NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TECHNICAL NOTE 2639

FATIGUE STRENGTHS OF AIRCRAFT MATERIALS

AXIAL-LOAD FATIGUE TESTS ON NOTCHED SHEET SPECIMENS OF 24S-T3 AND 75S-T6 ALUMINUM ALLOYS AND OF SAE 4130 STEEL WITH STRESS-CONCENTRATION FACTOR OF 1.5

By H. J. Grover, W. S. Hyler, and L. R. Jackson

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SUMMARY

This report presents results of axial-load fatigue tests on notched specimens of three sheet materials: 24S-T3 and 75S-T6 aluminum alloys and normalized SAE 4130 steel. Each specimen was notched by edge notches designed to have a theoretical stress-concentration factor of 1.5. Tests were run at four levels of nominal mean stress: 0, 10,000, 20,000, and 30,000 psi.

Results of these tests extend information previously reported from tests on unnotched specimens and tests on specimens more severely notched and afford data on the variation of fatigue-strength reduction with notch severity.

INTRODUCTION

This is the fourth of a series of reports summarizing work on an investigation of the fatigue strengths of metals commonly used in aircraft construction. This investigation has been conducted at Battelle Memorial Institute under the sponsorship and with the financial support of the National Advisory Committee for Aeronautics. A major objective of the investigation has been to obtain basic data on the fatigue strengths of three sheet materials: 24S-T3 and 75S-T6 aluminum alloys and normalized SAE 4130 steel.

Three previous reports (references 1, 2, and 3) present data on the following:

Reference 1: Results of fatigue tests on unnotched specimens

Reference 2: Results of fatigue tests on sheet specimens, notched (with three different types of notches, including edge notches), having a stress-concentration factor K_t of 2.0; and on specimens, notched (with two different types of notches, including edge notches), having $K_t = 4.0$

Reference 3: Fatigue tests on specimens with severe edge notches, having $K_t = 5.0$

The present report contains results of fatigue tests on specimens with edge notches having $K_t = 1.5$. These tests thus complete a series indicating the influence of severity of notch on the fatigue-strength reduction caused by the notch.

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EXPERIMENTAL PROCEDURE

The experimental procedure in the work described in this report was generally the same as that in the previous investigation of unnotched and of more severely notched specimens (references 1 to 3).

The materials used were supplied from selected stock retained for this purpose at the Langley Aeronautical Laboratory of the NACA. Coupons were cut from 0.090-inch-thick commercial sheets of 24S-T3 and of 75S-T6 aluminum alloys and from 0.075-inch-thick commercial sheets of normalized SAE 4130 steel.

Static-strength properties, some of which are repeated from reference 1, are given in table 1.

Figure 1 shows a dimensional drawing of the notched specimen used for the fatigue tests. The symmetrical edge notch is similar to that used in previous tests on specimens more severely notched. The dimensions of the notch were chosen, on the basis of available information, to give $K_t = 1.5$. The notch was cut with a tool especially designed to produce the contour desired. Machining cuts were successively lighter, so that the depth of each of the last two cuts was about 0.0005 inch. After machining, the notched specimens were electropolished. This removed about 0.0008 inch of material. Specimens were examined by a microscope comparator after electropolishing; the dimensions shown in figure 1 are representative of those measured after this final step.

Fatigue tests were run on Krouse direct repeated-stress testing machines at speeds in the range 1100 to 1500 cycles per minute. A description of these machines is given in reference 1. It is estimated that the precision of load measurement and maintenance was about ±3 percent in tension-tension tests. In tests involving reversal of load, sheet specimens were restrained from buckling by the use of guide plates. Estimation of precision of loading in such cases was indirect; it is believed that error in load value, in reversed-load testing, did not usually exceed ±5 percent.

RESULTS OF FATIGUE TESTS

Results of axial-load fatigue tests on the mildly notched specimens at nominal mean stresses of 0, 10,000, 20,000, and 30,000 psi are given in tables 2, 3, and 4.

These results are plotted in the form of S-N diagrams in figures 2, 3, and 4. All stress values in these diagrams are nominal net-area stresses. While the data are insufficient to afford a statistical evaluation of scatter, it may be noted that the observed points fall reasonably closely on the faired curves drawn.

Figures 5, 6, and 7 show the same results plotted in another manner - as constant-lifetime diagrams of nominal stress amplitude against nominal mean stress. In these derived diagrams, "points" are not directly observed values but are values read from the faired S-N curves in figures 2, 3, and 4.

DISCUSSION

Tables 5, 6, and 7 summarize results of fatigue tests on unnotched specimens and of fatigue tests on specimens with edge notches of various severities. It may be noted that the fatigue strength, for a particular lifetime at a specified mean nominal stress, decreases with increasing notch severity. However, this decrease is not in proportion to the increase in the theoretical stress-concentration factor for the notch.

Values such as those in tables 5, 6, and 7 could be used in design - with proper allowance for scatter in fatigue strengths - in application to sheet sections closely similar to the fatigue test specimens under loading conditions closely similar to the fatigue test conditions. Since such situations seldom, if ever, occur in aircraft design, it is highly desirable to formulate, as far as possible, reasonable rules for interpolation and extrapolation of notch fatigue-strength values. It is, therefore, of interest to examine trends shown in the effect of notches on the fatigue strengths of these materials and, in this examination, to include data previously reported from tests on more severely notched specimens of the same materials.

It is conventional to evaluate the effect of a notch on the fatigue strength of a specimen or structural part in terms of a "fatigue-strength reduction factor." For fully reversed loading, this fatigue-strength reduction factor may be defined as

$$K_f \equiv \frac{\text{Maximum stress for unnotched specimen}}{\text{Nominal maximum stress for notched specimen at same lifetime}}$$

Table 8 shows values of K_f, so defined, for specimens edge-notched with various severities. It should be kept in mind that the precision of values for K_f may be less than that for values of fatigue strengths of notched specimens, since data for the unnotched specimens may have considerable scatter.[1] However, the following trends appear in the results in table 8:

(1) K_f varies with the stress level (being generally less for high stress levels, corresponding to short lifetimes).

(2) For a specified lifetime, say, 10^7 cycles, K_f increases as the notch severity (indicated by K_t) increases.

(3) For a specified lifetime and a specified notch severity, K_f appears to vary for the different materials. For a long lifetime (10^7 cycles), K_f appears to be least for the 24S-T3 and greatest for the 75S-T6.

While the results noted in items (1) and (2) are to be expected, the apparent variation of K_f with materials is not yet fully understood.

As has been noted in previous reports (references 2 and 3), definition of K_f requires additional qualification for conditions where the load is not fully reversed. One definition that may be used is:

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[1]Some tests to evaluate the dependability of data on the unnotched specimens are incomplete, so that present estimates of the precision of K_f would be premature.

$$K_f \equiv \frac{\text{Maximum stress for unnotched specimen}}{\text{Nominal maximum stress for notched specimen at same load ratio and lifetime}}$$

Table 9 shows values of K_f so computed. For these computations, appropriate values for unnotched-specimen fatigue strength were determined by interpolation of data reported in reference 1. The precision of the K_f values in table 9 is not yet well determined and may, in some instances, be low. However, the tabulated values indicate the following trends:

(1) For a specified nominal mean stress of the notched specimen, K_f generally increases with increasing lifetime (or with decreasing nominal maximum stress).

(2) For a specified lifetime, K_f generally decreases with increasing nominal mean stress on the notched specimen.

(3) For specified lifetime and nominal mean stress, K_f increases with increasing notch severity.

(4) Usually, K_f is highest for the 75S-T6 and lowest for the 24S-T3. The several exceptions to this need reexamination when additional data concerning scatter become adequate for estimating the precision of the K_f values. The trends, noted in items (1) to (4), are compatible with qualitative expectations of effects of plastic deformation at the base of the notch (see reference 3). Quantitative effects are currently being studied with the objective of formulating design rules for interpolating and extrapolating such data.

CONCLUSIONS

Axial-load fatigue strengths have been obtained for sheet specimens with edge notches having a theoretical stress-concentration factor of 1.5. Tests were made on 24S-T3 and 75S-T6 aluminum alloys and SAE 4130 steel at nominal mean stresses of 0, 10,000, 20,000, and 30,000 psi. It can be concluded that:

1. These results, together with previously reported data for more severely notched specimens, show reduction of fatigue strength increasing with, but not always proportional to, the theoretical stress-concentration factor of the notch.

2. The fatigue-strength reduction factor K_f, as defined in this report, was never found to exceed the theoretical stress-concentration factor K_t. It was less than K_t, particularly for severely notched specimens tested at high stress levels.

Battelle Memorial Institute
Columbus, Ohio, May 30, 1951

REFERENCES

1. Grover, H. J., Bishop, S. M., and Jackson, L. R.: Fatigue Strengths of Aircraft Materials - Axial-Load Fatigue Tests on Unnotched Sheet Specimens of 24S-T3 and 75S-T6 Aluminum Alloys and of SAE 4130 Steel. NACA TN 2324, 1951.

2. Grover, H. J., Bishop, S. M., and Jackson, L. R.: Fatigue Strengths of Aircraft Materials - Axial-Load Fatigue Tests on Notched Sheet Specimens of 24S-T3 and 75S-T6 Aluminum Alloys and of SAE 4130 Steel with Stress-Concentration Factors of 2.0 and 4.0. NACA TN 2389, 1951.

3. Grover, H. J., Bishop, S. M., and Jackson, L. R.: Fatigue Strengths of Aircraft Materials - Axial-Load Fatigue Tests on Notched Sheet Specimens of 24S-T3 and 75S-T6 Aluminum Alloys and of SAE 4130 Steel with Stress-Concentration Factor of 5.0. NACA TN 2390, 1951.

TABLE 1.- STATIC-STRENGTH PROPERTIES OF SHEET SPECIMENS

Type of specimen	Average tensile properties			Compressive yield strength (psi)
	Elongation in 2 in. (percent)	Yield strength, 0.2-percent offset (psi)	Ultimate strength (psi)	
24S-T3 aluminum alloy				
Unnotched[1]	18.2	54,000	73,000	44,500
Notched (K_t = 1.5)	----	------	75,800	------
75S-T6 aluminum alloy				
Unnotched[1]	11.4	76,000	82,500	74,000
Notched (K_t = 1.5)	----	------	86,800	------
Normalized SAE 4130 steel				
Unnotched[1]	14.3	98,500	117,000	86,000
Notched (K_t = 1.5)	----	------	123,000	------

[1]Data from reference 1.

TABLE 2.- AXIAL-LOAD FATIGUE TEST RESULTS FOR 24S-T3

ALUMINUM-ALLOY SHEET SPECIMENS

[Edge notched with $K_t = 1.5$]

Specimen	Nominal maximum stress (psi)	Life (cycles)
Nominal mean stress, 0 psi		
A9S1-2	40,000	6,000
A5S1-2	35,000	10,000
A5S1-5	35,000	11,000
A7S1-1	32,500	26,500
A4S1-5	30,000	44,000
A7S1-3	25,000	95,000
A8S1-1	22,000	235,000
A4S1-3	18,000	530,000
A8S1-4	17,000	5,036,900
A4S1-1	16,000	6,347,000
A5S1-3	15,000	[a]>14,470,000
Nominal mean stress, 10,000 psi		
A9S1-4	44,000	23,000
A12S1-2	35,000	76,000
A7S1-5	28,000	472,000
A12S1-1	25,000	3,660,000
A9S1-5	24,000	[a]>10,600,000
Nominal mean stress, 20,000 psi		
A9S1-3	52,000	19,000
A12S1-3	42,000	65,000
A7S1-6	35,000	299,000
A8S1-6	33,000	241,000
A12S1-6	32,000	8,775,000
A8S1-5	31,000	[a]>14,052,000
Nominal mean stress, 30,000 psi		
A8S1-2	65,000	9,500
A5S1-6	60,000	16,500
A5S1-4	55,000	36,000
A7S1-4	50,000	54,000
A5S1-1	45,000	108,000
A8S1-3	43,500	207,000
A4S1-2	42,000	309,000
A4S1-4	41,000	3,525,000
A4S1-6	40,000	[a]>10,322,000

[a]Did not fail.

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TABLE 3.- AXIAL-LOAD FATIGUE TEST RESULTS FOR 75S-T6

ALUMINUM-ALLOY SHEET SPECIMENS

[Edge notched with $K_t = 1.5$]

Specimen	Nominal maximum stress (psi)	Life (cycles)
Nominal mean stress, 0 psi		
B12S1-1	39,200	13,000
B11S1-2	35,000	21,500
B10S1-6	30,000	37,700
B11S1-3	27,000	122,000
B8S1-4	23,000	374,000
B8S1-2	20,000	1,725,000
B8S1-5	19,000	2,965,000
B9S1-5	18,000	8,796,000
B10S1-1	17,500	2,617,000
B10S1-4	17,500	4,762,000
B11S1-1	16,500	16,123,000
Nominal mean stress, 10,000 psi		
B15S1-4	40,000	30,000
B11S1-5	32,000	101,000
B12S1-4	27,000	791,000
B12S1-5	26,000	4,125,000
Nominal mean stress, 20,000 psi		
B12S1-2	49,000	26,000
B15S1-5	46,000	33,000
B15S1-2	37,000	53,000
B15S1-3	34,000	217,000
B12S1-3	33,000	9,552,000
Nominal mean stress, 30,000 psi		
B9S1-3	60,000	11,000
B9S1-4	55,000	19,000
B9S1-2	50,000	25,000
B8S1-1	47,000	38,000
B8S1-3	45,000	95,000
B11S1-4	44,125	57,000
B9S1-6	42,500	302,000
B10S1-2	41,250	96,000
B10S1-3	41,250	355,800
B10S1-5	41,000	6,800,000
B8S1-6	40,000	[a]>10,630,000

[a]Did not fail.

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TABLE 4.- AXIAL-LOAD FATIGUE TEST RESULTS FOR NORMALIZED

SAE 4130 STEEL SHEET SPECIMENS

[Edge notched with $K_t = 1.5$]

Specimen	Nominal maximum stress (psi)	Life (cycles)
Nominal mean stress, 0 psi		
C9N1-3	50,000	72,000
C9N1-4	45,000	217,000
C10N1-2	40,000	503,000
C10N1-4	37,500	3,660,000
C8N1-2	37,000	659,000
C8N1-3	36,000	4,591,000
C9N1-2	35,000	[a]>10,384,000
Nominal mean stress, 10,000 psi		
C11N1-2	58,000	121,500
C11N1-1	50,000	384,000
C11N1-5	45,000	1,346,000
C11N1-6	44,000	[a]>11,887,000
Nominal mean stress, 20,000 psi		
C11N1-3	68,000	95,000
C10N1-6	60,000	360,000
C11N1-4	55,000	9,040,000
Nominal mean stress, 30,000 psi		
C12N1-2	80,000	63,000
C9N1-1	80,000	83,000
C8N1-6	76,000	102,000
C8N1-4	72,000	224,000
C9N1-6	68,500	161,500
C10N1-5	67,750	334,200
C10N1-3	67,000	571,000
C9N1-5	65,000	1,774,000
C10N1-1	62,500	6,667,000
C8N1-1	60,000	[a]>11,443,000

[a]Did not fail.

TABLE 5.- SUMMARY OF RESULTS OF AXIAL-LOAD FATIGUE TESTS ON

24S-T3 ALUMINUM-ALLOY SHEET SPECIMENS WITH EDGE NOTCHES

Notch severity, K_t	Nominal maximum stress (psi) at lifetimes (cycles) of - (1)						
	5×10^3	10^4	5×10^4	10^5	5×10^5	10^6	10^7
Nominal mean stress, 0 psi							
1.0	54.0×10^3	50.0×10^3	42.0×10^3	34.0×10^3	28.0×10^3	24.0×10^3	22.0×10^3
1.5	42.0	37.5	28.5	25.5	18.5	17.0	16.5
2.0	33.0	29.5	21.0	16.5	15.0	14.0	12.0
4.0	21.0	18.0	12.5	10.0	8.0	7.5	7.0
5.0	20.0	17.5	12.3	11.0	8.0	7.0	6.5
Nominal mean stress, 10,000 psi							
1.0	----------	60.0×10^3	47.0×10^3	41.0×10^3	32.0×10^3	30.5×10^3	29.0×10^3
1.5	50.5×10^3	46.0	37.0	33.0	27.5	26.0	24.0
2.0	42.0	38.0	29.0	25.5	21.5	21.0	21.0
4.0	28.5	25.0	20.0	16.0	15.5	15.0	15.0
5.0	26.5	23.5	18.0	16.5	15.0	14.8	14.5
Nominal mean stress, 20,000 psi							
1.0	----------	65.0×10^3	53.0×10^3	46.0×10^3	39.5×10^3	39.0×10^3	38.0×10^3
1.5	57.5×10^3	53.0	43.5	40.0	34.0	33.0	32.0
2.0	52.0	48.0	38.0	34.0	30.0	30.0	30.0
4.0	35.0	32.0	27.0	25.0	25.0	24.0	24.0
5.0	33.0	31.0	26.0	25.0	24.2	24.0	23.5
Nominal mean stress, 30,000 psi							
1.0	----------	70.0×10^3	59.0×10^3	54.0×10^3	48.0×10^3	47.0×10^3	46.0×10^3
1.5	61.0×10^3	59.0	51.0	48.5	44.0	43.0	41.0
2.0	59.0	56.0	47.0	43.0	39.5	39.0	39.0
4.0	45.0	41.0	36.0	35.0	34.0	34.0	34.0
5.0	42.3	40.0	36.0	34.7	33.8	33.3	33.0

(1)Values for unnotched specimens and for severely notched specimens are taken from references 1, 2, and 3.

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TABLE 6.- SUMMARY OF RESULTS OF AXIAL-LOAD FATIGUE TESTS ON

75S-T6 ALUMINUM-ALLOY SHEET SPECIMENS WITH EDGE NOTCHES

Notch severity, K_t	Nominal maximum stress (psi) at lifetimes (cycles) of - (1)						
	5×10^3	10^4	5×10^4	10^5	5×10^5	10^6	10^7
Nominal mean stress, 0 psi							
1.0	----------	53.0×10^3	41.0×10^3	35.0×10^3	32.5×10^3	32.0×10^3	30.0×10^3
1.5	47.0×10^3	41.0	31.5	27.5	22.0	20.0	17.0
2.0	35.0	31.0	24.0	20.0	17.5	16.5	15.5
4.0	20.0	17.0	13.0	11.0	8.5	8.0	7.5
5.0	20.0	16.5	11.5	10.0	8.0	7.3	6.0
Nominal mean stress, 10,000 psi							
1.0	----------	62.0×10^3	47.0×10^3	40.0×10^3	39.0×10^3	36.0×10^3	35.0×10^3
1.5	54.0×10^3	48.0	36.5	33.0	28.5	27.0	24.0
2.0	42.0	38.0	29.5	26.5	24.5	23.5	23.0
4.0	27.0	23.0	18.0	16.0	15.0	14.0	14.0
5.0	25.0	21.0	15.5	15.0	14.0	14.0	13.5
Nominal mean stress, 20,000 psi							
1.0	----------	70.0×10^3	52.0×10^3	45.0×10^3	43.0×10^3	42.0×10^3	41.0×10^3
1.5	60.0×10^3	54.5	41.5	38.5	34.5	34.0	32.5
2.0	50.0	46.0	33.0	32.0	30.0	29.5	29.5
4.0	33.0	31.0	25.0	24.0	23.0	23.0	23.0
5.0	31.0	28.5	24.5	23.7	23.0	22.7	22.5
Nominal mean stress, 30,000 psi							
1.0	----------	75.0×10^3	58.5×10^3	54.0×10^3	50.0×10^3	49.0×10^3	49.0×10^3
1.5	65.0×10^3	60.0	48.5	45.0	41.5	41.0	40.0
2.0	59.5	53.0	42.0	39.5	38.5	38.5	38.5
4.0	42.0	39.0	34.0	34.0	33.0	33.0	33.0
5.0	40.0	38.5	34.7	34.0	33.5	33.5	33.3

(1) Values for unnotched specimens and for severely notched specimens are taken from references 1, 2, and 3.

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TABLE 7.- SUMMARY OF RESULTS OF AXIAL-LOAD FATIGUE TESTS ON NORMALIZED

SAE 4130 STEEL SHEET SPECIMENS WITH EDGE NOTCHES

Notch severity, K_t	Nominal maximum stress (psi) at lifetimes (cycles) of - (1) (2)						
	5×10^3	10^4	5×10^4	10^5	5×10^5	10^6	10^7
Nominal mean stress, 0 psi							
1.0	-------	75.0×10^3	65.0×10^3	63.0×10^3	55.0×10^3	52.0×10^3	47.0×10^3
1.5	-------	(72.0)	55.0	49.5	40.0	38.5	35.5
2.0	-------	(55.0)	44.5	40.0	33.0	30.0	27.0
4.0	-------	45.0	32.0	27.0	19.0	16.0	14.0
5.0	-------	43.0	30.0	25.0	16.0	13.0	10.0
Nominal mean stress, 10,000 psi							
1.0	-------	87.0×10^3	79.0×10^3	73.0×10^3	68.0×10^3	60.0×10^3	60.0×10^3
1.5	-------	(77.0)	65.5	60.0	48.0	45.5	44.5
2.0	-------	(64.0)	54.0	50.0	41.5	39.0	37.0
4.0	-------	52.0	38.0	34.0	25.0	23.0	23.0
5.0	-------	43.5	33.0	29.5	23.0	21.0	20.0
Nominal mean stress, 20,000 psi							
1.0	-------	95.0×10^3	87.0×10^3	81.0×10^3	75.0×10^3	68.0×10^3	68.0×10^3
1.5	-------	(85.0)	74.0	69.0	58.5	55.0	52.5
2.0	-------	(76.0)	65.0	60.0	50.0	47.0	45.0
4.0	-------	58.0	45.0	41.0	34.0	34.0	33.0
5.0	-------	51.0	39.5	35.0	31.0	30.5	30.0
Nominal mean stress, 30,000 psi							
1.0	-------	103.0×10^3	93.0×10^3	89.0×10^3	82.0×10^3	76.0×10^3	76.0×10^3
1.5	-------	(90.0)	80.0	76.5	66.0	65.0	61.0
2.0	-------	(85.0)	72.0	69.0	58.0	57.0	57.0
4.0	-------	64.0	52.0	49.0	44.0	44.0	43.0
5.0	-------	55.0	45.5	43.0	40.5	40.0	39.0

[1]Parentheses indicate value obtained by extrapolation.

[2]Values for unnotched specimens and for severely notched specimens are taken from references 1, 2, and 3.

TABLE 8.- FATIGUE-STRENGTH REDUCTION FACTORS FOR

NOMINAL MEAN STRESS OF 0 PSI

Material	Notch severity, K_t	K_f at lifetimes (cycles) of -			
		10^4	10^5	10^6	10^7
24S-T3 aluminum alloy	1.5	1.3	1.4	1.4	1.3
	2.0	1.7	2.1	1.9	1.8
	4.0	2.8	3.4	3.5	3.2
	5.0	2.9	3.1	3.5	3.4
75S-T6 aluminum alloy	1.5	1.3	1.3	1.6	1.8
	2.0	1.7	1.8	1.9	1.9
	4.0	3.2	3.2	4.0	4.0
	5.0	3.3	3.5	4.4	5.0
Normalized SAE 4130 steel	1.5	---	1.3	1.4	1.3
	2.0	---	1.6	1.7	1.7
	4.0	---	2.3	3.3	3.4
	5.0	---	2.5	4.0	4.7

TABLE 9.- FATIGUE-STRENGTH REDUCTION FACTORS FOR NOMINAL MEAN STRESS GREATER THAN ZERO

Nominal mean stress (psi)	Notch severity, K_t	K_f at lifetimes (cycles) of -			
		10^4	10^5	10^6	10^7
24S-T3 aluminum alloy					
10×10^3	1.5	1.1	1.3	1.3	1.4
	2.0	1.7	1.8	1.7	1.6
	4.0	2.7	3.5	3.1	3.1
	5.0	3.0	3.3	3.2	3.3
20	1.5	1.2	1.2	1.4	1.4
	2.0	1.4	1.6	1.6	1.6
	4.0	2.2	2.8	---	---
	5.0	2.3	2.8	---	---
30	1.5	1.2	1.2	1.2	1.3
	2.0	1.3	1.5	1.5	1.5
	4.0	1.8	2.1	---	---
	5.0	1.8	2.1	---	---
75S-T6 aluminum alloy					
10×10^3	1.5	1.4	1.3	1.4	1.6
	2.0	1.8	1.7	1.7	1.7
	4.0	3.2	3.8	3.9	3.9
	5.0	3.5	3.9	3.9	4.5
20	1.5	1.3	1.2	1.2	1.5
	2.0	1.6	1.7	1.8	1.8
	4.0	---	3.1	---	---
	5.0	---	---	---	---
30	1.5	1.6	1.3	1.4	1.6
	2.0	---	1.6	1.7	1.7
	4.0	---	---	---	---
	5.0	---	---	---	---
Normalized SAE 4130 steel					
10×10^3	1.5	---	1.3	1.5	1.4
	2.0	---	1.6	1.7	1.8
	4.0	---	2.5	3.4	3.4
	5.0	---	3.0	4.0	4.2
20	1.5	---	1.2	1.4	1.4
	2.0	---	1.5	1.6	1.7
	4.0	---	2.4	2.7	2.8
	5.0	---	3.3	3.1	3.2
30	1.5	---	1.2	1.3	1.4
	2.0	---	1.3	1.5	1.5
	4.0	---	2.1	2.2	2.2
	5.0	---	2.5	2.7	2.7

NACA

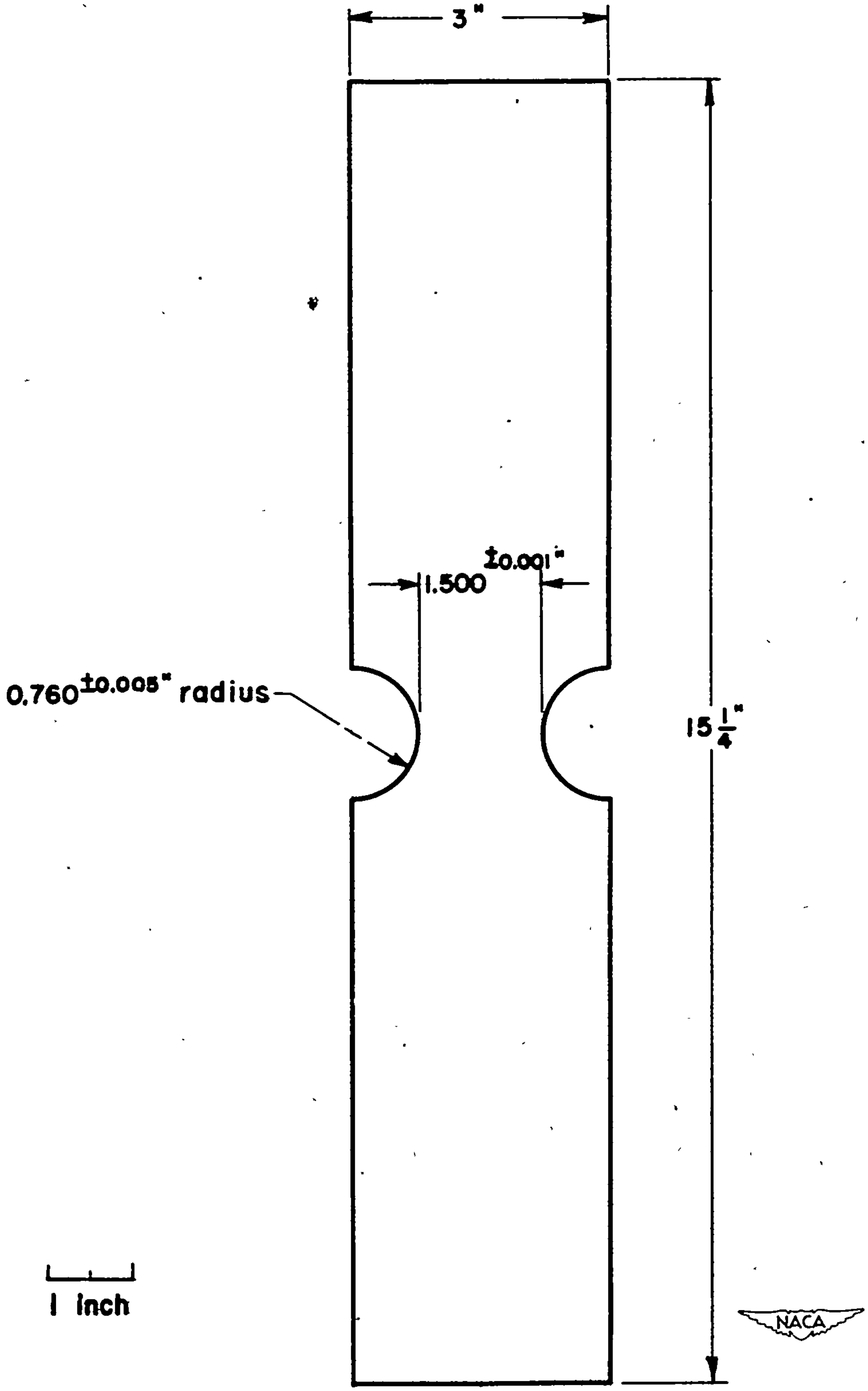

Figure 1.- Notched fatigue test specimen with $K_t = 1.5$.

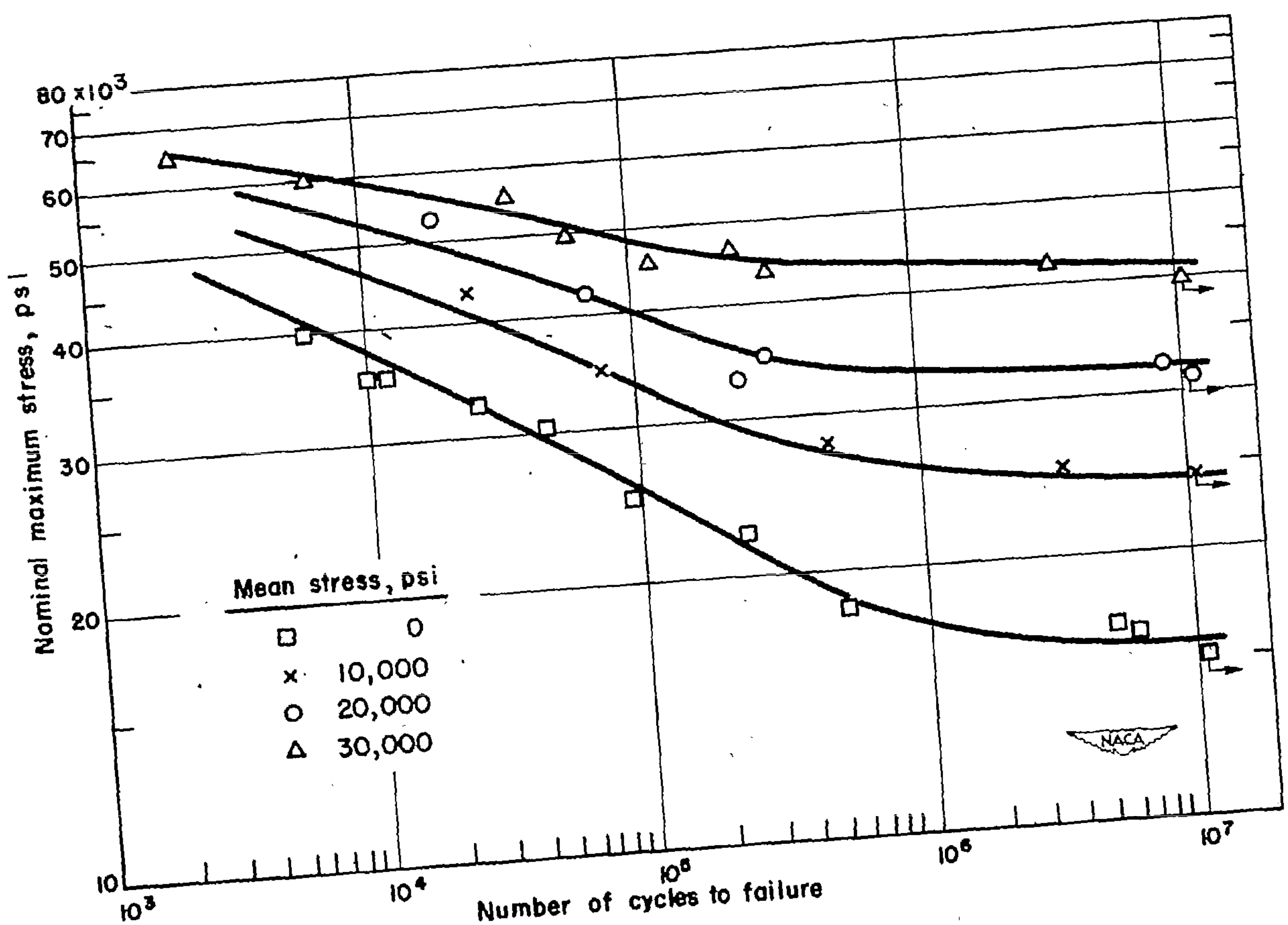

Figure 2.- Results of axial-load fatigue tests on 24S-T3 aluminum-alloy sheet specimens, edge notched with $K_t = 1.5$.

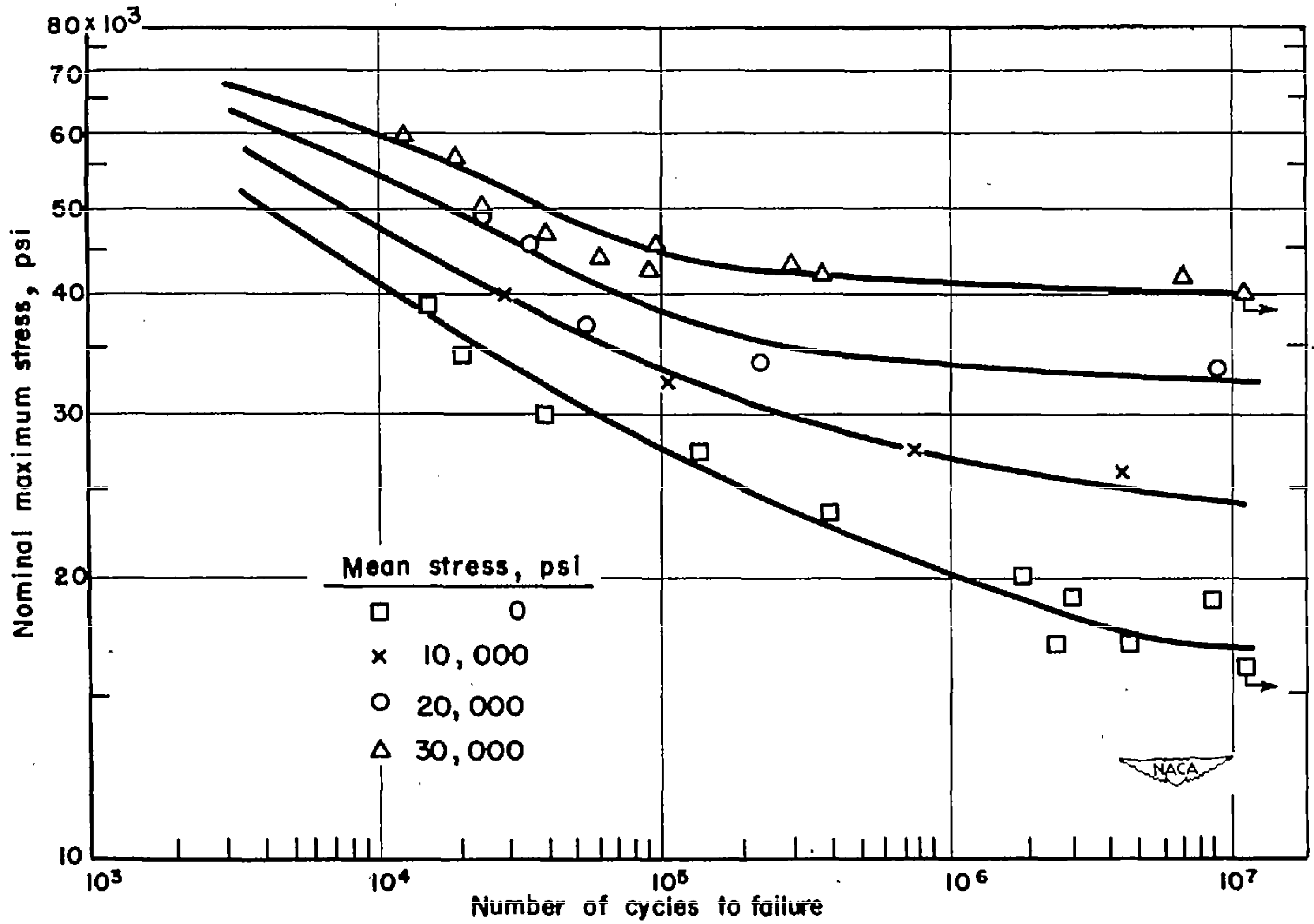

Figure 3.- Results of axial-load fatigue tests on 75S-T6 aluminum-alloy sheet specimens, edge notched with $K_t = 1.5$.

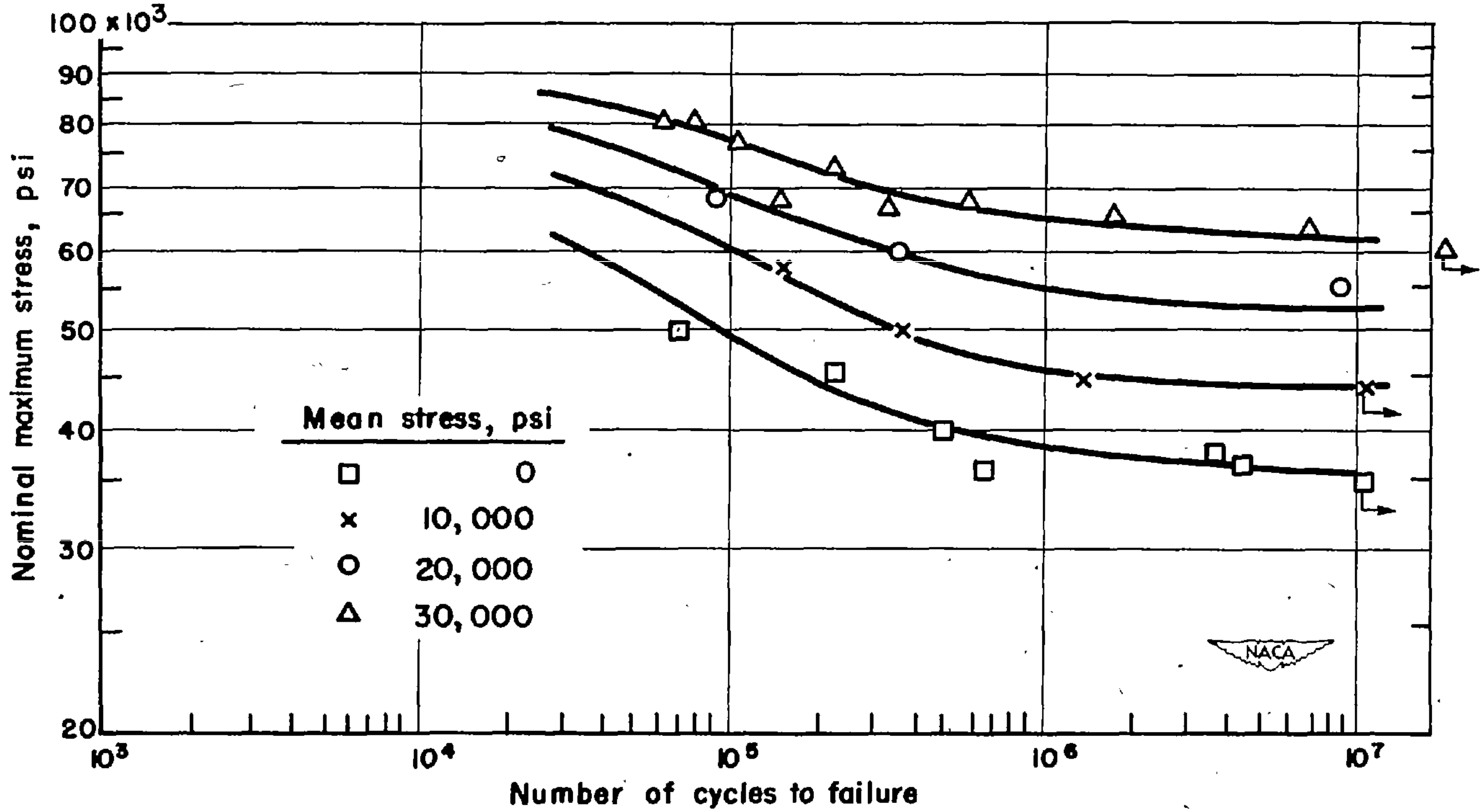

Figure 4.- Results of axial-load fatigue tests on normalized SAE 4130 steel sheet specimens, edge notched with $K_t = 1.5$.

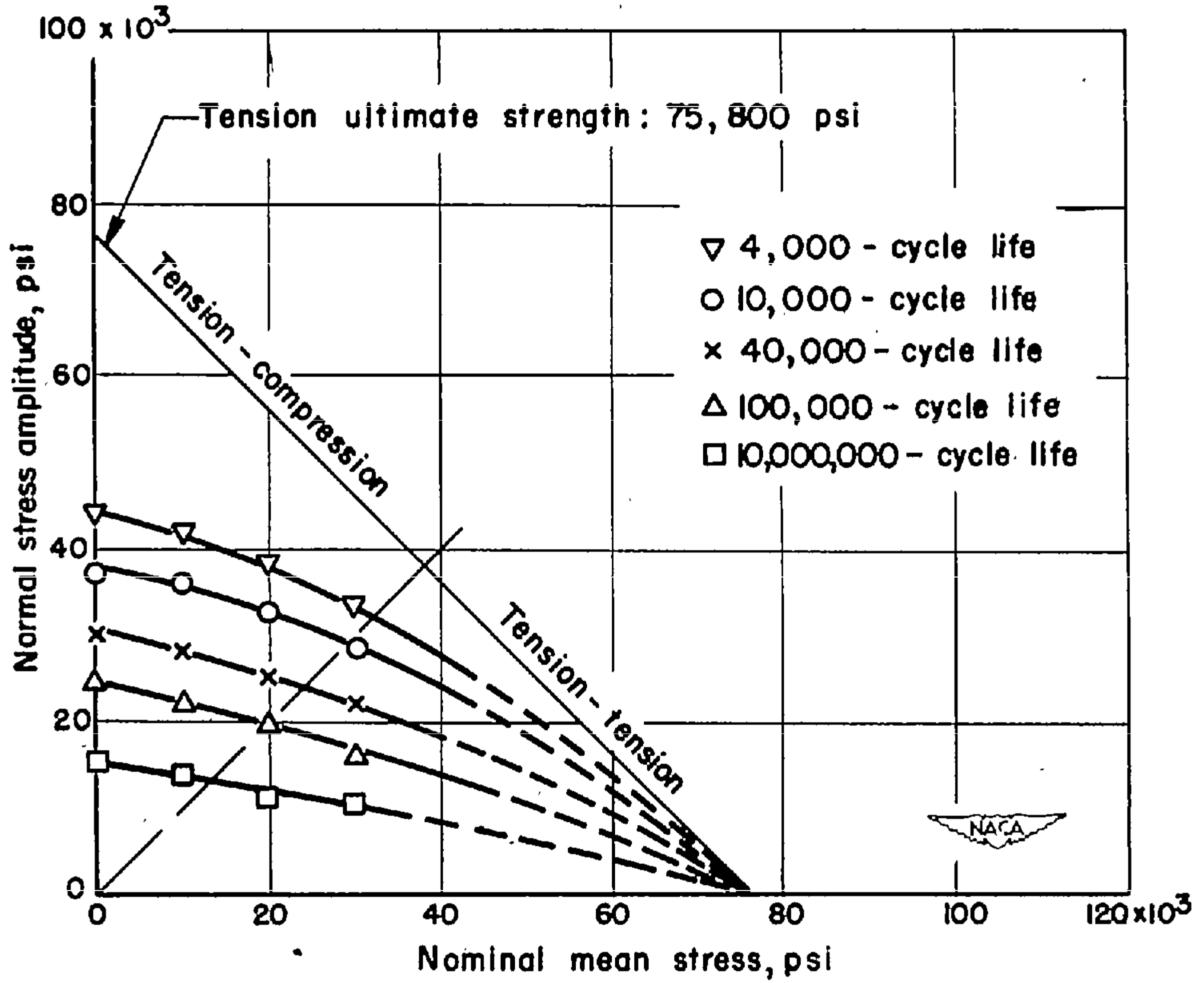

Figure 5.- Constant-lifetime curves for 24S-T3 aluminum-alloy sheet specimens, edge notched with $K_t = 1.5$.

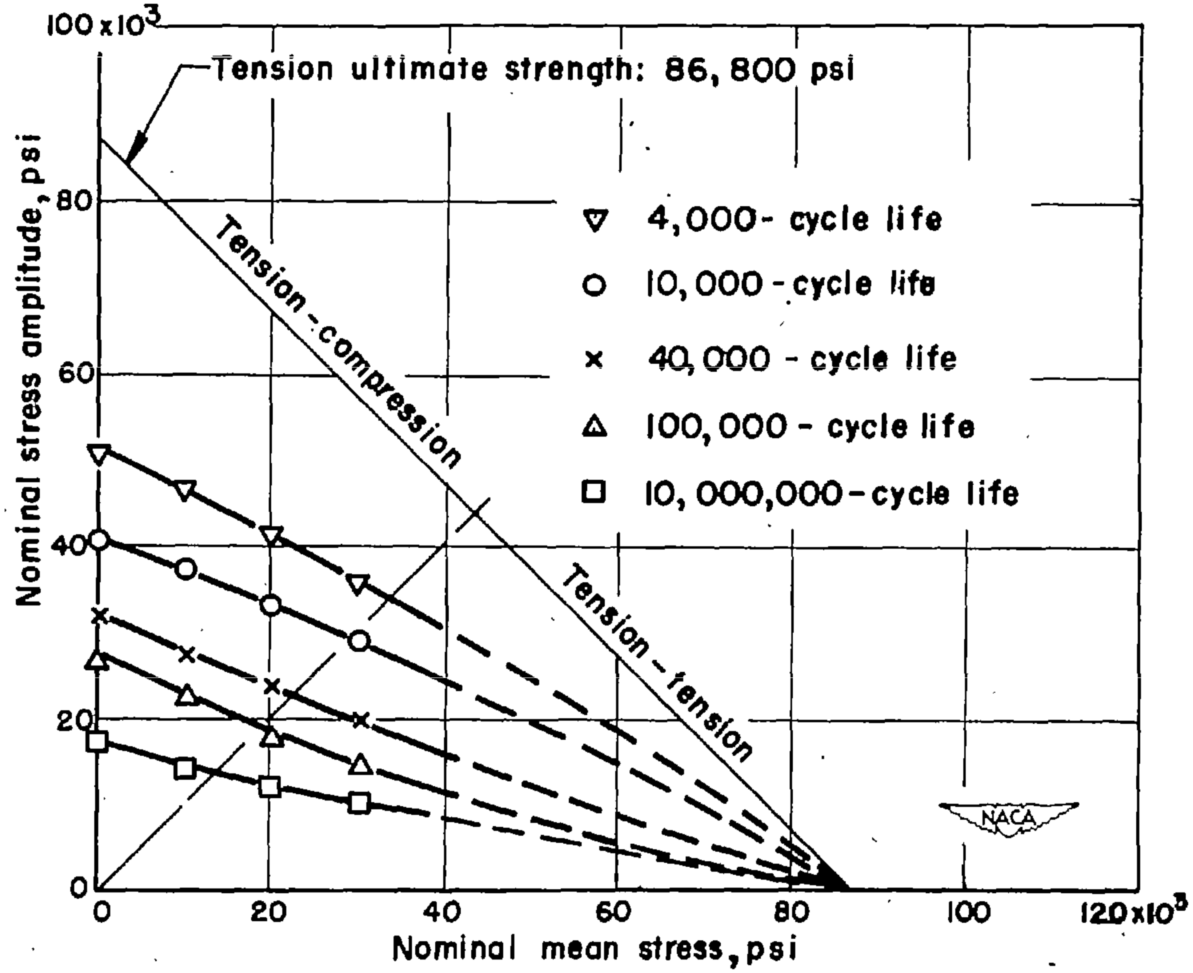

Figure 6.- Constant-lifetime curves for 75S-T6 aluminum-alloy sheet specimens, edge notched with $K_t = 1.5$.

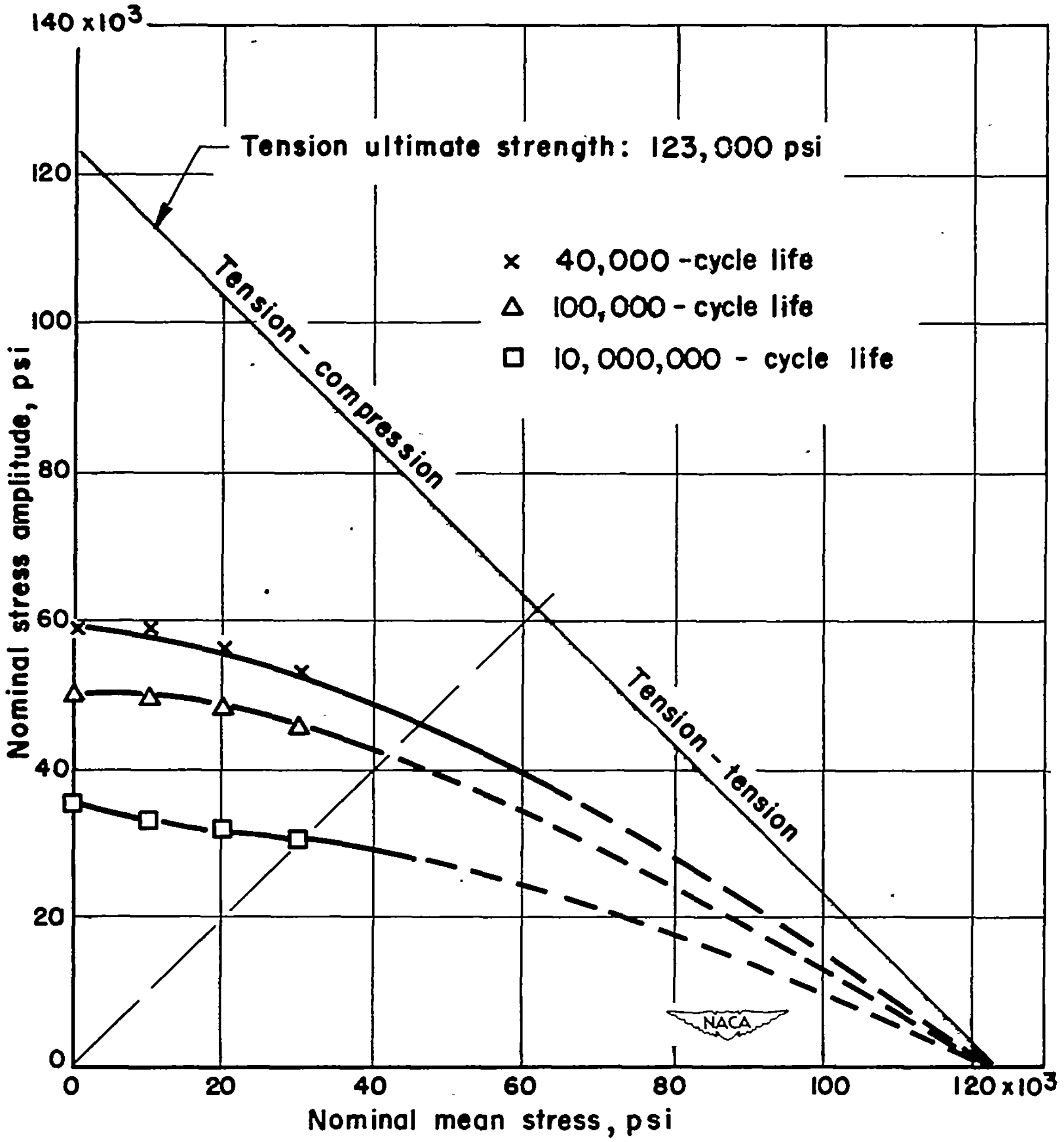

Figure 7.- Constant-lifetime curves for a normalized SAE 4130 steel sheet specimens, edge notched with $K_t = 1.5$.

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