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COLUMN AND PLATE COMPRESSIVE STRENGTH OF EXTRUDED XB75S-T ALUMINUM ALLOY

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SUMMARY

Results are presented of tests to determine the column and plate compressive strength of extruded XB75S-T aluminum alloy, and comparative values are shown for 24S-T aluminum-alloy sheet. Stress-strain curves are also given.

INTRODUCTION

Since the introduction of XB75S-T aluminum alloy there has developed a need for information on the column and plate compressive strength of this alloy. Because other alloys are also being introduced from time to time, some effort has been put on the development of quick and convenient methods for determining the various structural properties of these alloys. A method for the determination of the column curve from tests of thin-strip columns and the results of some tests of this type are presented in reference 1. Reference 2 gives the results of tests of 24S-T formed and extruded aluminum-alloy columns that developed local instability; from these results the plate compressive strength of the material was evaluated. Similar tests to those reported in these references have been made of extruded XB75S-T aluminum alloy and the results are presented herein.

RESULTS

Typical stress-strain curves for the extruded XB75S-T aluminum alloy are given in figure 1. For comparative purposes, stress-strain curves for 24S-T aluminum-alloy sheet are also given. Sheet, rather than extruded, material was used for comparison because complete test data of the type given herein are available for sheet material. This fact should be kept in mind in making comparisons between the data for 24S-T and XB75S-T alloys presented herein.

The column curve, obtained by the method outlined in reference 1, is shown in figure 2. In this figure σ_{cr} is the critical compressive stress for the column, L the length, ρ the radius of gyration, and c the coefficient of fixity in the Euler column formula. Column data for 24S-T sheet material are also included in this figure. The curve drawn for 24S-T alloy was not faired through the test points as was that for XB75S-T alloy but was computed according to the method outlined in reference 3.

Figure 3 shows the type of cross section of the specimen used for the determination of the plate compressive strength for the XB75S-T material. For this series of tests, specimens with b_W/t_W equal to about 15, 20, and 24 were used and in each case six or more values of the ratio b_F/b_W were included. The values of the critical compressive stress σ_{cr} obtained in these tests are plotted in figure 4 in the same form as the column curve, along with a comparable curve for 24S-T sheet material, determined from the tests of reference 2 and additional tests completed since the publication of reference 2. In this figure, μ is Poisson's ratio and k is the coefficient in the plate-buckling equation

$$\frac{\sigma_{cr}}{\eta} = \frac{k\pi^2 E t^2}{12(1-\mu^2)b^2}$$

where t and b are the thickness and width of the plate, respectively, and η is a dimensionless coefficient that takes into account the reduction in modulus of elasticity E at stresses beyond the elastic range.

Figure 5 shows a comparison of the column and plate-buckling curves, with the test data omitted for simplification.

In the plate tests, the procedure was the same as that followed in reference 2. Plots of test results comparable to figures 8, 10, and 11 of reference 2 are therefore given in figures 6, 7, and 8, respectively, of

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the present report. In figures 7 and 8, σ_{max} is the average stress at maximum load. The curves determined in reference 2 for 24S-T aluminum alloy are also drawn in figures 6 to 8 for comparison.

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REFERENCES

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2. Heimerl, George J., and Roy, J. Albert: Preliminary Report on Tests of 24S-T Aluminum-Alloy Columns of Z-, Channel, and H-Section That Develop Local Instability. NACA RB No. 3J27, 1943.

3. Osgood, William R., and Holt, Marshall: The Column Strength of Two Extruded Aluminum-Alloy H-Sections. NACA Rep. No. 656, 1939.

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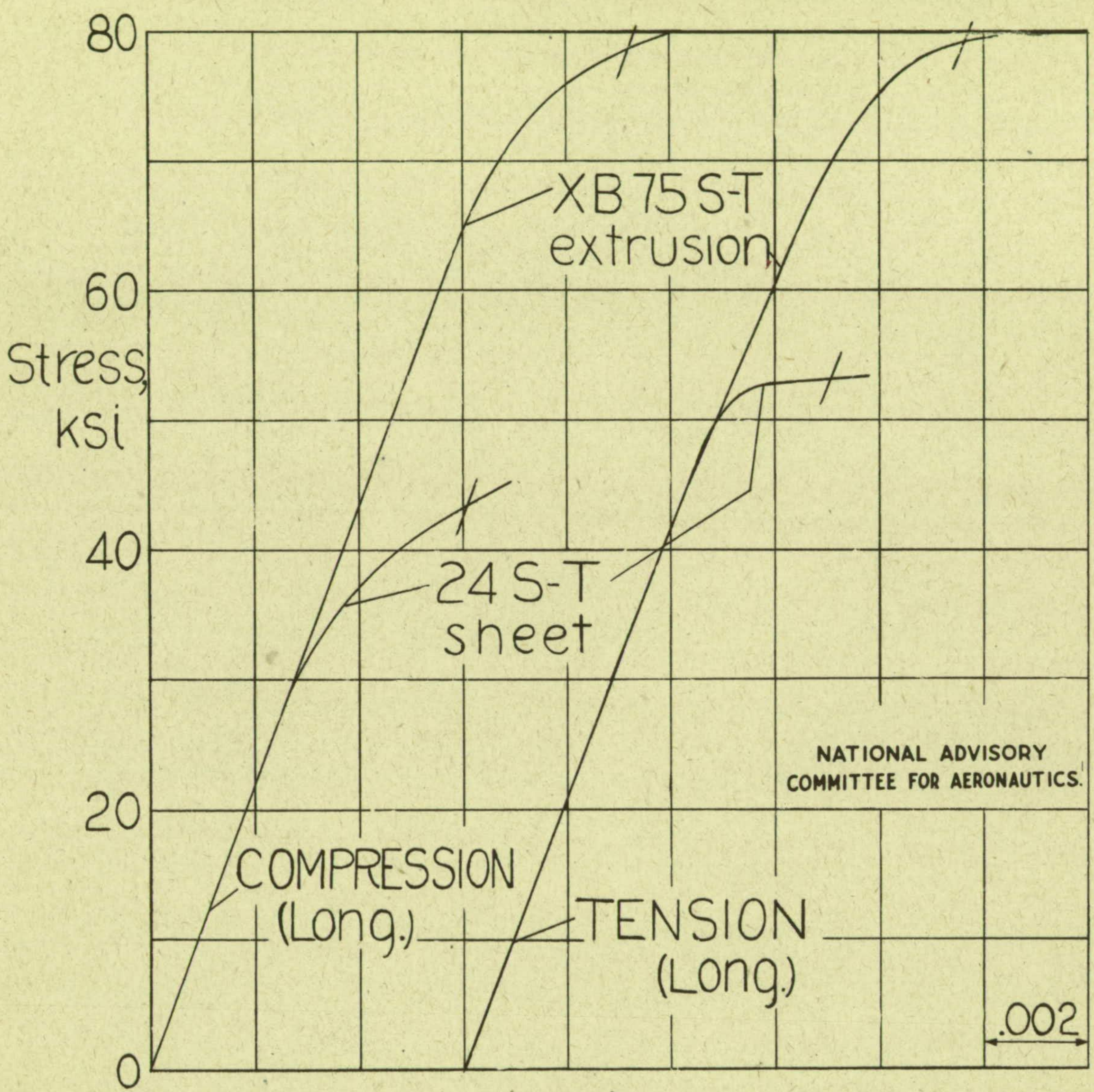

Figure 1.- Stress-strain curves.

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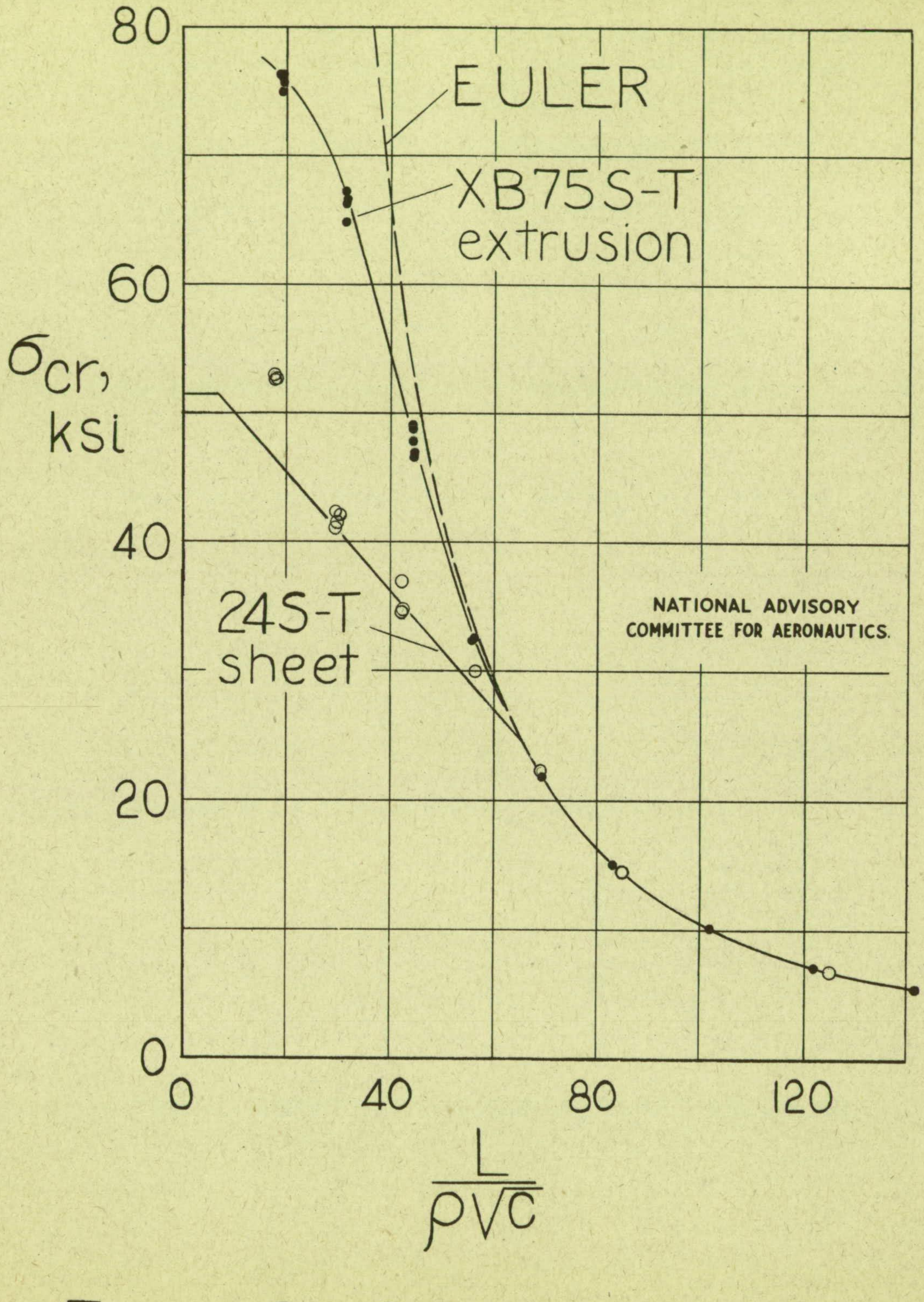

Figure 2.- Column curve.

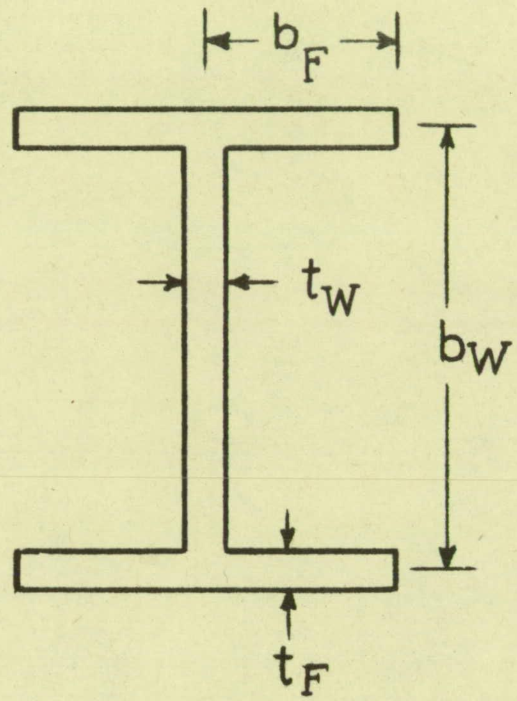

Figure 3. - Extruded cross section used for determination of plate compressive strength of XB75S-T aluminum alloy.

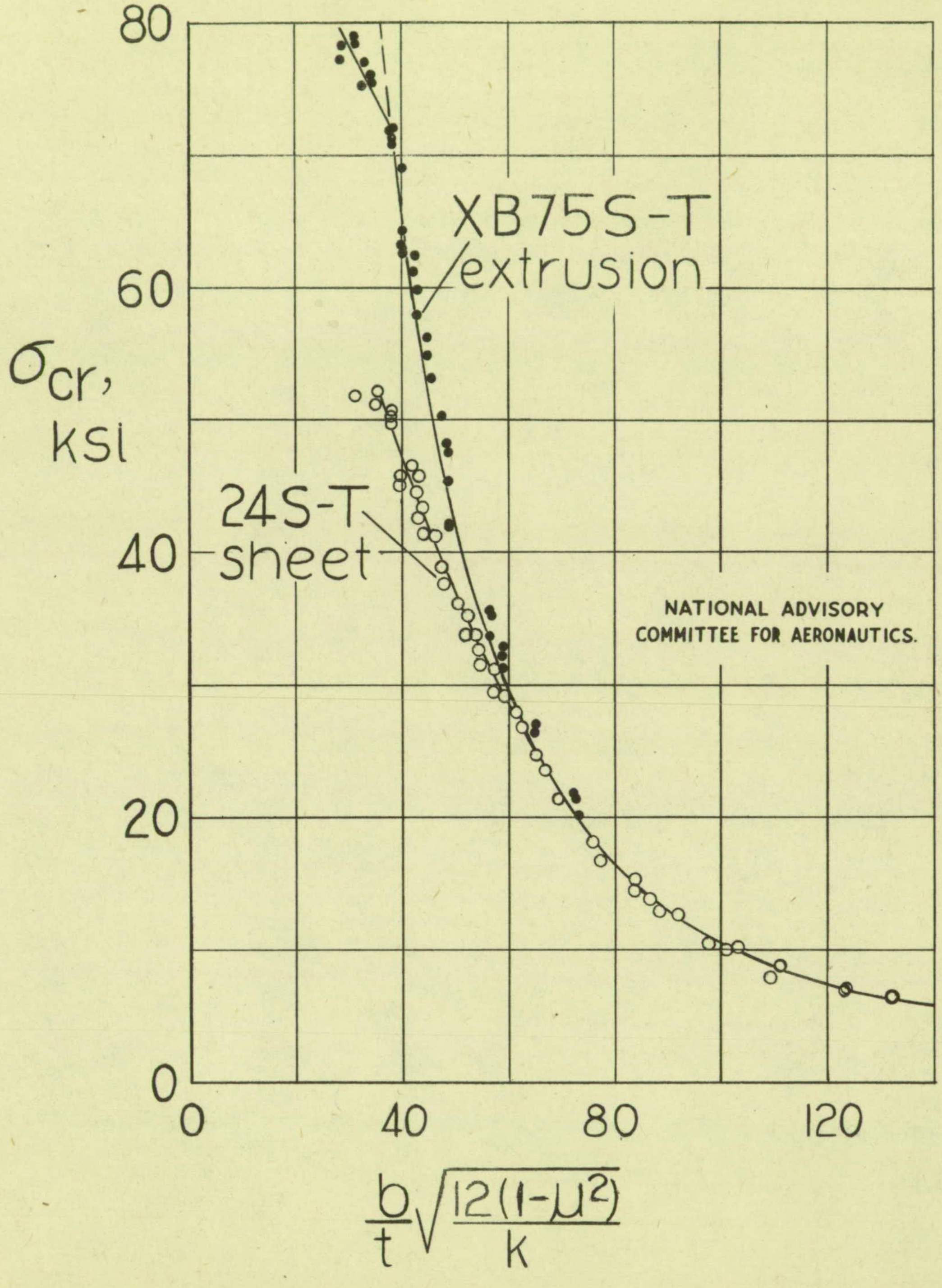

Figure 4.- Plate-buckling curve for compression.

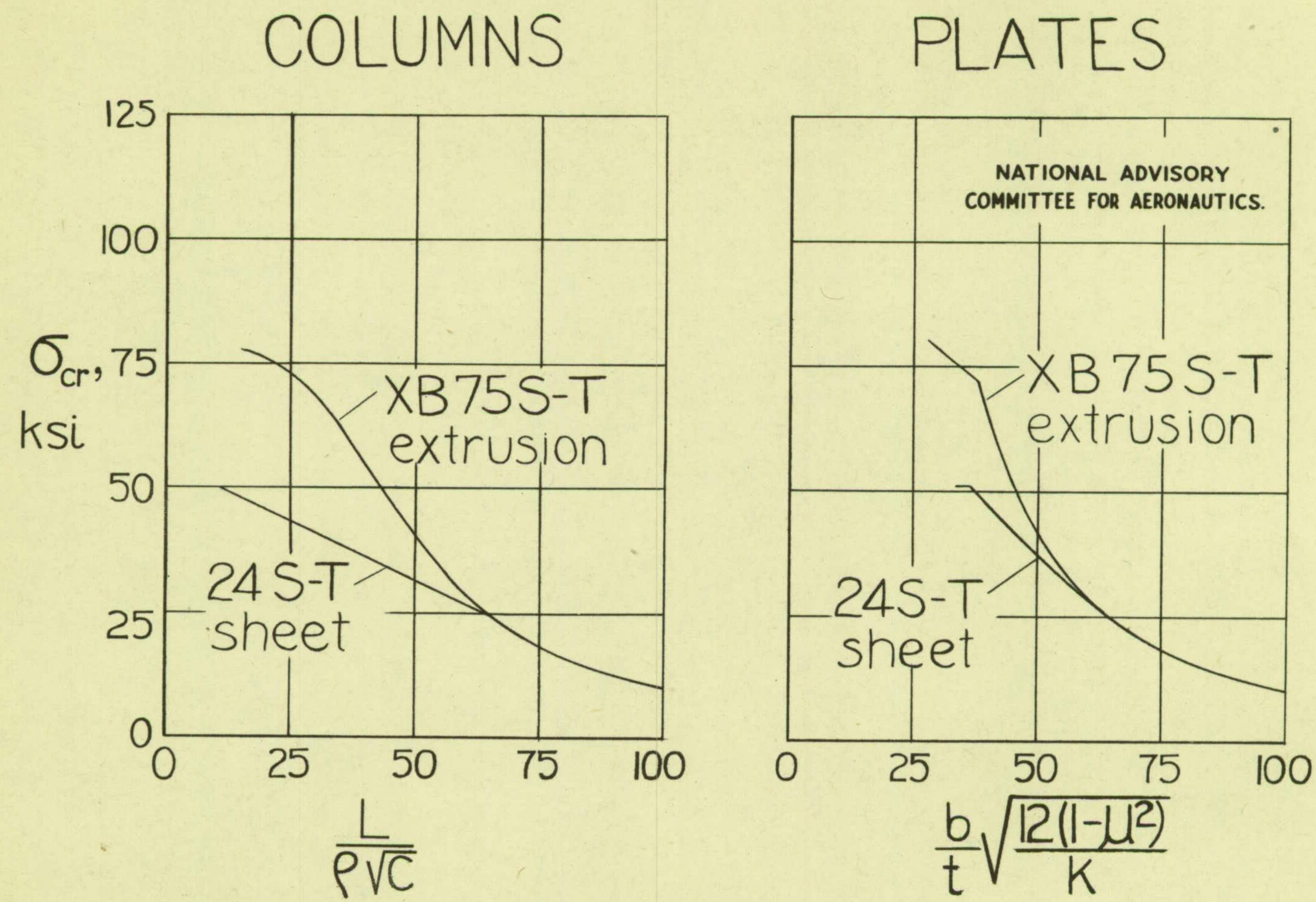

Figure 5.- Comparison of column and plate-buckling curves.

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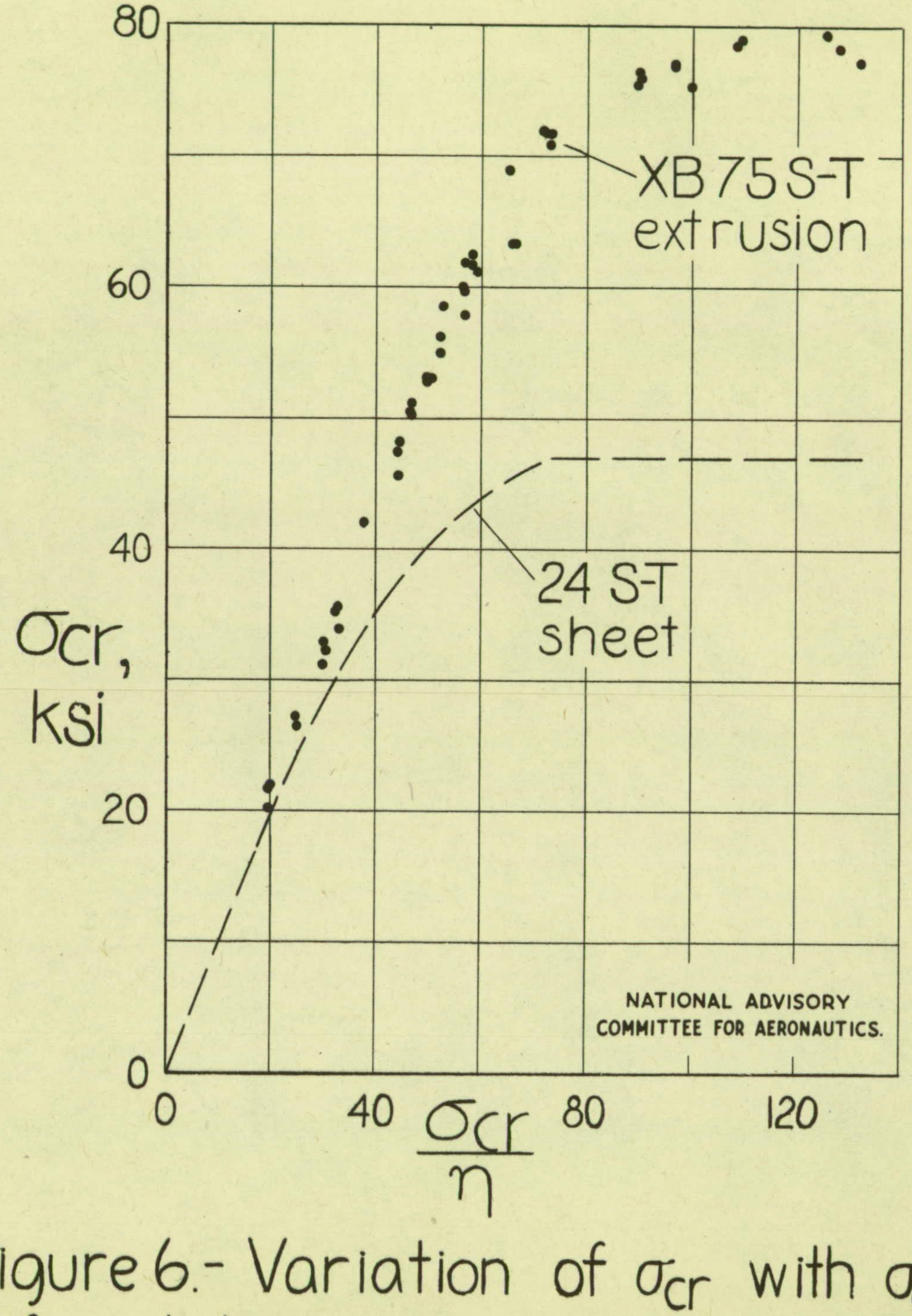

Figure 6.- Variation of σ_{cr} with σ_{cr}/η for plates under compression.

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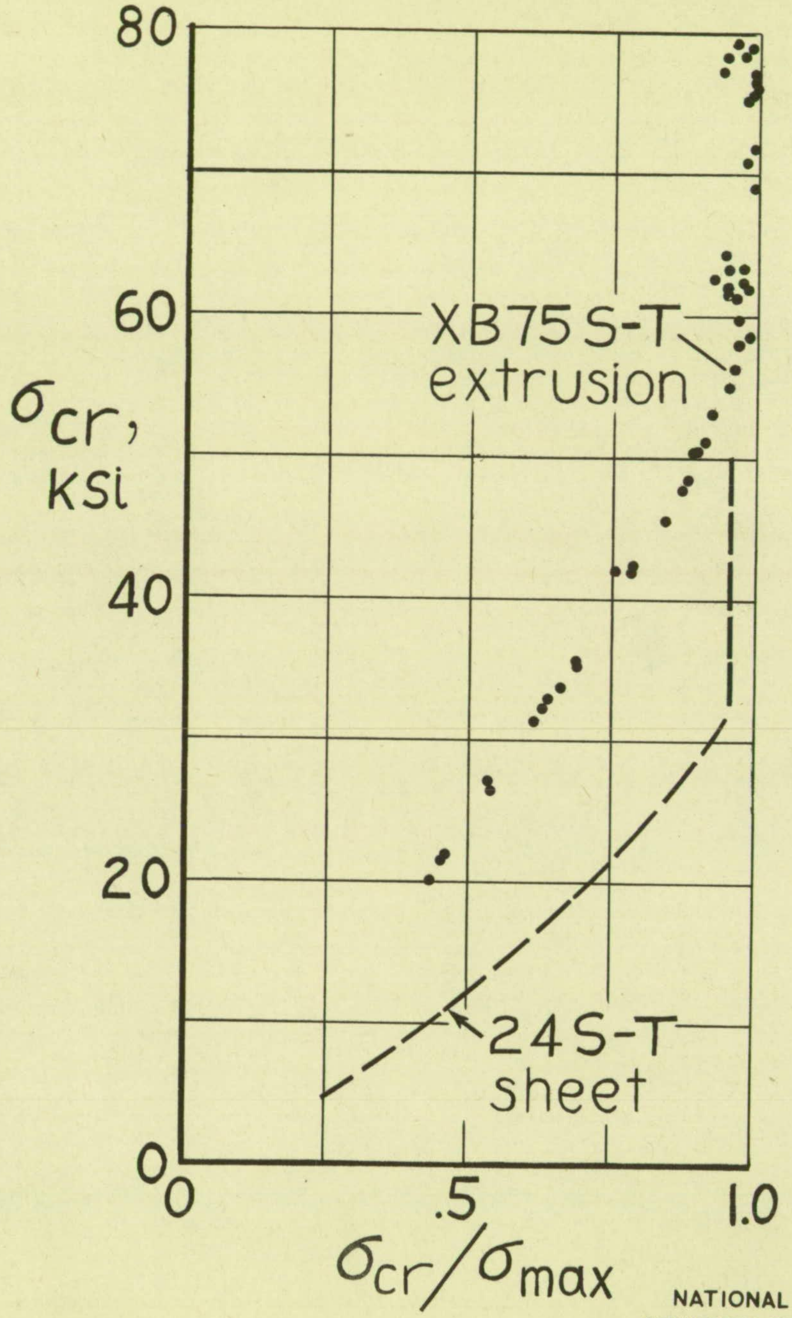

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Figure 7.- Variation of σ_{cr} with σ_{cr}/σ_{max} for plates under compression.

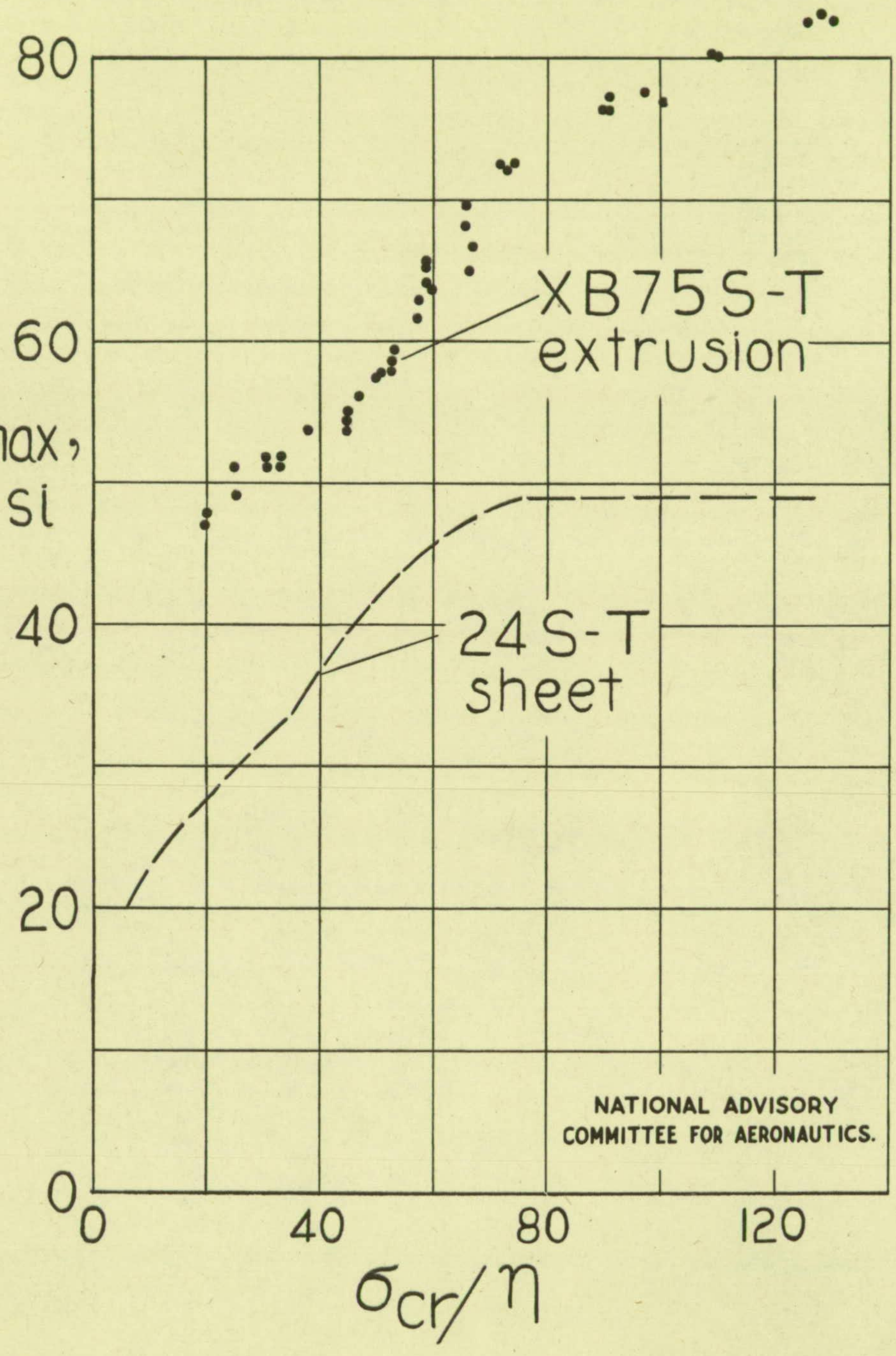

Figure 8.- Variation of σ_{max} with σ_{cr}/η for plates under compression.