4	0.4	ß		0			• • •	Q	<b>.</b> .	Ó	* *			ŝ		Ŋ	•	4		ý.
° ►	-3.0	0 80	- 2.4	° V	-2.4	ہ دہ	-7.9	0	- 0.6	٥	-0.1	0	-0.4	. °	-1.7	9	-2.3	。 、	-2.9	•	- 3.9	9 0 0
6		N		Ś		36		1.6		0		0		5.7		3.6		5		7		9
°	-5.4	0 N	- 4.7	, V	3.8	° B	-2.4	°	-1.3	•	0	0	-1.1	•	-2.6	•	- 3.7	° Q	- 4.5	•	- 5.2	? o
16.		Ā.		2		0)		2		0		0.6		10 4		83		0		12.1		<b>/J</b> .3
0	-8.1	0	-6.9	•	-6.2	0	-5.1	0	-1.2	¢	-2.6	0	-1.5	0	- 5.3	0	- 5.9	°	- 6.4	۰	-7.4	0
42.5	<b>.</b>	39.5	<b>.</b>	E.	<del>.</del>	238	4	- <b>N</b> O		-(		)-		13.8		270		23.0		21.1		14.0
0	-11.1	0	-8.1	o	-6.7	۰	- <i>6.2</i>	o	-0.9	0	-2.6	0	-0.9	0	- 5.9	•	-0.6	0	- 7.9	•	- 5.6	• •
21.8		18.0		(J.9		9.3		3.3		0.		27		5		40		8.8		6.3		<b>₽</b> 6.
0	-6.0	0	- 5./	0	- 4.1	0	-2.4	0	- <i>1.0</i>	0	-0.2	•	-0.9	。 。	-2.3	~	-4.5	• <b>N</b>	- 6.6	с <b>ч</b> о	-7./	vo o
21		8		2.2		2		6		0		2.		9		-3		4		8		9
•	-34	ч) 0	-2.8	~	-23	۰ ۲	-16	~	-02	Š	0	ç	-03	2	- 15	v	.01		20	2		2
2		~		N	2.0	- 5		Ŋ	-0.2	5	•	ŝ	-0.0	ņ	- 7.0	*	-2.1	~	- J.Z	Ś	- 4.5	°
~	• •	ŝ		Ŋ		€.				0		0		~		Ø		Ŋ		Ś	_	90
ہ ک	-2.0	0 10	- 1.8	о С	- 1.5	°.	-0.8	• •	-0.4	°	-0.3	<u>ہ</u>	-0.3	0 0	-1.0	•	-1.2	•	-1.7	0	-2.6	50
4		5		Ŵ		4.7				Ô.		õ		ö		1.6	•	¢,		T)		4
0	- 1.5	D	-/. <b>2</b>	0	-1.1	0	- 1.8	0	-0.3	۰	-0.2	0	-0.6	0	-0.4	0	-0.8	0	- 1.1	0	- 1.3	ô
FIG. A-116 PERCENT ELONGATION PLATE B-32XD (1- INCH GRID) "B" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 50.4 KSI TEMPERATURE 20-23°F 87% SHEAR																						

DW6. 44E203

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FIG.A-116

0 -1.2 0 -1.3 0 -0.3 0 -0.5 0 -0.3 0 -0.3 0 -0.7 0 -0.4 0 -0.5 0 -0.4 0 -1.7 0 ŗ. <u>d</u> Ö. 0 0 3. õ 6 o -/.4 o -/.6 o -/.6 o -0.6 o -0.5 o -0.7 o -0.5 o -0.6 o -/.4 o -/.3 o -/.7 o 25 0.2 0.2 1.6 0 20 .5 2 ٩j ٩j ŝ 0 -1.6 0 -1.7 0 -2.1 0 -1.4 0 -0.5 0 -0.5 0 -0.7 0 -1.3 0 -2.3 0 -1.8 0 -1.4 0 1.5 2.9 30 4 0 0 0 2 N Qj. Q, 0 -1.4 0 -1.8 0 -2.4 0 -2.1 0 -1.1 0 -0.5 0 -1.0 0 -2.2 0 -2.3 0 -1.8 0 -1.8 0 0 0 0 ۹Ì ۰. ○ -*1.6* ○ -*1.4* ○ -*1.6* ○ -*3.5* ○ -*1.4* ○ -*1.5* ○ -*1.5* ○ -*3.6* ○ -*1.8* ○ -*1.4* ○ -*1.5* ○ 9 o -0.8 o -0.9 o -0.9 o -2.7 o -0.8 o -1.1 o -0.7 o -3.2 o -1.3 o -1.1 o -0.9 o 6.3 2.1 5.3 N) 0.3 5 4.5 2 2 9 ŝ 0. ○ -0.9 ○ -1.3 ○ -1.8 ○ -1.5 ○ -1.4 ○ 0 ○ -0.5 ○ -1.8 ○ -2.0 ○ -1.6 ○ -1.1 ○ 2.6 2.8 6 *°*. ø 6. 5 ~ 0 Q, si. ٩j Q 0 -/.3 0 -/.8 0 -/.6 0 -/./ 0 -0.1 0 -0.2 0 -0.4 0 -/.1 0 -/.4 0 -/.5 0 -/.3 0 -0.5 2.0 θ, 15 0.9 0 Ø <u>G</u> Q. Q. o -1.0 o -1.2 o -1.1 o -0.1 o -0.1 o -0.3 o -0.1 o 0 o -1.9 o -1.3 o -1.2 o 20 1.6 8 2.1 0 0 8 ġ. 0 Q. 2 o -1.0 ° -0.7 ° -0.2 ° -0.1 ° -0.3 ° -0.2 ° 0 ° -0.3 ° -0.5 ° -0.9 ° -0.6 ° FIG. A - 1/7 PERCENT ELONGATION PLATE B-33XD (I-INCH GRID) "B" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 43.5 KSI TEMPERATURE (-3)-(0)° F. 0% SHEAR

DWG. 44E205

FIG. A - 117
• 8.2 • 12.5 • 25.6 • 16.6 • 8.4 • 4.8 · 3.1 a 4.2 ° 3./ 6 1.7 02 6.0 ₽. 2 90 A N 1.7 A-118 ٥ŋ ړ o 2.3 o 3.6 • 6.0 • 11.4 • 26.3 • 14.5 • 5.8 • 3.3 • 2.5 STEEL, -1.3 -2.1 -5.6 -6./ -4.1 0 Ūų. 2.3 ~ EMPERATURE N ò, PERCENT · 1.6 · 2.2 ٥ 4.5 ° 9.5 ° 22.7 ° 10.7 ° o 2.4 4.0 o 1.5 -1.1 -4.7 -1.5 -1.1 -5.2 0.8 Çij Cij Ñ 2.7 Ó Ġ, INCH • 7.9 • 17,8 • 7.5 • 2.3 • 1.6 • 0.9 • 1.1 • 1.4 • 2.6 -3.7 -3.8 0.5 ò -1.1 00 ~ ELONGATION ò 132°-136° F ġ, WIDE PLATE Ġ. ØD. Δ o 0.3 o -0.1 · 1.2 · 2.4 · 2.1 · 1.8 · 0.4 · 0.2 · 0.8 9.0--0.7 0.0 -0.9 ò N ò . О.б 0.1 0.1 Ň • 0.4 • 0.1 • 0.1 90.7 o • 0.4 • 0.3 • 0.1 • 0.6 -1.7 -1.5 -0.2 . О. З 0.1 0.2 0.0 0.2 0. PLATE • 0.5 • Y • 0.8 • 0.1 • 0.0 • 0.6 o 0.5 o 0.1 • -*0.1* NOMINAL -0.6 -0.7 0.8 0. . . . 0.1 0.3 0.1 0. 93% C-IIXD • 0.4 • 1.3 • 2.3 • 5.3 • 1.9 • 1.2 • 0.3 • • 0.4 0.5 -0.6 -1.9 -1.8 4 9.9 0 Ó . О.б SHEAR STRENGTH ý, 0 2 ◦ 1.3 ◦ 1.6 ◦ 2.6 ◦ 6.6 ◦ 16.7 र 20.0 ◦ 3.1 ◦ 1.6 ◦ 1.0 -2-8--/. <del>3</del> ( I - INCH . 0. 8 5.6 5.6 2.2 N 9 · 1.6 · 2.6 · 4.1 · 7.7 · 14.1 · 25.4 · 9.0 · 3.5 · 1.9 53.2KSI -3.3 3 0 -1.8 . e Å Vi -4-0 ò GRID • 3.8 • 5.2 • 8.3 • 12.4 • 16.5 • 14.0 • 6.2 • 3.2 ° 2.5 37 ся СЯ ية د 1.0 N. A. Gų. N N • 3.2 • 4.4 • 7.4 • 9.1 • 7.6 • 3.3 • 15.9 • 8.5 • 4.9 •

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$\begin{array}{c} -0.9 & 0 & -0.9 \\ 0 & -1.3 & 0 & -1.9 \\ 0 & -1.3 & 0 & -1.9 \\ 0 & -2.3 & 0 & -1.9 \\ 0 & -3.8 & 0 & -3.9 \\ 0 & -3.8 & 0 & -3.9 \\ 0 & -3.0 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & 0 & -4.9 \\ 0 & -3.9 & -4.9 \\ 0 & -4.9 & $	2.6 • -0.4 M 1.1 • -0.8 M 2.9 • -1.2 2.6 • -1.6 M 6.	• 0 • -0.4 • -0.9 • -1.4	• -0.1 • 0.3 • -0.1 • 0.3 • -0.1 • 0.3 • -0.1 • 0.3 • -0.1 • 0.3	• 0 • 10 • 0 • 0 • 0	-0.1 • 0 60 • -0 10 • -0 0.1 • -0.	• -0.2 • -0.6 • -0.2 • -0.6 • -0.6 • -1.0 • -1.1 • -1.6 • • • • • • •	6 • -0.9 • 5 • -1.3 • 6 -1.3 • 7 • -2.1 •
62 - 7.3 - 7.5 -	M 1.1 o - 0.8 M 1.9 o - 1.2 M 8.6 o - 1.6 M 6	10 -0.4 41 0 92 0 -1.4	1.0 - 0.1 0 0.3 - 0.1 0 - 0.3 0 - 0.2 0 0.3	0. 0. 0. 0	6:0 • • 0 0 • 1 0 0.1 • • 0. 0.1	4.0 - 0.6 o -1.0 8 o -1.1 o - 1.6 6.1 9.5	53 0 -1.3 0 -2.1 0 0 -2.1 0 0 0 0 0 0 0 0 0 0 0 0 0
0 - 1.3 0 -	1.1 o -0.8 F. d 1.9 o -1.2 F. d 5.6 o -1.6 F. d 6.6	• -0.4 • -0.9 • -0.9	• -0.1 • 50 • -0.1 •	• 1.0 • 1.0	0 • -0 10 0.1 • -0.	2 o - 0.6 o -1.0 2 i - 0.6 o -1.0 8 o -1.1 o - 1.6 6 j j j	0 -1.3 0 0 -1.3 0 0 -2.1 0 + +
$2^{+}$ $2.3 \circ -1$ $3^{+}$ $-2.3 \circ -1$ $3^{+}$ $3^{$	M. 1.9 o -1.2 7 7 8 6 o -1.6 M. 6 9	4 6   0 -0.9   97 -1.4   0 -1.4	· · · · · · · · · · · · · · · · · · ·	0.1 <b>0</b> 0.1	0.1 • -0.	8 - 1.1 - 1.6 9 - 1.7 - 1.6 9 :	67 - 2.1 o
$-2.3 \circ -1$ $-3.8 \circ -3$ $-3.0 \circ -4$ $-3.0 \circ -4$	1.9 o -1.2 7 8 8 6 o -1.6 m 6 1.6	o -0.9 9. 0 -1.4	• -0.1 •	• 1:0	0.1 o -0. 0.	8 o -1.1 o -1.6	o -2.1 o
- 3.8 • - 3 96 - 3.0 • - 4	74 76 o - 1.6 66	97 97 • -1.4		0.1	0.1	6. 7.6	4 4
-3.8 0 -3 96 -3.0 0 -4	8.6 o - 1.6	o -1.4	O E -			,	<i>S</i>
96 -3.0 • -4	6 6	<b>•</b> •	0 -0.5 0	0 0	-0.4 o -1.	1 02.3 0 -3.4	4 o -4.0 o
-3.0 •	16 . 17	e e	1.6 0.6	0.8	1.3	5.1	11.8
+	+.D Q -4.J	0 - <i>3.5</i>	o - <i>0.6</i> o	-1.4 o	-0.7 o -2.	5 o -4.8 o - 5.5	5 0 -7.0 0
-		9.9	<sup>4</sup> ,(			★	+ 51g
-3./ 0 -4	4.6 0 - 4.7	o - <i>3.9</i>	o - 0.6 o	-1.5 0	-0.7 0 -2.	9 0 - 4.5 0 - 5.4	1 o -6.8 o
9.5	6	6.5	<b>o o</b>	4	4 4	5.5 8.3	0.3
-3.7 o -3	3.5 o -2.8	0 -1.6	o - 0.8 o	0 0	-0.1 o -1.5	5 0 - 2.4 0 - <u>3 :</u>	30-3.70
5.5	0	N. C	<i>a b</i>	0	0	3.5	5.0 6.9
-2.3 0 -1	.8 o -/.4	o - 0.9	o -0.2 o	0.1 o	0 0 - 0.	~ 7 o - /.2 o - 1.7	r o - 1.8 o
0 10	1	9	<i>Б</i> . 5.	1.0	2		2 8
-1.4 o -1	./ o -0.8	0 - 0.4	• · O •	0.1 o	0 0 - 0.1	· · · 0.6 · - 0.8	· · · /.2 ·
0	Ю	2	4. 6.	0	~	4 0	2
-1.0 0 -0		o 0.1	O o	0	0.1 0	0 -0/ 0 -06	5 o - 0 9 o
FIG. A-119	PERCE	ENT ELC	ONGATIO	N PLA	TE C-5	IXD (I-INCH G	RID)
"c "	STEEL, 12	INCH W	IDE PLAT	TE /	NOMINAL S	TRENGTH 48.7	KSI
	TEMPERAT	TURE 120-	123 °F		100	% SHEAR	

0 2.2. 0 3.4 0 3.8 0 3.4 0 4 6 0 3.1 0 3.8 0 3.3 0 2.2 0 ы С -1.6 0 1.9 - / . 9 1.6 No. 0 1.6 0 2.4 0 4.1 0 4.7 0 5 4 0 4.6 0 4.2 0 2.7 0 1.6 <u>"</u> س 120 -1.7 5 -1.6 0 0 20  $\dot{v}$ 0.9 0 No. STEEL, Ġ, **TEMPERATURE** 0 6 Ň PERCENT 5 0 • 0.8 • 1.6 • 3.2 • 6.3 • 10.0 • 6.4 • 3.3 • 1.8 • 0.9 • . . -1.1 6 -0.2 -4.1 -1.2 20 0.6 2 2 in. . Go 12 • 0.9 • 1.7 • 4.0 • 14.9 • 4.3 • 1.8 • 0.9 • 0.1 • ° 0.1 INCH -1.1 -1.8 0.2 0 0 3 0 0 'n ELONGATION •06 WIDE 0 - 0.2 0 0.0 0 0.6 0 1.1 0 6<sup>5</sup> 5 0 1.2 0 0.6 0 0.0 0 - 0.2 0 -0.2 0.0 0.0 0.0 0.0 07 0.7 . . . 0 0. ٦. Ò PLATE لم ٥.٥ ٥ /٥.١ ٥ /٥٠ ٥ ٥.٠ ٨ · 0.1 · 0.0 · -0.1 · -0.2 · -0.2 - /. 3 -0.2 1 0 0 Ó 0 0 0 Ġ, 'n. Ċ. A Å o - 0.1 o 0.0 o 0.0 o 0.1 o \[
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\[ 0 NOMINAL PLATE 0 0 .<u>0</u>.2 0.0 0 0 0.0 0.2 0 0 0 0 9 **Ch** 0 201 ◦ - 0.1 ◦ 0.0 ◦ 0.8 ◦ 1.3 ◦ 5.1 ◦ 1.0 ◦ 0.8 ◦ 0.1 ◦ - 0.2 ◦ -1.1 -1.8 -1.9 0.0 0.1 0 0.2 9.7 0. SHEAR STRENGTH 0 0 52X0 · 0.1 · 1.0 · 1.8 · 4.6 · 18.3 · 4.0 · 1.8 · 0.9 · 0.1 0 0 Ň 0 2.2 0 ŝ 4 2 0 0 Ġ, 0 О, • 1.0 • 1.7 • 3.6 • 6.6 • 7.3 • 5.8 • 3.1 • 1.7 • 0.9 • ( I-INCH GRID) 46.6KSI - / 3 -1.6 0 0 N Ν N 0.8 0 ŧ 0 . On ່ທ 4 0 0 1.6 0 3.0 0 3.9 0 4.5 0 6 3 0 4.3 0 3.8 0 2.2 0 1.5 0 -1.3 :-0 М N 207 Ś ò • 2.4 • 3.6 • 3.8 • 3.1 • 4.7 • 3.1 • 3.7 • 3.0 • 2.1 •

DWG. 44E190

TEMPERATURE (-65) - (-63)°F

17%

SHEAR

FIG A-121

2.8 2.9 o 6,4 0 ο *3.2* 0 3.3 0 2.3 o 23 0 3,5 o 3.4 o 0 - /. 6 87--1.6 5.5 -.4 -11 .'.3 ö 6. 0.7 FIG. A-121 PERCENT ELONGATION *°*, o 0.3 2.9 3.8 6.4 ° 3.7 ° 3.9 • *3,0* 0 0 0 4.0 0 ٥ 0,6 0 STEEL, 12-INCH WIDE PLATE -1.2 - 25 -1.8 -03 <u>с</u>, 1.4 0 0.7 0. 2 0.7 • 3.9 o 5.3 o 9.2 • <u>3</u>,7 0.1 0 • 5.4 • 1.0 o 0 0,1 0 -2.9 0. -2.4 -2.4 0 -0.6 .0.4 2.1 20 0 • 6.3 • 12.3 • 7.1 • 0,1 0 • -0.1 • 1.0 • 1.1 o -0.1 o -0.1 -0.7 -4,3 -4.4 0. 0 0. 4 0 0 0 0 0.2 0 -0.2 0 -0.1 0 0.3 0 10.9 0 0.4 0 -0.2 0 0 0 • -0.2 • 0.7 0-0,2 0. 0 0.1 0 0 0 0 o -0,3 o -0,2 o -0,2 o -0,4 o • -0.4 • -0.3 • -0.2 0 -0,1 0 0. 20 0 0 0 0 0 0 0 0 o -0.3 o -0.3 o -0.3 ° -0.3 ° • -0.4 • -0.3 • -0.3 • -0.3 • NOMINAL 01 0.2 0, ō, PLATE N-13XD(1-INCH GRID) 0 0 ö 0 0 0 11,7 0 0,2 0 -0.3 0 -0.3 -0.3 0.4 o -0.4 o -0.4 • • 0 -0.4 STRENGTH 71.1 KSI -47 - 0, 8 0.1 4.8 0 -... 0 0 0 0 o 2.1 • *6.8* • -0.6 • -0.5 ο 1.4 • 6.6 • 1.3 • - 0.5 • - 0.3 • - 2, 2 - <u>3</u>0 -2.9 60-0.1 0.1 0 2.9 0 0 ° 9.2 ° 5.3 0,8 • 3.8 • 4.9 • 3.6 • -0.7 0 ٥ 1.0 • - 0.5 • - 1.3 -2.5 - 2.0 0.5 -2.4 9 <u>о</u> 5 1.7 . 0.7 2.1 o <u>3</u>4 • <u>3</u>.8 • <u>6</u>/ • <u>3</u>9 • 0.3 • *2.8* • 3,5 • 2.9 • 0.6 • -24 - /.9 - 1.3 -20 -1.3 <del>.</del>'--0.2 -1.7 ġ. 67 • 2,0 • 3.3 • 3.1 • 2.6 • 6.3 • 2.5 • 3.5 ° 3.5 ° 2.4 0

• -1.0 • -0.3 • -0.2 • 0.1 • -0.1 • 0.1 • 0 • -0.1 • 0.2 • -0.2 • -0.4 • QJ Б. О 2 6 0 5 0 O Ó • -1.2 • -0.4 • -0.3 • 0.1 • -0.1 • 0.3 • 0.3 • 0.2 • -0.1 • -0.9 • -1.1 • 0 9 9.6 9. 9 5 0 io oi 03 8 Ň m si. 0 0 ◦ -1.5 ◦ - 1.3 ◦ -1.3 ◦ -0.2 ◦ 0 ◦ 0.2 ◦ -0.1 ◦ 0.3 ◦ -1.1 ◦ -1.7 ◦ -1.2 ◦ e) E 0.0 2.5 0.3 8 4 5.6 2 N) O. 0 m In . ° -1.5 ° -1.1 ° -1.7 ° -1.0 ° -0.2 ° 0.2 ° -0.3 ° -4.1 ° -1.6 ° -2.4 ° -0.5 ° 5.8 0.4 6.1 à 0 Ś 0-1.2 0-1.2 0-1.0 0-3.6 0-0.2 0 0.2 0-0.5 0 -3.5 0-1.6 0-1.4 0-1.3 0 ιo. 2 8. ŝ { · -1.7 · -1.4 · -1.5 · -2.3 · -0.2 · 0.2 · -0.5 · -3.5 · -1.6 · -1.2 · -1.3 · 2.5 5.5 Q.I Ø, 10 3 0 0 ° -1.2 ° -2.3 ° -2.3 ° -1.7 ° 0.1 ° 0 ° -0.3 ° -1.5 ° -1.9 ° -1.9 ° -1.5 ° 5.6 5 0 6 **6 4** e.G 0 5 m) ◦ -1.7 ◦ -1.5 ◦ - 1.5 ◦ -0.5 ◦ 0.3 ◦ 0.2 ◦ 0.1 ◦ -0,2 ◦ -1.5 ◦ -1.3 ◦ -0.8 ◦ 5 4.4 N 0.2 17 0 0 6 Qj. Ø. ◦ -1.4 ◦ 1.2 ◦ -0.5 ◦ 0.1 ◦ -0.1 ◦ 0 ◦ -0.1 ◦ 0 ◦ -0.3 ◦ -0.8 ◦ -1.6 ◦ - 0.3 Ø 61 0 S In 0 0 0 0 0 O, 0-1.1 0 -0.3 0 0 0.3 0 -0.3 0 0.1 0 0 0 0.2 0 0.2 0 -0.4 0 -0.2 0 FIG. A-122 PERCENT ELONGATION PLATE N-14XD (1-INCH GRID) "N" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 69.6 KSI TEMPERATURE (38)-(36)"F 7% SHEAR

DWG. 44 E191

DWG. 44E192

0	- 0.5	•	- 0.5	•	0.1	•	- 0.2	<b>6</b>	0.7	0	- 0.1	0	- 0.3	9	0.1	•	- 0.2		- 0.3	•	- 0. 6	•
 N		2.0		0.9		0.1		0.		0.8		0.2		0		-0		0.9		1.1		91
•	-1.0	•	-0.7	0	-0.3	•	0	0	- 0.1	0	0.1	0 10	- 0.1	•	0	•	- 0,5	0	- 0.7	e io	-0.8	(
D Ni		2.8		6.1		0.6		Ó		0.2		0		0		1.1		Ε.		0		0
0	-1.5	•	-0.6	۰ ۴	- 1.1	•	- 0.2	o M	- 0.1	•	- 0.1	0	- 0.1	•	- 0.4	•	-0.8	• •	-1.2	•	-1.0	q
01		3.0		<i>В</i> .		2.0		0		õ		0		0		57		2.4		2		C
•	- 0.8	•	-1.3	0	- 1.7	•	-0.8	٢	0	0	- 0.4	0	0.2	•	-1.0	•	- 0.5	•	- 1.3	•	-1.2	
0.6		1.3		2.7		4		1.6		0		0		1.2		4		Ю. 4		3.0		0
•	- 0.1	•	- 0.2	•	-0,9	0	- 3.2	0 ()	- 0.2	0	- 0.1	•	0.1	•	-2.5	•	-1.0	•	-0.9	•	- 1.4	, ,
4	<b></b>	4.0		5.0	•	75	<b>ه</b> ـــــــ	0	<u> </u>	-(		)-		4	,	90		N	+	5.6		
•	- 0.2	G	- 0. 4	•	-1.2	0	- 2.7	0	0.1	0	0.3	G	0.2	•	- 3.0	•	- 1.4	<b>0</b>	- 0.7	٥	-0./	•
0.0		<u>8</u> .8		2.6		40		0		0.2		0.1		0		4.0		3.5		1.4		0
•	- 0. <b>8</b>	0	- 1. <b>2</b>	0	- 1.7	•	- 0.1	•	0.2	•	0.2	9	0.1	•	- 0.1	•	- 1. 9	•	- 1.5	•	- 0.7	
2.1		2.3		2.0		0.6		0.2		0.1		0.1		0.2		0.2		<u>8</u>		28		0
0	-1.5	0	-1.4	٥	0	0	0	0	- 0.5	6	0.2	•	0.3	0	- 0.2	đ	0	٥	- /. <b>4</b>	•	-1.3	
s S		171		0.3		-0.1		0.1		0.1		0		0.2		0.2		0.3		2.0		۲ د
o	-0.7	0	0.3	9	- 0,1	0	0.3	0	0.4	¢	0	9	- 0.3	0	0.2	٠	0	•	0	٠	- 0.6	;
1.2		01		0.1		0.3		0.2		0.2		0.2		0.2		0.2		0.3		0.2		(
•	0.2	0	0.1	ø	- 0.8	0	- 0.3	•	0	٥	- 0.1	۰	0	•	- 0. <b>4</b>	0	- 0.2	•	- 0.3	0	0.1	
F.	16	_ <i>/</i>	१र	Ļ		CE	NT	F		6/	ITIO		Þ		1 <i>7 F</i>	٨		ص	(1-14)	сч	GPI	
, ,	"О. Д "Л	(" )	z J STEE	Z,	12 IN	ICH	WID	E	PLAT	E	1770	, <b>ν</b> Λ	IOMIN		. STI	7 <b>7</b>	VGTH		66.7	KS	טו <i>דו</i> נ ו	''

•	-0.9	0	-0.2	0	0	•	0.3	0	0	0	0.1	0	0.2	٥	0	0	<b>0</b> .1	0	- 0.5	0	- <i>0.9</i>	0
۶.7		1.8		0.5		0		0.1		-0.1		-0.1		0.2		0.1		0.9		1.6		6.9
•	-1.6	0	-1.7	0	0	•	-0.1	0	0.1	0	0	0	-0.2	0	0.9	0	-0.5	0	- 1.2	0	- 1.5	0
4.7		3.3		1.9		0.4		0.2		-0.1		0.1		-0.2		0.8		2.1		35		4.7
0	- <i>2</i> .7	0	-2.0	0	- 1.4	o	-0.8	o	0	٥	0	0	-0.2	٥	- <i>0.6</i>	0	- <i>1.2</i>	٥	- 2.0	٩	-2.5	0
7.4		6.0		4,4		5.2		0.3		0		0		0.6		22		<b>4</b> .0		5.5		26
0	- 4.6	0	- 3.8	0	- 3.1	0	-1.7	0	-0.1	0	0	0	- <i>0.3</i>	0	-1.8	0	- 3.0	0	-3.6	0	- 4.0	0
122		11.9		9.7		22		2.0		1.0-		0		4.2		6.9		9.9		11.0		12.7
0	- 6.9	0	- <b>6.2</b>	•	- 5.1	0	- 4.5	0	-0.5	٥	-0.5	0	-0.3	0	- 4.6	0	- 4.9	0	-6.0	0	- 6.6	0
6.5	<b></b>	2,62	4	5.7	<b>4</b>	1.0	-	8				_	<b>-</b>	2		.00		5.7		8.0		بھ. 19
2	- 73	~	-62	~	- 57	m n		2	0		00		04	S S		di	40	2	60	4	70	η. Α
ŝ	- 7.5	Ø	-0.2	5	- 3.7	٥ ا	-4.5	5	U	0	-0.2	~	-0.4	Ů	- 4.4	č	-4.3	۵.	-0.0	~	- 7.0	80
Ś		2		0		Ø		1		0		ò		2		22		1.1		13.		16.
0	-4.6	٥	- 3.8	0	- 2.7	۰	-1. <b>E</b>	0	0.3	0	- 0.1	0	-0.3	0	-1.4	•	-2.9	o	- 3.8	0	- 4.5	0
83		6.3		4.6		<b>e</b> 0'3		0.2		0		-0.2		0.2		2.4		4.6		6.9		<i>8.6</i>
0	-2.5	0	- <b>2</b> .1	0	- 1.2	•	-0.2	ø	0.5	0	-0.5	0	0	o	-0.1	0	- /.4	0	- <i>1.</i> 8	0	- 2.7	0
4.9		3.5		1.6		-0.1		-0.4		- 04		-0.1		-0.5		0.2		2.0		3.2		5.1
•	- 1.5	٥	-0.9	0	- 0.1	0	0.3	٥	0.1	0	0	0	0	0	0.2	0	-0.3	0	-1.1	0	- 1.5	0
88		1.0		0		0		-0.5		-0.1		0		-0.5		0.1		-0.1		27		2.6
0	- 0. 6	0	0	٥	0	0	0.2	0	0.5	0	0.3	•	-0.4	0	0. <i>6</i>	0	-0.5	0	-0.3	0	- 1. 9	•
	FI	<i>G</i> .	A-12	24	PL	ĒR	CEN	IT	EL	01	VGA	TI	ON	PL	AT	-	N 16	X	D(I	IN	CH GI	R(D)

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"N" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 66.0 KSI

TEMPERATURE 32-33 °F.

100% SHEAR

DWG. 44E200

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FIG. A-124

.....

0-0.4 0-0.2 0 0.0 0-0.2 0-0.1 0-0.1 0-0.1 0 0.0 0 0.0 0 0.0 0 -0.5 0 90 ٩J 2 9 0 2 0 0 0 Ø, 0 0 0 0 0 o -1.7 o -0.8 o 0.1 o -0.1 o -0.1 o 0.0 o -0.1 o 0.0 o 0.0 o -0.6 o -2.1 o 5 m. 0 0 ŝ **N** 0 0.0 0 ~ ŝ Q. m, 0 0 o -2.8 o -2.8 o -1.1 o 0.3 o 0.0 o -0.3 o -0.5 o -0.4 o -1.4 o -2.7 o -3.2 o 0 ٩u Ф. 5 B 5 6 S 0 00 0 0 -5.0 0 -4.4 0 3.6 0 -1.5 0 -0.6 0 -0.5 0 -0.4 0 -1.1 0 -3.1 0 -4.0 0 -4.9 0 2.7 0 9 N 5 0 Ś Ø, 00 Ξ. 0 0 4 Ø. Ó o -5./ o -6.6 o -5.5 o -5.0 o -0.5 o -0.5 o -0.3 o -4.8 o -5.3 o -6.0 o -8.7 o 0 0 0 0 0 0 -0+++;+++0;+++0;+ 0 -**-**m --( )--a -4.4 a -5.3 a -4.9 a -4.5 a -0.2 a -0.4 a -0.3 a -5.0 a -5.6 a -6.5 a -8.2 a 6 0 ŝ ۰v 7.6 **N** 0 N m, 0 5 6 õ 0 0 0 N. 6 2 2 0 -4.0 0 -3.7 0 -2.9 0 -0.7 0 -0.2 0 -0.4 0 -0.2 0 -1.4 0 -3.4 0 -4.1 0 -4.8 0 0 B 0 N. 9 0 o' ŝ ø. 0 6 \* 0 - 2.7 0 - 2.2 0 - 0.5 0 - 0.7 0 0.1 0 - 0.3 0 - 0.1 0 - 0.2 0 - 1.2 0 - 2.2 0 - 2.9 0 b 0 6 9 Ś 0 Ø. 0 Ø. m m, 0 0 0 o -/.9 o -0.9 o 0.2 o 0.2 o 0.2 o 0.3 o 0.0 o 0.2 o 0.2 o -1.1 o -2.0 o 0 0 0 2 0 Ø, 0 0 0 Ø. 0 ◦ -0.2 ◦ -0.1 ◦ 0.0 ◦ 0.3 ◦ 0.0 ◦ 0.0 ◦ -0.2 ◦ 0.1 ◦ -0.2 ◦ 0.3 ◦ -0.6 ◦

FIG. A-125 PERCENT ELONGATION PLATE N-21XD (1-INCH GRID)

"N" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 68.4 KSI

TEMPERATURE -2 °F. 100% SHEAR

DWG.44 E178

◦ -0,8 ° 0,2 ° 0,2 ° 0,1 ° -0,1 ° 0,1 ° 0,1 ° 0 ° 0 ° -0,3 ° 20 *o* 0 0 0 0 0 0 с**л**" • -1.7 • -1.0 • -0.1 • 0.1 • 0 • 0.1 • 0 • 0.1 • 0 • 0.1 • -0.7 • -1.8 • 5,0 95 4. 50 9 o, 0 Ø, 0 5 0 0 • - 2.7 • - 2.3 • - 1.4 • 0 • 0.3 • 0.2 • 0.1 • 0 • - 0.9 • - 2.2 • - 2.8 • 9 5.0 4 25 6.5 4.4 0 ŝ 0 ġ. õ. • -3.5 • -3.8 • -3.5 • -1.5 • 0 • -0.2 • 0 • -1.0 • -3.3 • -4.3 • -4.1 • 0.2 6.3 8 0.2 4 8.2 1.2 9.8 n N *6*, 9.5 *6*. • -3.1 • -3.9 • -5.0 • -5.2 • -0.4 • -0.4 • -0.3 • -5.2 • -5.3 • -4.2 • -3.3 • +&+++& ----- 10 ----• - 2.9 • - 2.6 • - 3.9 • - 7.8 • - 0.1 • - 0.3 • - 0.3 • - 4.6 • - 5.2 • - 4.4 • - 3.1 • 76 50 6. ₽. 6) 2.2 3 0 0 5 • -3.1 • -4.5 • -5.3 • -1.6 • -0.1 • -0.3 • -0.1 • -1.1 • -3.2 • -3.6 • -4.1 • 0.2 2.8 N N 4. 74 Q, ~ ġ. õ ° -0.9 ° -2.1 ° -2.6 ° ° -3,3 ° -3,6 ° -2,0 ° 0,1 ° -0,1 ° -0,2 ° 0 ° 0 <u>0</u> 0≥ о! О 0 9 ŝ 0 0 0 ° - 2.4 ° - 1.7 ° - 0.1 ° 0.2 ° 0 ° - 0.3 ° - 0.2 ° 0.1 ° 0 ° - 0.7 ° - 1.6 ° \$ 9.0 6.0 0 0 õ 0 0 õ 0 • -1,4 • -0,2 • -0,4 • 0,1 • 0,1 • -0,2 • 0 • -0,1 • 0,2 • 0 • -0,4 • FIG.A-126 PERCENT ELONGATION PLATE N-22XD (1-INCH GRID)

"N" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 70.4KSI TEMPERATURE -60 °F. 35% SHEAR

DWG. 44E180

◦ 2.9 ◦ 5.1 ◦ 8.9 ◦ 31.1 <sup>↑</sup> ◦ 30.2 ◦ 12.5 ◦ 7.3 ◦ 4.4 ◦ 2.6 ◦ FIG 6 0 6.7 2.6 5.6 1 2.7 ։4 Ծ 4 A-127 1 • 1.2 • 3.7 • 6.6 • 4.3 • 29.3 • 11.0 • 5.8 • 3.2 • 0.7 • STEEL , I2 INCH -3.9 <u>6</u> 5.6 PERCENT ò 2 3.8 0 0 0 2.1 TEMPERATURE (+24) -(-22) • F. • 0.0 • 1.5 • 4.5 • 11.1 • 25.6 • 9.4 • 4.3 • 1.0 • 0.0 • -4.8 ů -3.1 0 0.1 44 0 0 0 0 0 • 0.0 • 0.0 • 1.8 • 8.0 • 20.6 • 6.9 • 1.3 • 0.0 • 0.0 • WIDE ELONGATION 14 .0.4 4.4 8 0.1 0 0 0 0 0 PLATE · 0.0 · 0.0 · 0.1 · 0.8 · 14.7 · 0.7 · 0.1 · 0.0 · 0.0 · 0 0 0 0 0 0 0 0 0 •-0.1 • 0.0 • 0.0 • 0.0 • ↓ • 0.0 • 0.0 • 0.0 • 0.1 • -0.2 0 0 0.1 0.7 0 0 0 0 ľ\3 • 0.0 • -0.1 • 0.0 • 0.0 • Y • 0.0 • 0.0 • 0.0 • 0.0 • NOMINAL PLATE . 0.2 0.1 0.1 0 0 0 0 0 0 100% SHEAR • 0.0 • 0.0 • 0.0 • 1.1 • 13.1 • 1.3 • 0.1 • 0.1 • 0.0 • STRENGTH N 🖌 🚽 -4 4 0 N-42XD (I-INCH GRID) 0 0 0 0 0 · 0.0 · 0.0 · 2.8 · 19.4 ₺ 19.5 · 7.4 · 2.3 · 0.0 · 0.0 · -5.4 - 3./ -1.3 0.1 4.2 0 2.0 0 0 68. I KSI • 0.0 • 2.9 • 8.7 • 30.8 • 16.0 • 8.5 • 4.6 • 1.9 • 0.1 • N -4.3 -2.1 1 - 1.5 G G 0 3.6 4 0 0 <u>/</u>`o ίų. · 2.4 · 5.7 · 21.9 · 16.2 · 11.9 · 8.6 · 5.7 · 3.6 · 1.5 · - 4.5 1 -2.6 4.4 N --1.6 34 0 -2.6 Lis • 4.6 • 8.3 • 33.5 \• 4.0 • 6.0 • 8.4 • 6.9 • 4.8 • 3.3 •

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FIG. A-128 PERCENT ELONGATION PLATE Q-3D(1-INCH GRID)

• -1.0 • -0.6 • -0.2 • -0.1 • -0.1 • 0.0 • -0.4 • -0.1 • -0.1 • -0.5 • -0.6 •

0-33 0-26 0-17 0-06 0-01 0-02 0-02 0-05 0-13 0-16 0-270

0-560-520-340-150-040-020-060-110-300-410-470

0-3.6 0-6.4 0-7.1 0-4.7 0-0.3 0-0.4 0-0.3 0-4.0 0-5.5 0-6.6 0-8.3 0

0-5,9 0-5,3 0-4,6 0-4,1 0-0,5 0-0,1 0-0.2 0-3.6 0-4.8 0-6.1 0-8.3 0

0-3.7 0-3.8 0-2.7 0-1.3 0-0.4 0 0.4 0-0.1 0-1.3 0-3.1 0-4.4 0-4.5 0

0-2.6 0-2.0 0-1.0 0-0.7 0-0.1 0 0.0 0 0.2 0-0.4 0-1.3 0-1.7 0-2.4 0

o-1.7 o -1.1 o -0.6 o -0.1 o 0.0 o -0.1 o 0.0 o -0.5 o -1.0 o -1.7 o

0-0.9 0-0.7 0-0.2 0 0.2 0-0.1 0 0.3 0-0.1 0 0.1 0-0.2 0-0.1 0-0.8 0

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o -// o -0.8 o 0./ o -0.1 o 0.3 o 0.2 o -0.2 o -0./ o -0.5 o -/.6 o

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DWG. 44E229

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o -11.5 o -7.4 o -6.3 o -4.9 o 0 o -0.3 o -0.1 o -6.2 o -8.1 o -8.2

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ŝ 2  $\sim$ 0-9.5 0-7.4 0-6.3 0-5.1 0-0.2 0-0.2 0-0.2 0-4.7 0-5.7 0-6.6 0-8.4 6 \$ Ø 9 4 Ф. o. 3 N. 90 ~ ○ -5.7 ○ -5.6 ○ -3.6 ○ -1.2 ○ -0.2 ○ 0.1 ○ -0.1 ○ -0.9 ○ -3.1 ○ -4.3 ○ -4.9 ○ 0 ŝ 0 6 0 0 N 5.1 0 O. N ര് Q. 0 -3.1 0 -2.5 0 -1.4 0 -0.4 0 0 -0.1 0 =0.2 0 -1.3 0 -2.1 0 -2.9 0 0 0 0 N 0.3 3.4 m) 6 θ 0 0 ġ 0 Ó m, 9 -0.8 9 -0.5 9 o -0.1 0 0.1 0 -0.1 0 0 0 -0.2 0 -1.0 0 -1.6 0 ŝ 5 m 0 ó ó Ó. Ó. ο. ò O. 0 o 0 o -0.1 o 0 0-0.9 0-0.3 0-0.1 0 0 0 0 0 0 -0.2 0 -0.8 0

FIG.A-129 PERCENT ELONGATION PLATE Q-11XD (1-INCH GRID)

"Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 60.0 KSI

0.1 0 0.1 0 -0.2 0 -0.9 0

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0 -1.4 0 -4.3 0 -5.7 0 -7.0 0

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0-0.2 0-1.5 0-2.6 0-3.9

0 0 -0.3 0 -1.1

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TEMPERATURE 100-101 °F.

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FIG. A-129

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m

◦ -5.7 ◦ -4.7 ◦ -3./ ◦ -1.0

o -0.1

o 0.1 o 0.1

0

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**Q** 

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0 -0.1

• -0.1	0 (	0 0	-0.6	o	0	0	0	0	0	0	-0.1	0	-0.1	0	о	0	0	0	0	o
<b>8</b> .0	0.1	N C	2	2.7		0		0		4		1.0		0		0		0		5.
o -0.7	0	0	- 0	0	-0.2	•	0	•	0.2	•	0	Ŷ	-0.1	o	-0.1		-0.1	0	-0.4	•
4	1.0	M C	, i	0.1		0.1		0.1		9.2		0		0.1		0.1		10		رع
• <i>-0.8</i>	o -0.	7	0.2	0	-0.1	۰ ٥	0.1	т 0	-0.1	•	-0.2	0	0.2	0	-0.2	•	-0.6	•	-0.6	0
4	4.	0	n Ż	0.6		0.7		0.3		0.1		0.3		0.3		1.1		1.3		1.2
• <i>-0.7</i>	• - <i>0</i>	.6 0	-1.0	0	-0.4	0	-0.1	۰ ٥	-0.3	0	-0.1	0	-0.3	0	-0.9	0	-0.8	0	-0.5	•
0.6	. 4	2	2	2.3		0.3		0		0.2		0.3		2.1		11		V.		<b>4</b> .
• - <i>0.4</i>	° -0	.4	-0.5	0	-1.6	o	0	0	0.1	0	0.1	٥	-1,4	0	-0.5	0	-0.4	0	0	o
+ 01 +	₩. <del>~</del>	Q	·	- 4	<b></b> -	2.5		-(		)		-93 19		4.4	<del></del>	-2-	<del>ب</del>	-2-		₽ -0; <del>*</del>
° -0.1	• -O	.5	• -0.6	• •	-1.5	٥	<b>0</b> .1	o	<b>0</b> .1	o	0	0	-1.8	0	-0.6	0	-0.5	٥	-0.6	o
0.7	£.1	0	, ,	2.5		0.3		0.1		0.1		0.6		2.5		6'		1.3		1.5
• <i>-0.5</i>	• -0	.4	-0.8	a	-0.4	o	0	•	0	٥	0	۰	-0.3	0	-1.0	o	-0.8	0	-0.5	o
1.2	9.1	a	<u>e</u>	1.0		-0.J		0.2		0.4		<u>8</u> .0		0.8		1.3		6.1		1.2
• -0. <b>4</b>	° -0	.7 (	-0.4	0	0	0	0.1	•	0.1	0	0	o	0	0	-0.6	0	-0.7	0	-0.8	o
1,2	2 1	a c	5	0.1		0.1		0		0.3		0.3		0		0.6		/.3		6.1
• <i>-0.6</i>	o -0	.2 (	o -0.1	۰	-0.1	۰	0.1	٥	0.2	0	0	o	0	•	0	0	-0.2	0	-0.5	•
1.0	0.7	ò	ડે	0.1		0.2		-0.2		0. 2		0		<i>.</i> 9		0.1		0.5		1.2
• <i>-0.3</i>	• 0.	.1 0	0.1	¢	0.1	0	-0.1	0	0.1	ø	0	o	0	۰	0.3	0	0	٥	-0.1	0
F	"G. A " q" s	-   3 TEEL	0 Pl	ER NCH	CEN	T DE	ELO. PLAT	NG E	ATIC	DN NC	F	2 2 12	NTE Stre	Q-,	<b>IЗХС</b> тн	) (I- 58.	INCH .4 KS	.GF SI	(סוק	
		ΤE	MPER,	4 <i>TU</i>	RE		0 °F.				0%	SI	HEAR							
DWG: 44E	196																		FIG. A	-130

DWG. 44E197

0-070-02000 0.1 0 0.1 • -0.1 0 02 0 0 0 0 0 -0.4 0 -0.6 0 6 8 0 0 0 m' Ò. 0 0 0 o. ٩i 0 - 1.9 0 -0.8 0 -0.3 0 0.1 0 0 o -0.4 0 • -0.2 • -0.8 • -1.5 0 0 0 o 0.3 9. 0 5 ò Ó. o. ю. ò ٩j ŝ 0 -4/ • -0.1 • 0.2 • -0.3 • -1.5 • -2.1 • -2.6 • -1.8 • -1.5 • -0.2 • 0.1 0 **Q** m 5.2 6 o. ò ó o. ٩i 6 • -5.7 • -5.5 • -4.3 • -1.1 • -0.3 • -0.1 • 0 0 - 1.1 0 -3.2 0 -4.4 0 -5.7 o Ø 0 Q 5 o' á 2 0 • -4.9 • -6.7 • -6.7 • -5.7 • -0.4 • -0.2 • -0.3 • -3.9 • -6.4 • -7.9 • -10.4 • 35.0 Ś 9.3 88 35. 0 -7.2 0 -5.9 0 -4.6 0 -0.3 0 -0.2 0 -0.1 0 -7.2 0 - 4.2 0 - 6.8 0 - 6.9 0 - 18.1 ò 14.0 N, **N** 0.9 0.8 M) m 8.5 0 4 0 ્યં ø. 5 6 2 o -4.4 o -3.2 o -0.8 o -0.4 o 0.1 0 -5.1 0 0 -0.7 0 -3.3 0 -4.2 0 -5.1 0 6 0 0.2 σ 0 6.9 N. 0 ъ, ١Ġ, o. 4 ۰Ö Q. 90 ◦ -3.0 ◦ -2.0 ◦ -1.3 ◦ -0.3 ◦ 0 0 0 0 0 0 -0.2 0 -0.8 0 -2.0 0 -2.9 0 Ó ŋ 2 0.4 0.3 0 0 1.0 6 o. m, ŝ mj. Ś o \_1.7 o \_1.2 o \_0.3 o \_0.1 o \_0.1 o \_0.1 ○ *0.2* ○ -*0.1* • O 0 -0.7 0 -1.7 0 6.0 m 9. 0 0 0 1.8 0 0 õ o, ◦ -0.9 ◦ -0.2 ◦ 0 ◦ -0.1 ◦ 0.2 ◦ -0.1 ◦ 0.3 ◦ -0.2 ◦ 0.2 ◦ -0.2 ◦ -0.5 ◦ FIG. A-131 PERCENT ELONGATION PLATE Q-14XD (1-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 61.9 KSI TEMPERATURE 68 °F. 100% SHEAR

0 -1.1 0 -0.4 0 O 0 -0.1 0 0.4 ◦ -0.4 ◦ -0.2 ◦ -0.3 ◦ 0 ◦ -0.4 ◦ -0.7 ◦ ø 5 5.7 0 0 0 0 0 N 0 o, 6 hj. 0 -1.5 0 -1.0 0 -0.3 0 -0.2 0 • -O./ • • -0.4 • -1.0 0 o 0 0 o -1.7 o 9 ŝ 9 4.0 4 0 0 0 80 ġ Ø, m പ 0 -2.4 0 -2.2 0 -1.2 · -0.4 • -0.1 • -0.5 • -1.3 0 0 • 0.1 ° -2.2 ° -2.1 0 Ś 4 0 m, 5 Ś 9 0 Ň Ь, 0 o. Ø o. 6 • -4.5 • -3.9 • -2.9 • -1.3 0 0 0 0 o 0 0 -// o -3.3 o -4.5 o -5.3 ο ŧħ, 6 5 9 σ b \$ 2 0 4 9 o. 5 Q Ś 5 ٥ń. 5 9 ◦ -7.8 ◦ -6.3 ◦ -5.1 ◦ -4.2 ◦ -0.2 ◦ -0.2 ◦ -0.1 ◦ -4.4 ◦ -6.5 ◦ -7.2 ◦ -8.8 ◦ Ø 30. N si M Ø 2 N 0 -7.2 · -7.1 · -5.8 · -4.6 · -1.1 o -0.2 o -0.1 0 - 4.1 0 -5.0 0 -5.6 0 -7.5 0 N ა 5 Ś m, o, 2.0 6 Ф. g 0 3. 5 0 Ś 90 Ø, ġ, Ξ. Ã. 0 -5./ o -4.2 o -3.4 o -<u>1.2</u> • -0.1 • -0.2 • 0 0 -1.0 0 -2.7 0 -3.5 0 -4.1 0 Ð œ 6 ŋ 2 0 ø 1.8 0 7.09 Ó. 0 ъ, Q, Ś А. ٩ì 4 ŋ. o -2.6 o -2.2 o -1.4 o -0.4 o *0.1* 0 0 0-0.2 0 O 0 -1.2 0 -1.9 0 -2.4 0 Ø 4 é, Φ 0 0 ٩j -0 0 0 Ø, 2 ° -1.7 ° -1.0 ° -0.5 ° -0.2 ° -0.2 ° 0.2 ° 0.3 ° 0.2 ° -0.4 ° -1.0 ° -1.3 ° Ø 0.8 m 0 0 0 0 0 0 0 Qj. 4 Ò. ŋ ● -0.7 ● -0.3 ● -0.1 ● 0.1 0 -1.0 0 0 0 -0.1 0 -0.3 0 -2.1 o 0 0 0 0.1 FIG. A-132 PERCENT ELONGATION PLATE Q-2IXD (1-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 60.0 KSI TEMPERATURE 57-59" F. IOO% SHEAR DWG 44 E186 FIG. A-132

• -0.8 • -0.6 • -0.5 • 0.4 • 0.2 • -0.1 • -0.1 • 0.2 • -0.2 • -0.4 • -0.8 • m, 0.6 0.6 **1** ò Q. 0 ~ 0 Q. 0 ٩i • -1.2 • -1.1 • 0.2 • 0 • -0.6 • -0.3 • -0.3 • -0.6 • -1.2 • -1.7 -2.1 3.2 2 m, -0.4 52 0. 0.6 0 1.8 Q. 0 -3.7 • -2.8 • -1.8 • -0.5 • 0.1 • 0 • -0.2 • -0.5 • -1.3 • -2.3 • -3.2 • 0.2 8.8 0.5 7.4 5.8 2.4 0 6 2. ્યં 0 • -6.9 • -5.3 • -4.1 • -1.6 • -0.2 • -0.4 • -0.8 • -1.3 • -3.5 • -4.6 • -5.6 • 243 24.0 16.2 83 13.4 1.3 1.6 õ 0 2 0 4 <u>\_\_\_\_\_\_</u>5.2 ° ヽ • - 5.2 • -0.4 • -1.2 • 0.1 • -1.8 • -6.4 • -7.6 • -6.6 • -4.2 . 2 20 30 2 Ňŋ 2 -6.2 • -5.4 • -4.7 • -4.7 • -0.4 • -0.6 • -0.3 • -4.5 • -5.6 • -6.8 • -6.8 • QD. 20 9.0 20 66 õ 4 2 0 0 2 Ľ. 0 -4.1 • -3.9 • -3.3 • -1.1 . 0 0 • -0.1 • -1.2 • -3.4 • -4.6 • -4.7 e. 0 0.3 ¢ ⊲i 8.8 9 . 0 6 0. 0 Ś. -2.6 • -1.9 • -1.4 • -0.4 • 0 • -0.1 • 0.3 • -0.4 • -1.4 • -2.2 • -2.8 • -0.4 9. S. 8 0 0 2 • -1.0 • -0.6 • -0.2 • 0 • -0.1 • 0 • -0.1 • -0.5 • -1.0 -1.4 • -1.7 • -0.7 О1 2.6 5 0.7 0 0 0.6 0 • -0.9 • -0.5 • -0.1 • 0 • 0.1 • 0 • -0.2 • -0.3 • 0.1 • -0.8 • -0.8 • FIG. A-133 PERCENT ELONGATIÓN PLATE Q-22XD (I-INCH GRID) "Q" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 62.2 KSI TEMPERATURE 32°F 82 % SHEAR

DWG. 44E189

· -0.5 · -0.4 · 0.1 • 0.1 • O · -0.3 · -0.2 · -0.7 · · -0.4 · 0 0 0 0 ò 0 0 ◦ - 0.9 • - 0.8 · -0.4 · -0.5 0.1 . 04 • -0.1 • -0.3 • 0 ~ • -0.7 • -0.9 • Ö Ø 0 ò Ø. ٩j • -1.1 • -1.1 •-0.8 •-0.5 •-0.2 • 0 •-0.3 •-1.3 •-1.0 •-1.0 •-1.0 6 • -0.7 • -1.0 0 -1.5 0-12 o - 0.4 · -0.1 · -0.2 0 -1.0 0 -1.6 0 -14 • -0.9 5 9 0 Q • -1.2 • -1.2 • -1.2 • -2.4 • -0.4 • -0.1 • -0.1 • -2.2 • -1.0 • - 0.8 • - 0.4 S. -1.3 •-0.7 •-0.9 •-2.4 •-0.3 • 0.3 • 0.1 • -2.5 • -0.5 • -0.9 • -0.6 Ó m • -0.8 • -1.0 -1.3 -1.0 0 0-0.3 0-0.2 0-0.9 0-1.5 0-0.6 0-0.8 0 6 0 Qj. Ö Ø, · -0.5 · -1.2 • -0.9 • -0.2 • O • 0.3 • -0.9 • -0.3 • -1.3 • -1.9 • -0.9 Q 0 0 • -0.3 • 0 0 0 • -0.9 • -0.2 • -0.3 • O • O.I 1.5 0 • -0.3 • 0.2 • -0.1 • -0.1 • -0.6 O. ø • -0.4 • -0.3 • -0.1 • -0.3 • 0 • 0 FIG. A-134 PERCENT ELONGATION PLATE Q-31XD(1-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 62.2 KSI TEMPERATURE (-21)-(-20) °F. 0% SHEAR

DWG. 44E232

0 - 0, 4	o -0.3	o <i>-0.1</i>	o <i>0.2</i>	o - <i>0.3</i>	o <i>-0.</i> /	o - <i>0.2</i>	o <i>-0.1</i>	o <i>0.1</i>	o <i>0</i>	o <i>0.8</i>	0
0.7	0.7	01	0	0	0	0.1	- 0.3	E-0.	0.2	0.3	0.9
o <i>-0.5</i>	• <i>0</i>	• - <i>0.4</i>	° 0.3	• <i>0</i>	0 <i>0.2</i>	0 <i>0.2</i>	° -0.5	• - <i>0.5</i>	o -1.1	° -0.5	٥
4	10	1.5	0.8	0	0.1	0.2	01	0.1	9.0	1.0	1.3
o - <i>0.6</i>	o - <i>0.7</i>	o - <i>0.3</i>	o <i>-0.2</i>	° 0.2	o <i>0.1</i>	° 0.1	• <i>-0.5</i>	o <i>-0.4</i>	• - <i>0.6</i>	0 <i>-0.7</i>	0
5.1	<u>6.0</u>	4	0.5	0.1	0.1	0.1	0	0.6	1.5	1.2	E'/
0 <i>-0.6</i>	o <i>-1.0</i>	o - <i>1.3</i>	o <i>0.4</i>	o <i>0.2</i>	o <i>-0.1</i>	0 - <i>0.4</i>	o <i>-0.2</i>	• -0.8	o <i>-0.</i> 7	o <i>-0.4</i>	o
0.8	1.2	~ ` `	2:2	0.6	0.1	õ	0.1	55	17	2	0.8
o <i>-0.2</i>	o <i>-0.6</i>	° -0.7	° - 1.6	0 <i>0.2</i>	o <i>0.1</i>	° -0.5	• <i>-1.5</i>	0 <i>-07</i>	0 - 1.0	0 - <i>0.</i> 4	o
ю м	- <del>2</del>	- 4	- <u>~</u>			)	- <u>₩</u>	-∽ ∽	· ;;		3.8
o - <i>0.3</i>	o -0.1	o - <i>0.7</i>	o -1.6	o 0	o <i>-0.1</i>	o 0.1	o <i>- 1.</i> 7	o <i>-0.</i> 7	o -0.5	o -0.1	0
0.6	1.2	4	с. С	8	0	0.1	0.3	5.3	1.8	0.8	0.5
0 - 0.1	o - <i>0.5</i>	0 -0.8	0 -0.5	o <i>0.4</i>	o <i>0.4</i>	0 0	0 - 0. <b>2</b>	o -1.0	o -03	o - <i>0.2</i>	0
17	0.0	5	<b>6</b> .0	20	<b>6</b> .0	0.	10	6.0	9.1	21	*!
o -0.5	o - <i>0.6</i>	o - <i>0.5</i>	0 -0.1	0 -0.1	0 0	• <i>0.4</i>	• <i>0</i>	o <i>~0.8</i>	0 - 0.9	0 - <i>0.9</i>	0
17	17	9	0.1	0.8	0	0.1	0.4	0.6	<b>8</b> .	1.3	0.7
o <i>-0.5</i>	o <i>-0.5</i>	0 0.1	o <i>0.4</i>	0 <i>-2.2</i>	• <i>0</i>	0 <i>0.2</i>	۰ ٥ <i>٥</i> . <i>६</i>	• • - 0.4	0 - 0.5	0 - 1.0	0
6.0	0.5	0.5	<b>0</b>	0.2 0	0	0.0	0.5	11	0.5	0.6	1.2
o <i>-0.2</i>	o - <i>Q2</i>	o - <i>0.2</i>	, 0 - <i>0.2</i>	, o -0.1	, 0	• <i>0.3</i>	·o 0.1	и о <i>О.1</i>	1 0 - 0.1	o -0.4	0
Fl	'G. A-13	5 PER	CENT	ELONO	GATION	' PLA	ATE Q	32XD (I	-INCH G	GRID )	
	"Q" 51	EEL, 12-	INCH W	IDE PL.	47E	NOMINI	AL STR	ENGTH	59.7 KS	7	
	TEM	PERATUR	E (-51)-(	(-50) °F	-			0% 5	SHEAR		
										4	

DWG. 44E250

0-2.3 0 -1.9 0 -1.3 0 -2.2 0 0 0 -0.1 0 -0.1 0 -0.3 0 -1.4 0 -2.1 0 -2.4 0 b **N**I 6 Q1 0 0 0 5 n, Q. o -2.8 o -3.4 o -3.0 o -1,1 o 0 o 0 o -0.1 o -1.2 o -3.2 o -3.4 o -2.8 o 0 2 m) m Ŋ 6 4 4.1 0 ø, 0 ø Ø 0-21 0-24 0-41 0-44 0-03 0-02 0 0 0-47 0-41 0-25 0-22 0 Ka 0-<u>~~~</u> <u>N</u>-8 0 00 Q1 6 2 5 0. N. 0 S. Ø 5 . N. ŝ N o -3.0 o -1.4 o 0 o 0 o -0.3 o -1.5 o -2.8 o -3.3 o -2.6 o o -2.6 o Ø 0 ŝ 00 5 m 0 0 0 0 0 4 10 4 ۹i. Ni S. o -2.3 o -2.0 o -1.5 o -0.4 o 0.1 o -0.2 o 0 o -0.6 o -1.6 o -2.0 o -2.4 o 0.2 5 2 5 0 0 0 ħ ٩i N. 0 ħ o -1.4 o -1.0 o -0.4 o -0.1 o 0 o -0.2 o -0.1 o 0.1 o -0.6 o -1.2 o -1.6 o Ø 0 0 0 0 · 0 0 0 ٩j o-0.7 o-0.3 o 0.1 o 0 o-0.1 o 0 o 0 o 0.1 o-0.1 o-0.6 o-1.1 FIG. A-136 PERCENT ELONGATION PLATE Q-ISD ( 1-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 69.0 KSI

o-0.8 o -0.2 o 0.1 o-0.1 o -0.1 o 0 o 0 o 0

0

0

0

¢.

5

0 0

0

0

o\_14 0\_10 0\_02 0\_01 0\_01 0 0 0\_01 0 0 0\_03 0\_10 0\_15 0-

0

0

. 6

TEMPERATURE (-1)-(1) °F.

IB % SHEAR

DWG. 44E240

FIG. A-136

149

NS.

ŝ

Qu

Ś

m

5

0 0 0 - 0.1 0 - 0.3 0

5

Ø

9

0

o'

• -0.9 • -0.5 • 0.1 • 0.2 • 0.1 • 0.0 • 0.0 • 0.1 • 0.1 • -0.5 • -0.9 • Q<sub>1</sub> m 0 \$ m 0 Ś 0 0 0 Q. m • -1.3 • -1.2 • -0.8 • 0.2 • 0.0 • 0.2 • 0.2 • 0.1 • -0.6 • -1.1 • -1.5 • 90 ŝ 5 2 ٩u \$ 9 -5 m. Q, Ø, 0 Ó Ś m 5 • -3.1 • -2.3 • -1.5 • -0.9 • 0.2 • 0.2 • 0.0 • -0.7 • -1.5 • -2.3 • -2.9 • 2 2 ŝ 0 ŝ ŝ o, R. ŝ o. 0 0 m N 0 Ś Q. 0 • -5.4 • -4.4 • -3.6 • -1.8 • -0.2 • -0.1 • -0.4 • -1.6 • -3.3 • -4.6 • -5.3 • 5 9 5 5 Q. 0 g) 0 2 9 Q. 0 m. 2 8 • ~5.9 • =6.9 • =6.1 • =5.1. • =0.3 • =0.9 • =0.6 • =4.9 • =6.5 • =7.5 • =9.1 • m ₹ 35. ~ %\_ 8 ∿ ---<del>~</del> ે.– • -7.4 • -7.3 • -6.0 • -4.8 • -0.8 • -0.7 • -0.8 • -4.7 • -5.6 • -6.2 • -8.2 • 90 0 0 ø 90 0 0 Ś 8 5 4 5 0 0 2 0 00 5 • ~ 5.4 • - 4.4 • - 3.5 • - 1.9 • - 0.4 • - 0.4 • - 0.4 • - 1.7 • - 3.3 • - 4.1 • - 4.8 • 5 **Q**1 ŀŋ. 7.0 47 2 N 0 0 Ś Ó. Ö ίΩ. • - 3.1 • - 2.2 • - 1.5 • - 0.7 • - 0.3 • - 0.4 • - 0.2 • - 0.7 • - 1.6 • - 2.4 • - 2.8 • m m 0 Ś 0 0.7 0 0.1 n. ₩j. مi ا Ó Ø. 0 m 0 Q. ທີ • -1.5 • -0.8 • -0.5 • 0.0 • 0.1 • -0.2 • 0.0 • 0.1 • -0.6 • -1.1 • -1.8 • 0 90 Ø 0 Ο 0 m, 00 σ . 0 0 mj 0 0 0 0 0 Ø. • -0.8 • -0.4 • 0.2 • 0.0 • 0.1 • 0.1 • 0.0 • 0.1 • 0.1 • -0.4 • -0.8 • FIG. A-137 PERCENT ELONGATION PLATE Q-2SD (I-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 66.8KSI TEMPERATURE 31-34 °F 89% SHEAR

120

DWG. 44E241

· ~0.8 · ~0.5 · ~0.2 · ~0.2 · 0.0 · 0.2 · 0.1 · 0.0 · 0.0 · -0.8 · -1.0 · Qu 9 Ø. ø. Ø, Ø. • - 1.7 • - 1.0 • - 0.7 • - 0.1 • 0.2 • - 0.2 • - 0.1 • 0.9 • - 0.6 • - 0.9 • - 1.6 • 0 0 ŝ ø 0 Ø. N Ó. Ø Ø 0 Ś Ś • -2.7 • -2.2 • -1.3 • -0.4 • -0.4 • 0.1 • -0.6 • 0.4 • -1.6 • -2.4 • -2.9 • 0 Ň Ś 0 0 0 o' m • -4.3 • -3.9 • -3.4 • -2.2 • -1.1 • -0.2 • -1.0 • -2.1 • -3.5 • -4.1 • -4.8 • m 0 ŝ 5 б. Ň ŋ 2 o. 0 • -6.6 • -5.4 • -4.9 • -4.5 • -0.5 • -1.0 • -1.1 • -5.1 • -5.5 • -5.9 • -7.3 • <u>0</u> 36 5 é. • -12.3 • -6.8 • -7.5 • -5.4 • -0.4 • -0.7 • -11.7 • -5.8 • -8.7 • -8.6 • -8.8 • Ð 10.0 5 4 .6 4 2 2 2 ò • ~6.5 • ~5.7 • ~4.2 • ~1.6 • ~0.2 • 0.2 • ~0.7 • ~1.6 • ~4.3 • ~5.6 • ~6.5 0 9 11.7 6 Ś 7.8 0 0 o' • -3.6 • -2.8 • -0.6 • -0.2 • -0.6 • -0.3 • 0.1 • -6.5 • -1.6 • -2.8 • -3.5 • Ó 9 0 6 ٩ì 0 ò. ò Ó • -1.9 • -1.2 • -0.2 • 0.0 • 0.3 • -0.1 • 0.1 • 0.0 • -0.6 • -1.3 • -2.0 • 6 ₹ Nj 0 0 0 Q, m • -1.1 • -0.1 • 0.3 • -0.1 • 0.0 • 0.0 • -0.6 • -1.0 • · 0.0 • 0.1 FIG. A-138 PERCENT ELONGATION PLATE Q-3SD (1-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 66.8 KSI TEMPERATURE 63-65 % 100% SHEAR

DWG. 44E238

0 Q1 0 m, ŝ 0 0 0 Q. Ø, 0 • -1.2 • -1.0 • -0.1 • 0.0 • 0.0 • 0.0 • 0.0 • 0.0 • -0.1 • -0.5 • -1.0 • 0 ŝ 5 \$ 0 О Qj. 0 Ó. ٩j 0 • -1.3 • -1.4 • -1.2 • -0.1 • -0.1 • -0.1 • 0.0 • 0.0 • -1.2 • -0.8 • -1.1 • m) ŝ 0 0 0 ٩i ۳ŋ' ٩j 0 0 0 2 ٩j N. 0 •-1.2 •-1.4 •-1.8 •-1.5 • 0.0 • 0.0 • 0.1 •-1.3 •-1.7 •-1.4 •-1.0 • 9 0 6 5 2 Q. 0 N) 4 0 2 2 ◦ -1.2 ◦ -1.1 ◦ -1.5 ◦ -3.3 ◦ 0.0 ◦ -0.2 ◦ -0.1 ◦ -3.4 ◦ -1.3 ◦ -0.9 ◦ -0.7 ◦ • -0.9 • -0.9 • -1.3 • -2.9 • -0.2 • 0.0 • -0.4 • -3.2 • -1.0 • -1.0 • -0.8 ŝ 2 0 m, Ò m, ~ Q. Q. o. 4 • -1.0 • -1.8 • -1.9 • -1.1 • -0.1 • 0.2 • -0.3 • -1.4 • -2.2 • -1.4 • -1.1 ٩u 5 5 2 0 0 0 õ ٩ì QÚ. \$ • -1.2 • -1.2 • -1.0 • -0.3 • -0.1 • 0.0 • -0.8 • 0.0 • -1.1 • -1.8 • -1.0 • Q. Q. Ŋ 0 2 0 m Ø Q. O. • -1.1 • -0.6 • 0.0 • -0.1 • -0.4 • 0.2 • -0.8 • -0.2 • 0.1 • -0.9 • -0.9 • 0 0 0 9 0 0.1 0 0 0 O. õ 0 Ó. Ó. 0 • -0.6 • 0.0 • 0.0 • -0.1 • -0.1 • -0.1 • -0.1 • -0.1 • 0.0 • 0.0 • -0.5 • FIG.A-139 PERCENT ELONGATION PLATE Q-4SD (I-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 68.6KSI TEMPERATURE (- 30)-(-29) °F 0% SHEAR

• -0.7 • -0.2 • -0.1 • -0.1 • -0.2 • -0.1 • 0.0 • 0.0 • 0.0 • 0.0 • -0.6 •

•-0.7 • -0.1 • -0.1 • 0.1 • 0 • 0.1 • 0.1 • 0.1 • 0.1 • 0.1 • 0.1 5 0  $\mathcal{O}$ 0 0 0 0 2 Ó ŝ •-1.0 •-0.8 •-0.2 • 0.1 • 0 •-0.1 • 0.1 •-0.4 •-0.2 •-1.4 •-1.2 ŝ 9 2 9 00 2 0 5 0 0 0 Ŵ. 0 0 Qj. • -1.0 • -0.8 • -1.2 • -0.1 • -0.2 • 0 • -0.1 • -0.3 • -1.1 • -1.0 • -1.3 • Ś 0.2 5 23 2 0 Qu. 0 0 5 S, Ó. **N**i -0 01 Q. SV. Ni -• -1.0 • -1.3 • -1.9 • -1.3 • -0.1 • 0.2 • -0.2 • -1.4 • -1.9 • -1.7 • -1.0 • 2 Ø 2 4 5 1.7 0 4 0 Ø Ò. 4 Qj. Qj -Ni m) ħý. • -1.2 • -1.1 • -1.3 • -3.1 • -0.3 • -0.1 • 0 • -3.5 • -1.4 • -1.3 • -0.7 • 6 <u>ي</u>ن • -0.7 • -1.0 • -1.0 • -2.8 • -0.3 • 0 • -0.3 • -3.3 • -1.3 • -1.1 • -0.9 • .5 Ø 9 9 0.2 5 \$ 2 n, 0 0 Q. m, ٩j • -0.5 • -0.9 • -1.7 • -1.2 • -0.1 • 0 • -0.1 • -1.4 • -2.0 • -1.5 • -1.2 0  $\sim$ 6 m Qj. 0  $\sim$ 0 0 0 2 2 N. Qj. • -0.7 • -1.1 • -1.0 • -0.1 • -0.1 • 0 • -0.1 • -0.2 • -1.2 • -1.7 •.-1.8 • 5 0 5 0 • -0.6 • -0.5 • 0 • 0 • -0.1 • 0 • 0 • 0 • 0 • -0.3 • -0.4 • -1.5 Qu **Q**1 0 6 6 0 0 0 Ø. Q • -0.5 • 0 • 0 • -0.1 • -0.3 • 0 • -0.2 • -0.1 • -0.3 • -1.0 • 0 FIG. A-140 PERCENT ELONGATION PLATE Q-5SD (I-INCH GRID) "Q" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 66.7 KSI TEMPERATURE (-14)-(-13) °F 0 % SHEAR

4 2 3 -0.1 2 0 Ø 3 ŝ ġ. ٩ì 0 4 Ś o-3.0 o-3.3 o-2.9 o-1.4 o 0 o 0.2 o-0.6 o-1.8 o-3.5 o-3.1 o-6.0 o 0 ø 0.2 2.0 M σ 2 4 N σ 0 2 Ø 4 Ś.  $\mathbf{N}$ 6 οġ. ŝ 0-2.0 0 -2.5 0 -4.1 0 -4.5 0 -0.2 0 -0.4 0 -0.4 0 -5.2 0 -3.9 0 -2.2 0 -1.9 0 8 Ni -9 9 · -2.4 · -2.5 · -4.5 · -4.6 · -0.3 · -1.2 · -0.8 · -5.3 · -4.3 · -2.8 · -2.4 · ŝ, Ø Ω. 0 N Ø ø 2 0 0 Ŋ 6 00 ΦÓ N. N Ś •-2.8 •-3.5 •-3.4 •-2.0 •-0.7 • 0 •-0.7 •-2.0 •-3.6 •-3.7 •-2.8 • 9 ø 90 5 2 N ø 0 6 0 40 4 0 m' ∿. •-3.3 •-3.4 •-2.5 •-1.4 •-0.6 •-0.5 •-0.7 •-1.5 •-2.6 •-2.5 •-3.3 • 0 2 \$ 0 40 6 0 Q. Ö. Ö. Ó. mj. Q. ◦-1.9 ◦-0.8 ◦-0.5 ◦ 0.1 ◦ 0.1 ◦-0.1 ◦0.1 ◦-0.4 ◦-0.7 ◦-1.2 ◦-1.5 ◦ 5 Ι. θ Ø 0.4 m 0 0 0 Ó Ø. ó N. • -0.8 • -0.7 • -0.1 • 0 • 0 • 0 • 0 • -0.1 • 0 • 0 • -0.8 • -1.2 •

• -0.5 • -0.1 • 0.2 • 0 • 0.3 • 0 • -0.1 • -0.1 • -0.4 • -0.4 • -1.4 •

•-1.6 •-0.8 •-0.3 •-0.1 • 0 • 0 •-0.1 • 0.1 •-0.8 •-1.4 •-1.8 •

o-2.5 o -1.9 o -1.3 o -0.6 o 0.1 o 0.1 o 0.2 o -0.9 o -1.4 o -2.3 o -2.8 o

0

0

0

0

0

0

0

1.0

FIG. A-141 PERCENT ELONGATION PLATE Q-6SD (I-INCH GRID)

"Q" STEEL, I2-INCH WIDE PLATE NOMINAL STRENGTH 69.3 KSI

TEMPERATURE 15 °F.

19 % SHEAR

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DWG. 44E244

FIG. A-141

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N

m

2

Q.

4

9

m

4

5

m

0-1.5 0-1.1 0-0.3 0-0.3 0-0.2 0-0.4 0-0.3 0-0.3 0-0.6 0-0.9 0-1.0 0 9 <u>v</u> 9.0 6 8.0 Q. <u>.</u> 2 5 0-1.4 0-1.2 0-0.9 0-0.5 0-0.5 0-0.4 0-0.9 0-1.3 0-1.2 0-1.2 0-1.2 0 0.5 0 0 9 4 0.4 Ņ N N 2 2.6 0-1.5 0-1.6 0-1.6 0-1.1 0-0.3 0-0.1 0-0.4 0-1.1 0-1.6 0-1.6 0-1.5 0 2 8 2.8 4 36 9 6 0 7 1 3.6 0 - 1.4 0 - 1.7 0 - 2.2 0 - 1.7 0 - 0.8 0 - 0.1 0 - 0.7 0 - 1.8 0 - 2.4 0 - 1.8 0 - 1.3 0 2.9 0.5 5 4 **N** 4 4 50 4 0 -1.1 0 -1.1 0 -1.4 0 -3.4 0 -0.5 0 -1.5 0 -0.5 0 -3.9 0 -1.6 0 -1.3 0 -1.4 0 0 -1.1 0 -1.2 0 -1.4 0 -3.6 0 -0.6 0 -1.2 0 -0.6 0 -3.9 0 -1.6 0 -1.3 0 -1.2 0 2.9 5.4 6.2 50 4 0.0 N. I 0 -1.3 0 -1.7 0 -2.3 0 -1.9 0 -0.7 0 0 -0.7 0 -1.7 0 -2.6 0 -2.0 0 -1.4 0 3.0 N. A 10 Å. R. 0 4 8 3.8 N.  $\circ -1.4 \circ -1.7 \circ -1.6 \circ -1.2 \circ -0.2 \circ -0.1 \circ -0.2 \circ -1.0 \circ -1.7 \circ -1.8 \circ -1.8 \circ -1.7 \circ -1.8 \circ -1.8 \circ -1.7 \circ -1.8$ ~ ~ ~ 4 ~ N O 0.3 0.8 0.3 2 8.4 0 - 1.4 0 - 1.2 0 - 1.0 0 - 0.6 0 - 0.2 0 - 0.2 0 - 0.4 0 - 0.6 0 - 1.2 0 - 1.3 0 - 1.5 0 0.7 0.7 0.7 50 0.0 à 9 0 1.2 9 0 -1.1 0 -0.9 0 -0.6 0 -0.4 0 -0.4 0 -0.4 0 -0.4 0 -0.5 0 -0.7 0 -1.0 0 -1.1 0 FIG. A-142 PERCENT ELONGATION PLATE H-1D (1-INCH GRID)

"H" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 53.3 KSI TEMPERATURE (-1)-(2)°F 0 % SHEAR

DWG. 44E198

···/.3 ···0.9 · ·0.6 ···0.3 · ·0.3 · ·0.3 · ·0.3 · ·0.2 · ·0.8 · ·/.0 · ·/.4 · 0.6 ~ Ø 6 0 0 ۹. Q. 0 th) 0 •-1.9 •-1.4 •-1.2 •-0.6 •-0.2 •-0.1 •-0.2 •-0.6 •-1.3 •-1.6 •-2.0 • 3 8 0 0) 9 Ó. Ń. 5 Ó. Q. 0 • - 2.9 • - 2.3 • - 1.7 • - 0.9 • - 0.3 • 0.1 • - 0.4 • - 1.2 • - 1.9 • - 2.5 • - 3.2 • ŝ 4 0 ю. Ø, ١Ġ. • -4.8 • -4.2 • -3.0 • -1.6 • -0.6 • 0.1 • -0.8 • -2.0 • 3.9 • -4.6 • -5.2 • 2 6 Ø 0 0 6 5 0 0 Q. ð ° -9.0 ° -7.0 ° -5.7 ° -4.5 ° -0.7 ° -1.6 ° -0.6 ° -5.3 ° -6.3 ° -7.0 ° -8.1 ° -( • -9.0 • -7.4 • -6.4 • -4.9 • -1.2 • -2.1 • -0.6 • -4.5 • -5.9 • -7.0 • -8.3 • ŋ 5 9 ¢0 5 ŝ 5 N 4 o. ŝ ٩j 0 Ø, ° ~ 5.4 ° - 4.9 ° - 3.7 ° - 2.0 ° - 0.7 ° 0.0 ° - 0.7 ° - 1.7 ° - 3.5 ° - 4.6 ° - 5.3 ° 5 ø N ò 0 5 m ŋ 9 5 N. ◦ -3.3 ◦ -2.7 ◦ -2.0 ◦ -1.3 ◦ -0.2 ◦ -0.5 ◦ -0.3 ◦ -1.0 ◦ -1.9 ◦ -2.4 ◦ -3.1 ◦ Ø, 9 9 9 9 0 o. m 0 o' 2 • -2.0 • -1.5 • -1.2 • -0.6 • -0.2 • 0.0 • 0.0 • -0.5 • -1.0 • -2.0 • -1.8 • 6 5 5 5 0 Qu 9 N ŋ 2 mi Q. ~ o' 0 0 0 N. 0 ŋ • -1.3 • -1.1 • -0.7 • -0.5 • -0.4 • -0.4 • -0.5 • -0.6 • -0.7 • -1.2 • -1.3 • FIG.A-143 PERCENT ELONGATION PLATE H-2D (I-INCH GRID.)

"H" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 53.2 KSI. TEMPERATURE 23°-27° F. 74% SHEAR

FIG.A-143

0 - 2.1 0 - 1.5 0 - 1.1 0 - 0.6 0 - 0.6 0 - 0.3 0 - 0.4 0 - 0.6 0 - 0.1 0 - 1.6 0 - 1.9 0 9.6 0 0 2.0 m 0 ٩. o -3.0 o -2.6 o -2.0 o -1.4 o -0.4 o -0.1 o -0.4 o -1.4 o -2.1 o -2.7 o -3.5 o 7.0 Q,  $\mathbf{\tilde{k}}$ 8 5 œ, õ Ś. • -3.7 • -4.2 • -3.9 • -2.2 • -0.9 • 0.1 • -0.7 • -1.9 • -3.8 • -4.9 • -5.2 • 50 0 <u>b</u> 2 1 6 oj. <u>B</u> 0 -6.7 0 -5.7 0 -5.4 0 -5.2 0 -0.8 0 -1.9 0 -0.7 0 -5.5 0 -6.1 0 -7.0 0 -8.5 0 શું ř. <u>,</u>₩00 – 32 0 - 4.7 0 - 7.5 0 - 8.9 0 - 6.0 0 - 0.7 0 - 1.7 0 - 0.8 0 - 5.1 0 - 6.3 0 - 7.7 0 - 10.0 0 0 0 91 0.6 Ø ØD, 25.2 S, Q શં 5 2 mj. 2 o' 0 -7.1 0 -6.5 0 -4.7 0 -2.2 0 -0.9 0 -0.1 0 -0.5 0 -2.4 0 -3.6 0 -4.7 0 -5.5 0 3.6 9 20 5 õ чó. n. 5 a -4.2 a -3.0 a -2.1 a -1.4 a -0.5 a -0.1 a -0.3 a -1.5 a -2.0 a -2.7 a -3.2 a 0.5 0.3 D. 3 8 R 2 eri. 5 ۱Ġ 6. 0 -2.3 0 -1.8 0 -1.2 0 -0.8 0 -0.5 0 -0.6 0 -0.4 0 -0.9 0 -1.3 0 -1.5 0 -2.1 0 3 50 ñ 9 Š. Ö 0 In. o -1.5 o -1.5 o -0.7 o -0.6 o ~0.6 o -0.6 o -0.5 o -0.5 o -0.8 o -1.1 o -1.2 o FIG. A-144 PERCENT ELONGATION PLATE H-3D (1-INCH GRID) "B" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 53.4 KSI

0 -1.3 0 -1.1 0 -0.8 0 -0.3 0 -0.6 0 -0.5 0 -0.2 0 -1.1 0 -1.0 0 -1.1 0 -1.4 0

6

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0

**X** 

TEMPERATURE 40-43 F. 66 % SHEAR

DWG. 44E201

0

FIG. A-144

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Ë.

•-0.9 •-0.8 •-0.6 •-0.5 •-0.1 • 0.1 •-0.3 • 0.4 •-0.4 •-1.0 •-2.0 • 0 Г. Э 6.1 0 9 2 8 00 N . ₩) 0 0 S. 0 0 2 ~ 0 • -1.7 • -1.4 • -1.1 • -0.4 • 0.0 • 0.3 • 0.2 • -1.0 • -0.7 • -1.5 • -2.3 • Ø m. 0 ŝ m. 4 0 0 4 N) N) 0 Qj -5 ۰. **N** 0 • -3.3 • -2.4 • -1.9 • -0.7 • -0.9 • 0.1 • 0.0 • • • • 5 m, 5 5 Ś 2 9 0 9 5 0 ŝ m) Q ŝ 00 0 0 • -5.6 • -4.4 • -3.7 • -1.9 • -0.7 • 0.2 • -0.5 • -1.7 • -4.6 • -7.0 • -7.9 • ĸ ٩D, m 5 9 ~ Ν. ŝ 20. N. 2 0 5 0 0 9 m, + -7.0 + -7.3 + 5 \* 0 ŝ 0 -----2 N. • -8.1 • -6.4 • -5.8 • -4.8 • -0.8 • -1.3 • -0.7 • -4.3 • -5.1 • -5.4 • -6.2 σ ŝ ŝ 2 2 4 5 4 4 4 o. <u>~</u> Ň 9 6 4 9 r, 0 2 • - 4,9 • - 4,3 • - 3,4 • - 1,6 • - 0,3 • 0,3 • - 0,7 • - 1,8 • - 3,3 • - 3,8 • - 4,0 • **N** N 0 9 6 4 3 4 N. o. 0 ò 5 0 N. 4 é) • - 3.3 • - 2.5 • "1.7 • -1.1 • - 0.2 • 0.0 • -0.1 • -0.9 • -1.4 • -2.3 • -2.3 • 'n, 9 5 Ø 6 ×. 0 ŋ 6.0 F. 6.0 9 ~ ŝ N -N. 4 4 9 é ~ •-1.9 •-1.6 •-1.1 •-0.5 • 0.0 •,-0.3 •-0.4 • 0.5 •-1.6 •-1.2 •-1.6 • 2 9 1.0 0.0 6 Ø 6 2 0 9 N 0 ~ • -/.6 • -0.9 • -0.3 • -0.6 • 0.0 • -0.1 • -0.6 • -0.2 • -0.9 • -0.6 \* -1.3 •

FIG. A-145 PERCENT ELONGATION PLATE H-4D (1-INCH GRID)

"H" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 52.7 K.S.I.

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b

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m,

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FIG. A-14

TEMPERATURE 60°-63° F.

92% SHEAR

DWG. 445202

◦ -0.8 ◦ -0.6 ◦ -0.4 ◦ -0.1 ◦ -0.1 ◦ -0.1 ◦ -0.1 ◦ -0.1 ◦ -0.5 ◦ -0.7 ◦ -0.8 ◦ 0 Ö. ġ ◦ -1.0 ◦ -0.9 ◦ -1.1 ◦ -0.3 ◦ -0.3 ◦ -0.1 ◦ 0 0 -0.3 0 -0.9 0 -1.0 0 -1.1 0 0 0 0 2 Q o. ◦ -1.3 ◦ -1.3 ◦ -1.4 ◦ -0.9 ◦ -0.2 ◦ -0.1 ◦ -0.1 ◦ -1.0 ◦ -1.3 ◦ -1.3 ◦ -1.3 ◦ N ŝ 0 ai 0-1.1 0-1.3 0-2.2 0-1.7 0-0.7 0-0.2 0-0.7 0-1.6 0-1.8 0-1.4 0-0.9 0 Ω. 0.8 Q. 9.6 0.2 Q. •-0.9 •-1.2 •-1.3 •-3.4 •-0.6 •-1.1 •-0.6 •-2.9 •-1.3 •-1.0 •-0.9 • Q. -( )----**≻**``;----≻°°° ---◦ -1.0 ◦ -1.0 ◦ -1.3 ◦ -3.1 ◦ -0.7 ◦ -1.0 ◦ -0.5 ◦ - 3.0 ◦ -1.2 ◦ -0.9 ◦ -1.1 ◦ ŝ Ċ. .0. 0 m ġ Qj. 0 -1.4 0 -1.9 0 -1.6 0 -0.6 0 -0.1 0 -0.6 0 -1.5 0 -1.7 0 -1.4 0 -1.2 0 0 -1.1 5 3.0 2 0 0 Q 9 ٩i من Q. ٩j • -1.4 • -1.4 • -1.3 • -0.8 • -0.1 • 0 • -0.1 • -0.9 • -1.2 • -1.3 • -1.3 • 2 0 0 o' Q. ○ -1.4 ○ -1.2 ○ -0.8 ○ -0.2 ○ O ○ O 0 -0.2 0 -0.4 0 -0.8 0 -1.1 0 -1.1 0 5 04 9 0 0 Qj -0 0 0 0 · -1.2 · -0.8 · -0.5 · -0.2 · -0.2 · -0.2 · -0.1 · -0.4 · -0.4 · -0.7 · -0.7 · FIG. A-146 PERCENT ELONGATION PLATE H-5D (1-INCH GRID) "H" STEEL, 12 INCH WIDE PLATE NOMINAL STRENGTH 51.9 KSI TEMPERATURE (-22 -(-20) °F 0 🗶 SHEAR

DWG. 44E233

o-1.5 o -1.1 o -0.8 o -0.3 o -0.4 o -0.5 o -0.4 o -0.3 o -0.7 o -1.1 o -1.3 o 0 5 ŝ 90 Qj 10 0 6.0 9.0 4 6 • -2.0 • -1.6 • -1.2 • -0.7 • -0.3 • -0.1 • -0.5 • -0.7 • -1.4 • -1.1 • -2.1 • 0.3 0 0.3 2.0 ĥ. 2 ŝ 0 o -2.9 o -2.5 o -2.0 o -1.3 o -0.4 o -0.1 o -0.3 o -1.0 o -2.0 o -2.6 o -3.0 o 8.6 5 3 0.7 1.6 N. 60 20 0 0-44 0-41 0-3.5 0-18 0-0.8 0 0 0-0.9 0-2.0 0-3.4 0-4.6 0-51 0 1.9 11.5 8.9 8.7 0.5 0.5 3.2 9.9 11.9 õ 3.4 1 0 - 5.6 0 - 5.5 0 - 5.1 0 - 4.7 0 - 0.7 0 - 1.8 0 - 0.7 0 - 5.3 0 - 6.1 0 - 6.6 0 - 5.1 0 35 2 0 5 Ő. 8 0-3.9 0-4.3 0 0-6.1 0-0.7 0-22 0-0.8 0-5.0 0-6.1 0-7.2 0-5.7 0 3.3 0.7 6.6 83 0 0 4 10 5 • - 5.9 • - 6.3 • -4.5 • - 2.1 • - 0.9 • + 0.1 • - 0.8 • - 2.0 • - 3.6 • - 4.8 • - 5.6 • 3.8 36 1.8 1.4 5.2 2 0 0 1.6 8 2.0 0 o -4.0 o -3.2 o -2.2 o -1.5 o -0.2 o 0 o -0.5 o -1.1 o -2.0 o -2.7 o -3.3 o 5.3 3.6 0.8 0.8 8 5 2 à 6 0 - 2.3 0 - 1.6 0 - 1.3 0 - 0.8 0 - 0.3 0 - 0.2 0 - 0.2 0 - 0.9 0 - 1.1 0 - 1.6 0 - 2.1 0 40 0.8 1.6 Ø 0.8 Đ m. 0.9 2 2 Ö Ś mj. o - 1.6 o - 1.2 o - 0.8 o - 0.5 o - 0.3 o - 0.3 o 0 o - 0.4 o - 0.7 o - 1.1 o - 1.4 o FIG. A-147 PERCENT ELONGATION PLATE H-6D (1-INCH GRID) "H" STEEL, 12 - INCH WIDE PLATE NOMINAL STRENGTH 55.0 KSI TEMPERATURE 10-13 °F 44 % SHEAR

0.3 2 8 0.0 9.3 4 5 5./ 17 m Ś · -2.1 · -1.3 · -1.2 · -0.6 · -0.1 · 0 · -0.1 · -0.3 · -1.3 · -1.4 · -2.0 · 0.3 0.3 6 0.8 3.0 4.6 9.9 5 κ. 2 e. 3 • -3.4 • -2.3 • -1.7 • -1.2 • -0.2 • 0.3 • -0.1 • -1.3 • -2.0 • -2.8 • -3.5 • 4.6 9 3.6 0 Q 0 Ś o -5.7 o -4.7 o -3.4 o -2.1 o -0.7 o 0 o -0.5 o -2.2 o -3.5 o -4.5 o -5.4 o 5 0 6.6 17.9 9.9 Ò 4 4 2 õ 4 ÷, • -8.8 • -6.9 • -6.0 • -5.0 • 0 • -1.5 • -0.1 • -5.3 • -6.1 • -7.1 • -8.9 • ÷2-33.0 —<u>→</u>% — ---+<u>6</u>\_----• -8.9 • -7.9 • -6.7 • -5.2 • -1.4 • -1.5 • -1.0 • -4.1 • -5.4 • -6.2 v • -8.1 • 12.6 b) 6.4 9.8 ŋ 8.4 15. 0 9 2 5 0 Ś Q. • -5.6 • -4.9 • -3.1 • -1.6 • -0.5 • 0.1 • -0.8 • -1.8 • -3.0 • -4.1 • -5.0 • Ś 5 5.4 7.5 0.4 6.9 3 0 Ö 4 5 ĥ 6 • -3.1 • -2.6 • -1.6 • -1.2 • -0.1 • 0.1 • 0.1 • -1.0 • -1.9 • -2.1 • -3.0 • Ø 0.6 5.6 5.8 8 6.) 4 0 0 0 m αi • -1.9 • -1.2 • -1.3 • -0.2 • 0 • -0.1 • 0.2 • -0.7 • -0.7 • -1.5 • -1.6 • 0.6 0.0 9 0.7 0. 0.0 2 9 ŝ 1.8 0 • -1.4 • -0.8 • -0.7 • -0.4 • -0.1 • -0.1 • -0.6 • -0.3 • -0.6 • -1.2 • -1.1 • FIG. A-148 PERCENT ELONGATION PLATE H-7D (I-INCH GRID) "H" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 52.6 KSI 100% SHEAR TEMPERATURE 98 ° F

• -0.8 • -1.1 • -0.6 • -0.4 • -0.2 • -0.2 • -0.2 • -0.5 • -0.6 • -1.4 • -1.0 •

DWG. 44E237

		*	ø	<b>3</b> .9	•	4.2	•	<b>4</b> .2	٥	3.5	0	6.4	•	<b>3</b> .6	0	4.1	٥	4.3	٥	3.4	۰
		-16.	-1.4		-1.9		-2.0		-1.7		-1.6	Î	-1.6		-21		- 2.2		- 1.9		-0.7
	Ŧ.		o .	2.9	0	4.0	•	4.8	۰	4.4	٥	8.6	e	4.4	0	4.6	Q	3.6	o	2.8	o
ы	=	149	- 1.4		-1.6		- 2.0		- 2.5		-1.5	Î	-1.6		-2.7		- 24		- /.S		-1.1
EMP	STEL		0	2.3	ο.	3.2	0	5.0	0	5.8	o	7.6	٥	5.6	0	4.6	0	3.0	o	2.0	۰
ERAI	52, 12	ŒR	- O. 8		- 1.5		- 2.1		- 3, 2		-2.5	Ì	- 22		- 3. 2		-2.0		- J. <b>3</b>		- 0, 8
URE	<u>ē</u> -M	SEI	o	1.3	0	2.2	o	<b>3</b> .5	٥	7.5	•	11.0	0	7.6	0	3.6	٥	2.1	٥	1.4	٥
i,	NCH	57	-0.8		-10		-1.3		-21		-4.6	t	- 5.1		-2.0		-10		- 0, 8		- 0,6
6	WID	ELL	o	1.1	0	1.0	o	I. 6	0	2.9	0	62	٥	3.0	0	1. <b>6</b>	o	0.9	0	0.9	0
لر ه	Ъ Р	ONG	-0.7		-0.2		-0.2		- 1.0		- 0.7		-0.7		- 1.0		-0.2		-0.4		- 0, 3
	AT	47.	0	1.0	0	0.9	c	0.3	٥	0.3	0	Y	۰	0.4	٩	0	٥	0.2	٩	0.9	٩
	ليرآ	NON	-0.8		-0.4		- O.3		0. ₽		- 1.5		-1.6		-0,4		-0.1		-0.2		-0.4
			0	0.9	0	0.3	o	0.1	0	0.6	۰	Υ	٥	0.3	۰	0	٥	0.3	o	0. <b>8</b>	•
		PLA	-0.4		0.2		-0.4		- 1.0		- 0.6		- 0. 8		0.5		-0.1		-0.3		-0.5
	<b>§</b>	TE	0	1.0	0	0.9	0	1. <b>6</b>	•	3.3	0	3.1	٥	3.0	٥	1. <b>6</b>	0	0.9	o	1.0	٥
	MINA	Ĭ	-0.6		-0.8		- /. <b>3</b>		- 2.1		-4.5		- 4.8		- 1.6		-1.0		-0.7		-0.6
Ś	Ś	1 Ch	o .	1.3	•	2.1	o	3.5	0	7.5	٥	10.6	0	7.4	٥	3.5	٥	2.0	o	1.2	•
% %	TREN	0	-0.4		- 1. 1		-1.7		-3/		- 1.8		-2.2		- 3./		-2.0		- 1.2		- 0, 8
ΉĘ	VGT.	(1-	o 2	2.0	•	3.1	0	4.7	0	5.4	o	7.1	٥	5.6	0	4.6	٥	2.8	o	<b>2</b> .3	0
48	H 57	INCH	- 1.2		-1.6		-2.1		- 27		-1.5		-1.7		-23		- 1.9		-1.2		- 1.0
	6 X	6	0 2	2.7	•	3.5	o	4.4	Ð	4.2	o	ў 5.9	0	4.3	o	4.4	0	3.6	0	2.7	o
	/S/	( מוי	-1.2		- 1.7		-20		-1.7		- 1.4		-20		- <i>1. 8</i>		-2.1		- 1.7		-1.6
			o 3	3.3	ο.	3.9	0	3.8	٥	3.1	0	<b>†</b> 5.2	•	3.7	0	4.0	0	4.0	0	3.5	0

Ą.

o-1.1 o-1.1 o-0.7 o-2.4 o-0.5 o 1.4 o-2.4 o 0.4 o-2.6 o 0.3 o-1.9 o 0 0 O, o-1.3 o-1.3 o-1.0 o -0.7 o -0.1 o -0.1 o-0.4 o -0.4 o -1.0 o -1.3 o -1.8 o Ś 2 0.6 9 8.0 3 2. Q. 0 0-0.2 0 0.0 0-0.1 0-0.9 0-1.8 0-1.6 0-1.4 0-1.5 0-1.9 0-1.5 0-1.1 0.0 2 ¢0 3.0 35 Ŷ 2 0. ٩. Ŋ. øj. ٩ċ ٩j o-1.3 o-1.5 o-2.2 o-1.5 o-0.7 o 0.0 o-0.7 o-1.6 o-2.1 o-1.7 o-1.4 S 3.6 ŝ 9 4 6 Ň ٥i Q. Ó Qi. m 0 o-1.1 o-1.0 o-1.4 o-3.4 o-0.7 o-1.1 o-0.6 o-3.7 o-1.4 o-1.0 o-1.1 0 - 7<del>4</del> ÷ 20 6 •-1.0 •-1.0 •-1.2 •-3.6 •-0.7 •-0.9 •-0.4 •-3.2 •-1.0 •-1.0 •-1.3 • 6 Q, m Ň o' o - 0.7 • 0.0 • - 0.4 o -1.7 . -1.9 o -1.5 a - 2.2 o - 1.5 0-1.7 0-1.2 0 0 - 1.2 n M n. Q. 0 m, ٩i •-1.4 •-1.6 •-1.6 •-1.2 • 0.0 • 0.2 •-0.5 •-1.0 •-1.5 •-1.6 •-1.5 • Q, 0 c, 0 o -0.8 o -1.4 o -1.0 o -0.4 o -0.1 o -0.1 o -0.2 o -0.5 o -0.9 o -0.9 o -1.3 0.8 6 õ <u>.</u> •-0.6 • 0.1 •-0.2 •-0.7 •-0.1 •-0.7 •-0.5 •-1.0 • ■ -0.7 ■ -0.9 ■ -0.4 FIG. A-150 PERCENT ELONGATION PLATE H-9D (1-INCH GRID) "H" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 53.0KSI TEMPERATURE (-/0)-(-//)\* F 0% SHEAR

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◦ -0.9 ◦ -0.9 ◦ -0.4 ◦ 0 ◦ -0.2 ◦ 0.4 ◦ 0 ◦ 0 ◦ -0.3 ◦ -1.3 ◦ -1.1 ◦ 1.6 -0.1 0.3 õ ŝ <u>.</u> 0 Q. · -1.0 · -1.2 · -0.7 · -0.3 · 0 · 0.1 · -0.1 · 0 · -0.1 · -0.2 · -1.4 · 9 Q. 0.0 5 8.2 1.3 Qi ¢, Q. 0 ° -1.3 ° -1.4 ° -1.3 ° -1.0 ° -0.2 ° 0.1 ° -0.1 ° -0.8 ° -0.3 ° -1.4 ° -1.3 ° 1.4 0.2 5 4.2 9 5.7 0. 2.1 Qj . mj -Qj -◦ -1.2 ◦ -1.5 ◦ -2.0 ◦ -1.3 ◦ -0.7 ◦ 0.1 ◦ -0.6 ◦ -0.6 ◦ -2.1 ◦ -1.5 ◦ -0.5 ◦ <u>6.0</u> 2.4 5.0 5.6 5 Ś m) Ó. ٩j Ø. m o - 1.1 o - 1.1 o - 1.3 o - 3.1 o - 0.5 o - 1.3 o - 0.7 o - 3.6 o - 1.2 o - 0.7 o - 1.4 o ◦ -0.8 ◦ -0.8 ◦ -1.2 ◦ -3.3 ◦ -0.5 ◦ -1.0 ◦ -0.7 ◦ -3.5 ◦ -1.2 ◦ -0.9 ◦ -0.9 ◦ 8 S) 2.0 5.0 2.7 ° -1.1 ° -1.4 ° -1.6 ° -1.0 ° -0.6 ° -0.3 ° -0.8 ° -1.8 ° -3.1 ° -1.3 ° -1.2 ° 3 5.1 à. 4 0 1.3 mj -Q. o -1.6 o -1.4 o -1.6 o -0.6 o -0.4 o 0.2 o 0 o -1.0 o -1.2 o -1.4 o -1.0 o 2 3.0 0.5 0.3 2:0 5.3 .3 2.3 0 • -1.8 • -1.2 • -0.7 • -0.1 • 0.1 • 0 • 0.1 • -0.1 • -1.0 • -0.9 • -1.0 • 2 £.3 0 0 0 6 4 1.0 1.6 0 • -1.2 • -0.7 • -0.5 • -0.2 • 0.1 • 0.2 • 0.8 • -0.3 • -0.3 • -0.2 • -0.9 • FIG. A-15 I PERCENT ELONGATION PLATE H-IOD (I-INCH GRID) "H" STEEL, 12 - INCH WIDE PLATE NOMINAL STRENGTH 53.8 KSI TEMPERATURE (-42)-(-41)\*F 0 % SHEAR

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FIG.A-152

o <i>0.0</i>	o <i>0.0</i>	o 0.2	o - O. 4	• 0.1	o 0.0	o 0.0	o 0.1	• 0.2	o 0.1	o -0.4	0
0.1	9.6	0	0.0	0.1	0.0	0.1	0.1	0.2	1.0	0.1	1.2
o <i>-0.6</i>	• 0.0	• <i>0.1</i>	• - <i>0.2</i>	o 0.0	o 0.1	o <i>0.0</i>	• <i>0.2</i>	o 0.1	o -0.6	• <i>-0.6</i>	•
£.1	1.2	<u>в</u> .	1.0	0.3	0.2	0.2	1.2	0.3	l. 3	<i>.</i>	1.2
o 0.5	• - <i>0.6</i>	o -0.1	o <i>-0.3</i>	• 0.2	• 0.1	• <i>-0.2</i>	• <i>0.0</i>	• -0. <b>8</b>	• -0.8	• - <i>0.7</i>	•
1.0	1.2	1.5	8.0	0.1	0.1	0.2	0. 19	1.5	1.8	1.5	1.2
• - <i>0.5</i>	• <i>-0.6</i>	• <i>-0.8</i>	• -1.0	• 0.1	• <i>0.1</i>	• <i>-0.2</i>	• -0.9	• <i>-0.9</i>	• <i>-0.3</i>	• - <i>0.8</i>	0
0.1	1.3	8.1	4	<b>6</b> .0	0.1	0.1	1.5	5.0	2	1.6	1.1
• -0.5	• <i>-0.2</i>	• -0.6	• <i>-2.1</i>	• 0.1	• <i>-0.3</i>	• -0.5	• - <i>2.1</i>	• -0.7	• <i>-0.6</i>	• <i>-0.4</i>	o
د. ج	<u>&gt;</u>	· · · ·	~		-	)	- <u>0</u>	4	5.6	6	2.9
9 -0.4	• <i>-0.4</i>	• -0.6	o -/.6	• -0.2	• -0.1	o -0.1	• - <i>1.8</i>	• - <i>0.8</i>	• <i>-0.7</i>	• -0.5	0
0.7	1.0	.5	4	. <del>.</del>	0.0	0.0	4	4	8	E./	1.0
• - <i>0.5</i>	• -0.7	o -1.0	• -0.8	• -0.1	0.1	• - 0.1	• -0.6	o -1.0	o -0.7	• <i>-0.6</i>	٥
1.0	4	5	0.7	0.3	0.0	0.1	0.1	6.1	1.6	1.6	Э.
• -0.6	• -0.6	o -0.5	• 0.6	· 0.0	• 0.1	• 0.0	• <i>0.5</i>	• -0.9	• - <i>0.8</i>	• - <i>0.7</i>	0
1.2	8.	N. 0	0.0	0.0	0.	2.0	1.0	0.6	1.1	S.	4
• -0.7	o -0.3	° 0.0	• 0./	• 0.1	· 0.0	o - 0.1	• 0.3	· 0.0	• <i>-0.5</i>	o -0.7	0
0	0.5	0.0	4	0.2	0.1	0.1	<i>.</i>	0.0	20	2.0	1.3
• -0.5	• 0.0	° 0.0	• 0.3	• 0.0	• <i>0.1</i>	• 0.0	• 0.1	· 0.0	• 0.0	• - 0.9	0
Fi	'G. А-15 "н' st тем	52 PER TEEL, 12- IPERATUR	PCENT INCH W PE - 64	ELOI UDE PLA	VGATIC ATE	DN P.	VATE VAL STR	H-81/ Rength % sheai	XD (1-1 47.4 к. R	INCH GR	(סו

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• - 0.5 • - 0.1 • 0 • 0.1 • 0 • 0 • 0 • 0 • 0.1 • 0.3 • 0.1 • - 0.3 • 1.0 0.0 0.0 0.0 0.0 0.0 0.0 8 0 4 0.1 5 ◦ -0.7 ◦ -0.3 ◦ -0.2 ◦ 0.1 ◦ 0 ◦ 0.1 ◦ -0.1 ◦ 0.1 ◦ 0 ◦ -0.6 ◦ -0.6 ◦ 0 4 5, 5, <del>7</del>, 0 Ś 4 0.1 0 · -0.7 · -0.7 · -1.1 · -0.3 · 0 · 0.1 · 0.1 · -0.1 · -0.3 · -0.7 · -1.7 · 0.5 0 1.7 5.1 1.5 0.1 0.1 2 • -0.7 • -0.8 • -1.2 • -1.2 • 0 • 0.1 • 0.1 • -1.1 • -1.2 • -0.6 • -0.5 • 3.6 8 4 5.1 1.0 .0 2.7 0 0 -0.7 0 -0.4 0 -1.0 a -2.1 a -0.3 a -0.2 a -0.3 a -1.8 a -0.6 a -0.4 a -0.3 a 0 -0.6 0 -0.7 0 -0.7 0 -2.1 0 -0.1 0 -0.3 0 -0.2 0 -2.0 0 -0.7 0 -0.5 0 -0.5 0 3.0 0.1 0.2 2.0 20 ŝ 6.3 6./ 2.0 ~ 1.5 2 0 -0.4 0 -0.8 0 -1.2 0 -1.0 0 -0.1 0 -0.5 0 0 0 -1.3 0 -1.2 0 -0.8 0 -0.6 0 0.5 ).5 |.8 2:1 2:1 2:1 0.1 8. ~. 5 Ó Ø. ◦ -0.7 ◦ -0.9 ◦ -0.7 ◦ 0.1 ◦ 0 ◦ 0 ◦ 0.3 ◦ -0.5 ◦ -0.3 ◦ -0.7 ◦ -0.8 ◦ 1.6 1.6 0.7 0.2 0.2 0.2 0.8 2 5.2 9 6 Ó. • -0.6 • -0.2 • -0.3 • -0.1 • 0.2 • 0 • 0 • 0 • 0 • -0.5 • -0.6 • -0.7 • ei N 5 · - 0.6 · - 0.5 · 0.1 · - 0.2 · - 0.5 · 0 · - 0.1 · 0 · 0 · 0 · - 0.5 · FIG. A-153 PERCENT ELONGATION PLATE H-82XD(1-INCH GRID) "H" STEEL, 12-INCH WIDE PLATE NOMINAL STRENGTH 47.4 KSI TEMPERATURE -40°F. 0% SHEAR

DWG. 44E 252


Origin of Break

FIG. B-I VIEW OF TUBE "O" AFTER FRACTURE, TESTED AT - 40°F.



VIEW OF TUBE "L" AFTER FRACTURE, TESTED AT -40° F. Fig. B-2



FIG.B.3 PERCENT ELONGATION IN TUBE SPECIMEN "O" AFTER RUPTURE.

		ΨV									-M							~~~~	4						1	M.
┝╸				. <u> </u>	<b>6</b> - <i>5</i> A	ACE	5 @	5″-				╺┥╱┞	<b>4-</b>			-6-	SPAC	E\$ 6	<u>•</u> 5-					-		TRANSO
<del>دی</del> ا	ORIGI	**** W 0	hining FBR	EAK	*****	*****	******	~~~	******		****		******	*****	بمحمحم	معجمه	<del>,</del>	****	*****	***	فيصحونه	****	*****	1 1 1	5	
•	0	÷.	-	~	-a1.	_0	0	0	0	0	12		0.1	• •	0.2	ò	a/	0	ar	0	-	- <b>.</b> -		1	(0	•
ų A		~3		1		6.		52		-	<	£.	-	-		ກ	~	<u>,</u>		N		2	<b>U</b> 1,	. <u>3</u> .	) ື	
。 o	0.3	• •	0.4	 0	07	0	0.6	, . , .	0.6	r o	47	~	*	`.'	-	- Ĵ	1.9	N O	1.8	5 5	1.8	יי ס	1.9	<b>৸</b> ৠ্ ৸ ০০০০	{	
2		*		53		10		53		Ŋ		010	_	*		55	-	,o		~		N	0.0		[	
0	2.7	, 0	1.7	0	1.6	ч П	<i></i>	'' 0	1.6	וי ה	1.6	"₹¶ 0.400	3./ P	~	æ./	۰ ٥	20	אי ה	1.8	ъ С	/.8	*1	17	ື່າ≹" ດ(/ດ	0	
ņ		0		50		0		9,		ē,		0 10	(	ē.		5	2,0	0		ø		e.		• \$0		
n 5	.3.3	•	3.2	<b>۲</b>	3./	*	3/	₩ 0	30	0 4:	41	₩ ₩ ₩	\$7	v• 0	34	₩.	30	ې ک	53	*	32	প	28	₩ ₩ ₩	}	
-		۔ رو		5		<b>9</b> 0				۰ ۹		530	)	ų		ħ		N				o o		. 1.		
<b>n</b>	40	*	4.2	*	4.2	*	42	A.	<b>4</b> ×	*	47	434	52	<b>A</b> .	44	*	40	Æ	47	<b>A</b> .		hi -	87	~ 34	0	
0	110	ŭ	,	Ň		N.		ب س	7.0	ų	77	•0£70		<b>u</b>	2749	6 6	4.0	u u	74	0 6	74	0 19	<b>3</b> .7	0270	ゔ	
¢ a		¥		*	44	4	45	¥		4.		* * *	+	4		*	*-	4		¥		Ŷ		* *		
•	713	N N	713	<b>n</b>		<u>م</u>	44	0	7.3	0 19	4.4	6 \$ 6	1	0	74	0 6	40	o n	46	0 16	9.6	o h	<b>#</b> .5	0240	(	
ř.		¥		¥		4	40	4		*		* 1 *		¥		¥		*		¥		¥		¥ ¥¥	)_	
D N	3.7	° ~	4.7	0	7.0	•	46.0	•	4.5	0	4.5	o7o ⊾≹	36	0	4.7	٥ ٣	-68	0	46	0 1-	47	<b>v</b>	43	o₹⁄o	20	
¢	• •	¥		¥		¥		*		¥		4 <u>1</u> 4		4		4		¥		<b>Å</b>		Ą,			}	
•	5.0	•	48	•	47	•	46	。 	4.2	0	46	0290	ଣ୍ଟ 	ŝ	5,5	•	48	0	<b>48</b>	°	48	0	₹5	03.50 *		
5 5		*		<b>A</b> . A		¥		4		4		* 1*	Ļ	*	1	¥		4		4.5		4		¥ 14	1	
D	<i>5</i> .3	•	4.9	0	48	0	48	0	<b>4</b> 2	0	5.4	0160	6.3 	٥	` <b>€.</b> 2 ∖	0	50	0	47	0	50	0	3.9	0 <i>27</i> 0	2	i.
F		4		¥		40		*		4.6		*		4. 2	$\mathbf{A}$	*		40		54		*		*		7050
c	51	0	52	0	<b>#9</b>	¢	47	0	45	<u>،</u>	<b>\$</b> 5	0260 \$/	<b>*</b> 9	0	<b>1</b> 9,	°	<b>¶</b> 9	0	<b>4</b> ,9	0	5.0	٥	<b>4</b> 4	02.70		3
í		4		4.7		4.7		¥		\$ *		₹₹		46		N.		₹		5		¥		4 4 7 1 4 7		INEN
þ	49	0	4.8	0	49	0	4.8	o	47	٥	46	° 0	4.8	٥	46	0,4	51	0	<b>₹.8</b>	٥	50	0	₹5	0200	0	205
n F		÷		*		ي پر		₹3		<b>4</b> 9		/{{\		A 6		*7		¥		¥		5		4.8 4.9		¥
0	<b>4</b> 8	0	46	0	48	0	47	٥	48	٥	44	0/40	47	۰	46	٥	5.7	٥	50	٥	5.Z	٥	<b>*</b> #	02.60	ł	
ĥ		4		4		47		**		₹7		245		4.7		<b>\$</b>		₹7		46		4		5 <b>*</b> *	}	2.NC
2	46	0	45	٥	<b>4</b> .7	0	<b>*6</b>	0	46	0	5.7	0640	45	0	4.5	o	αz	٥	4.8	0	50	o	<b>«</b> 2	05.70	é	757
ř		*		Å 6		4		lg.≱		₹3		***		46		94	1	44		¥		5		44		
	49	0	46	٥	46	٥	44	0	45	o	46	0430	45	0	<b>45</b>	0	5,9	0	<del>6</del> 8	0	<b>4</b> .9	0	<b>4</b> 3	02.70		
6 F		₩ ¥		4.0		46		\$		*/		5		46		46		£¥		£.5		4		234		
c	44	٥	4.6	•	<b>#</b> #	۰	42	٥	<b>55</b>		48	0539	47	Ø,	46	•	<b>#8</b>	<b>`</b> 0	47	o	48	0	**	× 240	2	
4 K		Ť		¥		S¥		A.S		4		242		46		4.6		4		53		\$		212		
,	<b>1</b> 1	o	42	٥	<b>4</b> /	0	<b>4</b> /	0	, 10	٥	4.2	0260	47	•	4.1.	0	4.6	•	15	0	48	0	42	02/0		
r F		4 4		¥		5.6	,	/*		4		***		8		4		\$9 *		÷.		Âĥ		5	}	
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FIG.B-A-PERCENT ELONGATION IN TUBE SPECIMEN "L" AFTER RUPTURE.





FIG. 8-6-EFFECTIVE STRESS VS. EFFECTIVE STRAIN CURVES FOR TUBES A,C,D,E, AND H TESTED AT APPROXIMATELY 70°F.



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AND WELD OF TUBE J, AT 70 % AND-40%

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View of Internal Surface of Tube at Break (15x)



View of Fractured Edge (15x)

FIG. B-11 - DEFECT IN PLATE AT ORIGIN OF BREAK IN TUBE "L"





"AS ROLLED" CONDITION. c=0.25 % mn=0.49 % 3/8-inch diameter tensile bars



DWG: 44E278

FIG. C-3



(STEEL "A")

STRENGTH AT -300 °F

IRUE FRACTURE STRESS IN TENSION , PSI.









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FIG. D-5 -- Apparatus for Measuring Photogrids on Size Effect Specimen