NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TECHNICAL NOTE 3631

RESULTS OF AXIAL-LOAD FATIGUE TESTS ON ELECTROPOLISHED 2024-T3 AND 7075-T6 ALUMINUM-ALLOY-SHEET SPECIMENS WITH CENTRAL HOLES

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SUMMARY

Results are presented of axial-load fatigue tests at stress ratios of 0 and -1.0 on electropolished 2024-T3 (24S-T3) and 7075-T6 (75S-T6) aluminum-alloy-sheet specimens with central holes. The specimen widths and hole diameters were varied in order to provide data suitable for a study of the effect of notch size. The data are compared with previously published results of tests on unnotched electropolished specimens and on unpolished specimens containing central holes.

INTRODUCTION

During the past several years, the National Advisory Committee for Aeronautics has sponsored a long-range experimental program intended to provide data for an evaluation of the effects of notches on the fatigue behavior of aircraft structural materials. One series of tests (refs. 1 and 2) was conducted at the National Bureau of Standards on unpolished 2024-T3 and 7075-T6 aluminum-alloy-sheet specimens with and without holes. Battelle Memorial Institute (refs. 3 to 6) provided data from axial-load fatigue tests of electropolished-sheet specimens made of 2024-T3 and 7075-T6 aluminum alloys and normalized SAE 4130 steel. The latter tests included nine specimen configurations and four mean-stress levels. Battelle (ref. 7) also tested rotating-beam specimens of 7075-T6 aluminum alloy.

Another part of the long-range program was conducted at the NACA Langley Laboratory and is reported herein. The present results are from axial-load tests of electropolished 2024-T3 and 7075-T6 aluminum-alloy-sheet specimens containing single central holes.

SPECIMENS AND TESTS

The material from which the specimens were made was taken from the NACA stock of 2024-T3 and 7075-T6 sheet described in reference 8. Specimen identifications are in agreement with the sheet layout given in reference 3. The specimen blanks were cut from the sheets with the long dimension parallel to the direction of rolling and were clamped in stacks for machining the edges. The specimen configurations and the various combinations of central-hole diameters and specimen widths are presented in figure 1. The central holes were made in three steps as indicated in table I. Tool speeds, depths of cuts, and feeds given in table I were chosen to give uniform cutting conditions, to avoid tool chatter, and to minimize work hardening of the surface. All holes of 0.490-inch diameter or greater were bored and the rest were drilled. Drill sizes were chosen to give approximately the same depth of cut obtained in the bored holes. Extreme care was exercised throughout the preparation to avoid damaging the specimens in any way. After being machined and deburred, all specimens were sent to Battelle Memorial Institute for electropolishing; this process removed approximately 0.0008 inch from the surface.

Axial-load fatigue tests were conducted on a series of specimens for each combination of hole diameter d and width W in both materials at stress ratios R of 0 and -1.0, where R is the ratio of minimum stress to maximum stress in the cycle. The maximum stress S_{max} for each specimen was computed for the area of the net cross section. The testing procedure and monitoring techniques used in this investigation were the same as those described in references 8 and 9. All fatigue specimens were clamped between guides similar to those described in reference 10 except five which were tested at a stress ratio of 0.02 without guides.

Most of the tests were performed in subresonant fatigue testing machines with capacities of 20,000 pounds at 1,800 cpm (ref. 8). Because of the trial-and-error procedure required to start each test, it was not practical to use these machines for tests in which failure occurred in less than 10,000 cycles. Consequently, a hydraulic machine operated at 180 cpm was used for tests in which failure was expected to occur in 500 to 10,000 cycles. Tests in which failure was expected to occur in less than 500 cycles were performed in a static testing machine which was manually controlled to apply load at approximately 2 cpm.

RESULTS AND DISCUSSION

The results of all tests are presented in tables II and III and data are plotted in figures 2 to 24. Those tests which ran less than one thousand cycles and those which resulted in failure at the grip line are not plotted. The data for specimens which did not fail are plotted with arrows pointing to the right. On four occasions the automatic cutoff failed to operate when the specimen failed and fatigue life was estimated for each specimen. Due to the fact that these were long-life tests, the possible error in position of the plotted point is small. Static tensile tests were performed on each type of specimen and the tensile strengths are plotted with arrows pointing to the left.

Table IV gives average values of stress at various fatigue lives (given by the number of cycles to failure N) for 1-inch-wide, unnotched, electropolished sheet specimens of 2024-T3 and 7075-T6 aluminum-alloy sheet taken from the same lot of material, tested at Battelle Memorial Institute and the NACA Langley Aeronautical Laboratory, and reported on in reference 8. These values of stress were divided by the corresponding values of stress in notched specimens of various widths at the same lifetime to obtain the fatigue-stress-concentration factors K_F given in table V. For the most part, the variations in K_F for a given configuration tested at a given load ratio are not significant. However, the 2024-T3 specimens tested at $R = 0$ show some tendency for K_F to decrease with increasing stress (decreasing life). In these latter specimens the maximum local stress was probably in the plastic range, and a reduction in the stress-concentration factor is to be expected.

A comparison of K_F values at some long life, where plastic action will not affect the results, is of interest in an evaluation of the notch-size effect (ref. 11). Values of K_F at $N = 10^7$ cycles are plotted against the ratio d/W for each material and stress ratio in figures 25 and 26. The theoretical elastic stress-concentration factor K_T from reference 12 is shown for comparison. It is clearly evident that K_F decreased with decreasing size for a given d/W (therefore the same K_T). Also, the difference between K_F and K_T showed a tendency to increase with decreasing d/W. These plots form a consistent pattern which appears to give definite evidence of a notch-size effect. Preliminary analysis of these data indicates that the Neuber technical factor K_N (refs. 11 and 13) with a material constant of 0.02 inch provides a possible method of predicting this effect.

The National Bureau of Standards (NBS) conducted tests (refs. 1 and 2) similar to the present tests, except that unpolished specimens were used. In addition, a series of unnotched specimens with a width corresponding to each width of notched specimens was tested. Surface defects and a "sampling" effect due to various sizes of specimens probably contributed significantly to the rather large scatter in results of tests on the unnotched specimens. These factors probably explain why values of K_F computed from the NBS data produced apparently unrelated curves and gave only slight or inconclusive evidence of a size effect in notched specimens.

The effect of surface defects is probably not so important for unpolished notched specimens since the maximum stress occurs in a rather localized area and the chance of having a scratch nearby is negligible. Consequently, a comparison of data from unpolished notched specimens with data from polished unnotched specimens might be expected to exhibit better correlation. However, a comparison between the NBS data on notched specimens (ref. 2) with the data on unnotched specimens given in table IV (from ref. 8) yields curves of K_F against d/W which also appear unrelated. This lack of correlation may be attributed in part to the fact that the burrs around the holes of specimens in reference 2 were not removed. Such burrs may have influenced the fatigue failure in some erratic fashion.

CONCLUDING REMARKS

Axial-load fatigue data on electropolished 2024-T3 and 7075-T6 aluminum-alloy-sheet specimens with central holes have been presented. The specimen widths and hole diameters were varied in order to provide data suitable for study of notch-size effect. The data are compared with data from tests of unnotched electropolished specimens made from the same lot of material. The fatigue stress-concentration factors K_F are plotted against the ratio of hole diameter d to specimen width W. From these plots it is evident that K_F decreased with decreasing width for the same value of d/W; the difference between K_F and the elastic stress-concentration factor K_T increased with decreasing d/W. Definite evidence of a notch-size effect was thus indicated.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., December 13, 1955.

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TABLE I.- SPECIMEN MACHINING DATA

Hole diameter, in.		1/32	1/16	1/8	1/4	1/2	1	2
Starting size, in.		0.021	0.052	0.116	0.238	0.490	0.990	1.990
Second cut, in.		0.026	0.059	0.120	0.246	0.496	0.996	1.996
Final cut, in.		0.031	0.0625	0.125	0.250	0.500	1.000	2.000
2024-T3								
W = 4 in.	Speed, rpm Feed per rev., in.	------- -------	------- -------	1450 0.0016	1450 0.0016	385 0.0016	385 0.0016	385 0.0016
W = 2 in.	Speed, rpm Feed per rev., in.	------- -------	2240 0.0003	2240 0.0003	385 0.002	385 0.002	385 0.002	------- -------
W = 1/2 in.	Speed, rpm Feed per rev., in.	2240 0.0002	2240 0.0002	1450 0.0002	935 0.0003	------- 0.0006	------- -------	------- -------
7075-T6								
W = 4 in.	Speed, rpm Feed per rev., in.	------- -------	------- -------	1450 0.00035	1450 0.00035	------- -------	------- -------	385 0.0015
W = 2 in.	Speed, rpm Feed per rev., in.	------- -------	1450 .00035	1450 0.00035	------- -------	------- -------	385 0.0015	------- -------
W = 1/2 in.	Speed, rpm Feed per rev., in.	2240 0.0002	------- -------	1450 0.0003	935 0.0006	------- -------	------- -------	------- -------

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 4 in.; d = 1/8 in.					
A148D8-7	62.2	Static			
A148D8-3	40.0	24,000	A143D4-2	25.0	11,000
A148D8-5	40.0	24,000	A143D4-3	22.0	30,000
A146D4-7	35.0	35,000	A143D4-4	19.0	130,000
A146D4-6	35.0	46,000	A143D4-5	16.0	418,000
A146D4-5	30.0	62,000	A144D4-5	15.0	235,000
A146D4-3	30.0	74,000	A144D4-4	14.0	303,000
A148D8-1	25.0	99,000	A143D4-6	13.0	3,115,000
A148D8-2	25.0	182,000	A143D4-7	12.0	1,029,000
A145D4-4	20.0	703,000	A144D4-6	12.0	1,586,000
A145D4-6	20.0	887,000	A144D4-1	11.0	4,596,000
A146D4-2	17.0	818,000	A144D4-7	10.0	7,097,000
A146D4-4	17.0	8,692,000	A144D4-2	10.0	8,864,000
A145D4-5	17.0	[a]18,775,000	A144D4-3	9.0	58,657,000
A145D4-7	17.0	[a]48,226,000			
A148D8-4	17.0	[b]79,881,000			
A146D4-1	15.0	64,907,000			
A145D4-1	15.0	[b]99,681,000			
W = 4 in.; d = 1/4 in.					
A148D4-2	63.1	Static			
A146D8-7	40.0	11,000	A144D8-6	25.0	7,000
A148D4-1	40.0	18,000	A144D8-7	25.0	10,000
A146D8-1	35.0	25,000	A144D8-4	20.0	39,000
A145D32-7	35.0	36,000	A144D8-5	19.4	44,000
A146D8-3	30.0	57,000	A144D8-3	14.5	249,000
A146D8-2	30.0	63,000	A144D8-1	14.5	274,000
A146D8-5	25.0	112,000	A143D8-1	12.0	657,000
A146D8-4	25.0	190,000	A143D8-7	12.0	741,000
A145D32-5	20.0	262,000	A143D8-4	10.0	9,029,000
A145D32-4	20.0	298,000	A143D8-3	10.0	12,637,000
A145D32-1	17.0	890,000	A143D8-6	9.0	17,053,000
A145D32-6	17.0	986,000	A144D8-2	8.75	17,575,000
A145D32-3	15.0	39,455,000			
A145D32-2	15.0	40,856,000			

[a]Failed at grip line.

[b]Did not fail.

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 4 in.; d = 1/2 in.					
A150D4-3	63.2	Static			
A150D4-2	45.0	7,000	A145D8-1	25.0	5,000
A150D4-1	45.0	10,000	A145D8-2	25.0	7,000
A148D32-7	40.0	17,000	A144D64-3	20.0	22,000
A148D32-6	40.0	17,000	A144D64-1	20.0	25,000
A148D32-5	35.0	38,000	A143D32-2	15.0	99,000
A148D32-4	35.0	44,000	A143D32-1	15.0	145,000
A148D32-2	30.0	[c]27,000	A144D64-6	15.0	171,000
A148D32-3	30.0	[c]32,000	A143D32-4	12.0	397,000
A146D32-5	30.0	61,000	A144D64-5	12.0	416,000
A146D32-6	30.0	70,000	A143D32-3	12.0	421,000
A145D8-4	25.0	91,000	A143D32-5	10.0	1,994,000
A145D8-3	25.0	104,000	A143D32-6	10.0	2,296,000
A145D8-6	20.0	132,000	A144D64-2	10.0	2,354,000
A145D8-5	20.0	254,000	A144D64-4	10.0	4,386,000
A146D32-1	17.0	658,000	A144D64-7	9.0	[d]20,000,000
A146D32-4	17.0	1,065,000	A143D32-7	9.0	20,092,000
A148D32-1	17.0	[c]2,690,000			
A146D32-7	17.0	[c]3,376,000			
A146D32-2	17.0	9,974,000			
A145D8-7	15.0	15,824,000			
A146D32-3	15.0	21,374,000			
W = 4 in.; d = 1 in.					
A150d16-7	66.5	Static			
A150D16-5	45.0	12,000	A143D16-3	27.0	6,000
A150D16-4	45.0	13,000	A143D16-5	25.0	8,000
A150D16-2	40.0	16,000	A143D16-4	25.0	10,000
A150D16-3	40.0	24,000	A145D64-2	20.0	26,000
A148D16-4	35.0	51,000	A145D64-1	20.0	48,000
A148D16-5	35.0	55,000	A145D64-3	20.0	48,000
A148D16-3	30.0	65,000	A145D64-4	15.0	133,000
A148D16-2	30.0	74,000	A144D32-6	15.0	197,000
A148D16-1	25.0	153,000	A145D64-5	15.0	213,000
A146D16-7	25.0	280,000	A144D32-5	15.0	237,000
A146D16-2	20.0	212,000	A144D32-2	12.9	483,000
A146D16-6	20.0	837,000	A144D32-1	12.0	547,000
A146D16-1	20.0	924,000	A144D32-3	10.0	[a]3,791,000
A145D64-7	17.0	476,000	A144D32-4	10.0	11,889,000
A145D64-6	17.0	[d]15,000,000	A143D16-7	10.0	13,459,000
A146D16-5	17.0	18,944,000	A144D32-7	10.0	14,185,000
A150D16-1	15.0	850,000	A143D16-6	9.7	13,541,000
A146D16-3	15.0	[a]8,494,000	A143D16-2	9.0	46,985,000
A148D16-7	15.0	13,558,000	A143D16-1	9.0	47,193,000
A146D16-4	15.0	38,054,000			
A148D16-6	15.0	[c]52,056,000			

[a]Failed at grip line.
[c]No guides.
[d]Estimated life.

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 4 in.; d = 2 in.					
A150D64-6	69.7	Static			
A150D64-1	50.0	15,000	A145D16-4	25.0	12,000
A150D64-2	50.0	17,000	A145D16-3	25.0	15,000
A148D64-4	45.0	18,000	A143D64-2	20.0	44,000
A148D64-3	45.0	26,000	A143D64-1	20.0	84,000
A148D64-2	40.0	31,000	A143D64-3	18.0	53,000
A148D64-6	40.0	46,000	A143D64-4	18.0	65,000
A146D64-7	35.0	39,000	A143D64-5	15.0	321,000
A148D4-1	35.0	53,000	A143D64-6	15.0	361,000
A146D64-5	30.0	61,000	A144D16-1	12.0	993,000
A146D64-6	30.0	63,000	A144D16-5	12.0	1,025,000
A146D64-4	25.0	162,000	A143D64-7	12.0	[a]1,806,000
A146D64-3	25.0	185,000	A144D16-6	12.0	3,090,000
A148D64-7	22.0	213,000	A144D16-2	10.0	7,259,000
A148D64-5	22.0	752,000	A144D16-3	10.0	24,151,000
A146D64-2	20.0	[d]6,000,000	A144D16-4	10.0	26,825,000
A146D64-1	20.0	9,345,000	A145D16-5	10.0	27,993,000
A150D64-5	20.0	9,395,000	A145D16-6	10.0	34,081,000
A150D64-3	18.0	12,713,000	A145D16-1	9.0	35,710,000
A150D64-4	18.0	17,337,000	A144D16-7	9.0	61,900,000
A145D16-7	15.0	[b]103,970,000	A145D16-2	9.0	81,946,000
W = 2 in.; d = 1/16 in.					
A145C2-6	63.6	Static			
A149C2-1	64.6	Static	A146C32-6	25.0	18,000
A143C2-6	64.0	94	A143C32-1	25.0	23,000
A149C2-7	63.0	197	A143C8-3	25.0	23,000
A143C8-4	60.0	255	A143C32-7	20.0	52,000
A143C8-1	60.0	529	A143C8-6	20.0	58,000
A146C32-1	55.0	1,650	A150C2-6	20.0	81,000
A149C2-4	55.0	2,031	A143C8-2	15.0	268,000
A143C32-6	50.0	3,516	A145C2-7	15.0	374,000
A149C2-2	50.0	4,075	A143C2-7	15.0	401,000
A144C2-6	45.0	8,000	A143C8-7	13.0	523,000
A143C2-4	45.0	14,000	A146C32-4	13.0	2,079,000
A150C2-3	40.0	18,000	A144C2-7	13.0	2,318,000
A144C2-2	40.0	26,000	A143C8-5	11.0	5,418,000
A150C2-5	35.0	32,000	A149C2-5	11.0	5,819,000
A144C2-1	35.0	34,000	A143C2-2	11.0	9,373,000
A150C2-1	30.0	75,000	A146C32-7	11.0	9,505,000
A144C2-5	30.0	113,000	A149C2-6	10.0	13,060,000
A150C2-4	25.4	94,000	A149C2-3	10.0	27,186,000
A150C2-2	25.0	124,000	A144C2-4	10.0	32,526,000
A144C32-3	22.0	350,000			
A143C32-2	22.0	555,000			
A146C32-2	20.0	1,009,000			
A144C2-3	20.0	7,719,000			
A146C32-5	18.0	30,438,000			
A143C32-4	18.0	32,348,000			
A143C2-1	17.0	105,511,000			
A143C2-5	17.0	[b]126,085,000			
A143C2-7	17.0	[b]166,717,000			

[a]Failed at grip line.
[b]Did not fail.
[d]Estimated life.

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 2 in.; d = 1/8 in.					
A145C4-1	63.9	Static			
A149C32-5	61.6	Static	A149C32-7	26.0	8,000
A150C4-3	61.0	Static	A144C4-6	26.0	9,000
A149C32-1	60.0	344	A145C4-6	25.0	12,000
A146C4-1	60.0	533	A150C4-4	20.0	33,000
A145C4-4	50.0	1,681	A144C4-3	20.0	43,000
A148C32-6	40.0	9,570	A146C4-4	20.0	53,000
A148C4-6	40.0	15,156	A148C32-3	15.0	138,000
A148C4-7	35.0	31,000	A150C4-5	15.0	186,000
A148C32-2	35.0	38,000	A150C4-1	15.0	218,000
A143C4-3	30.0	38,000	A146C4-2	13.0	213,000
A148C4-3	30.0	65,000	A144C4-4	13.0	411,000
A148C4-2	25.0	100,000	A149C32-2	13.0	1,838,000
A149C32-3	25.0	104,000	A144C4-1	11.0	976,000
A144C4-7	20.0	172,000	A144C4-5	11.0	1,063,000
A148C4-5	20.0	409,000	A148C32-4	11.0	1,472,000
A146C4-6	18.0	2,005,000	A148C4-1	10.0	13,864,000
A148C32-5	18.0	12,607,000	A146C4-7	10.0	16,860,000
A150C4-2	17.0	8,970,000	A148C32-7	10.0	[b]91,920,000
A148C32-4	16.0	34,008,000			
A145C4-7	15.0	43,221,000			
A148C32-1	15.0	117,776,000			
W = 2 in.; d = 1/4 in.					
A145C8-7	64.2	Static			
A148C8-2	62.0	Static	A145C8-6	25.0	9,000
A148C16-1	61.0	280	A148C16-6	25.0	9,000
A144C8-3	40.0	13,000	A148C16-2	25.0	10,000
A148C8-5	40.0	19,000	A148C16-7	20.0	30,000
A146C8-5	30.0	51,000	A146C16-7	20.0	31,000
A145C8-2	30.0	56,000	A146C8-4	20.0	31,000
A150C8-1	25.0	90,000	A148C8-3	15.0	90,000
A148C8-7	25.0	158,000	A146C8-1	15.0	112,000
A146C16-2	20.0	124,000	A144C8-1	15.0	175,000
A145C8-1	20.0	155,000	A145C8-5	10.0	731,000
A146C16-4	18.0	286,000	A148C16-3	10.0	2,485,000
A146C16-3	18.0	4,196,000	A146C16-6	10.0	3,529,000
A146C8-3	18.0	5,300,000	A150C8-5	10.0	5,714,000
A144C8-7	16.0	9,578,000	A148C16-5	10.0	6,639,000
A150C8-6	16.0	11,995,000	A148C16-4	9.0	6,637,000
A144C8-6	15.0	20,883,000	A144C8-4	9.0	29,305,000
A150C8-4	15.0	25,848,000	A146C8-7	9.0	32,134,000
A150C8-2	14.0	66,472,000			
A148C8-4	14.0	138,541,000			

[b]Did not fail.

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 2 in.; d = 1/2 in.					
A150C4-1	68.0	Static			
A150C16-4	63.0	Static	A144C16-5	25.0	8,000
A146C2-5	40.0	16,000	A145C16-2	25.0	9,000
A150C16-5	40.0	16,000	A146C2-1	25.0	9,000
A149C8-1	35.0	25,000	A144C16-6	20.0	29,000
A146C2-4	35.0	25,000	A149C16-7	20.0	32,000
A144C16-2	30.0	39,000	A149C16-4	20.0	36,000
A144C16-7	30.0	46,000	A149C16-6	15.0	108,000
A143C16-5	25.0	62,000	A150C16-1	15.0	122,000
A150C16-6	25.0	71,000	A149C16-4	15.0	125,000
A146C2-2	25.0	223,000	A143C16-3	12.0	340,000
A149C16-3	20.0	128,000	A149C16-1	12.0	516,000
A143C16-6	20.0	163,000	A149C16-5	12.0	674,000
A144C16-4	18.0	395,000	A149C16-2	10.0	[d]16,000,000
A144C16-1	18.0	12,507,000	A146C2-7	10.0	18,767,000
A149C8-5	16.0	368,000	A145C16-7	10.0	25,450,000
A149C8-3	16.0	381,000			
A143C16-7	16.0	474,000			
A145C16-6	15.0	33,810,000			
A146C2-6	15.0	37,120,000			
A145C16-5	14.0	77,092,000			
A149C8-2	14.0	129,020,000			
W = 2 in.; d = 1 in.					
A145C32-1	69.7	Static			
A143C4-2	64.0	Static	A150C32-6	25.0	15,000
A148C2-1	40.0	23,000	A149C4-4	25.0	16,000
A149C4-6	40.0	34,000	A149C4-2	25.0	19,000
A143C4-1	35.0	41,000	A148C2-4	20.0	41,000
A143C2-3	35.0	57,000	A148C2-2	20.0	55,000
A148C2-3	30.0	50,000	A143C32-5	20.0	74,000
A149C4-1	30.0	62,000	A145C2-4	15.0	131,000
A150C32-7	25.0	78,000	A148C2-7	15.0	171,000
A148C2-5	23.6	280,000	A144C32-5	15.0	190,000
A145C32-4	20.0	6,049,000	A149C4-5	12.0	1,336,000
A150C32-4	20.0	10,326,000	A144C32-3	12.0	7,441,000
A146C4-5	20.0	20,917,000	A143C4-6	12.0	7,853,000
A146C32-7	18.0	1,438,000	A150C32-2	10.0	23,328,000
A143C4-5	18.0	18,514,000	A149C4-3	10.0	42,305,000
A150C32-1	18.0	19,590,000	A149C4-7	10.0	114,576,000
A148C32-6	17.0	48,550,000			
A145C32-7	17.0	49,227,000			
A150C32-3	15.0	[b]161,857,000			
A144C32-2	15.0	[b]163,096,000			

[b]Did not fail.

[d]Estimated life.

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 1/2 in.; d = 1/32 in.					
A146A1-4	66.2	Static			
A149A8-6	35.0	37,000	A149A1-5	30.0	12,000
A145A1-1	35.0	61,000	A148A1-4	30.0	13,000
A150A0-6	33.0	259,000	A144A1-6	25.0	29,000
A149A1-3	30.0	88,000	A145A1-3	25.0	45,000
A146A1-3	30.0	169,000	A146A1-8	20.0	77,000
A143A0-2	30.0	408,000	A146A1-7	20.0	94,000
A143A1-4	25.0	455,000	A149A1-2	15.0	592,000
A144A1-5	25.0	616,000	A143A1-3	15.0	654,000
A150A0-7	23.0	[a]1,113,000	A148A1-8	15.0	843,000
A148A8-7	23.0	10,204,000	A143A1-5	15.0	[a]1,521,000
A146A4-8	23.0	1,368,000	A144A1-2	15.0	1,777,000
A150A1-1	23.0	12,192,000	A143A1-7	13.0	2,522,000
A144A1-3	20.0	5,652,000	A148A1-5	12.0	3,889,000
A148A1-6	20.0	11,963,000	A148A1-3	12.0	56,860,000
A145A1-5	19.5	1,092,000	A144A1-8	11.0	14,387,000
A150A1-7	16.5	[b]51,634,000	A148A1-2	11.0	14,674,000
A146A1-6	15.0	[b]51,137,000	A149A1-6	11.0	55,163,000
A144A1-1	15.0	[b]53,839,000	A143A1-1	10.0	20,399,000
			A144A1-4	10.0	85,779,000
			A149A1-7	10.0	[a]91,315,000
			A143A1-8	9.4	[a]25,493,000
W = 1/2 in.; d = 1/16 in.					
A145A2-3	67.1	Static			
A145A2-2	35.0	41,000	A145A2-4	30.0	9,000
A146A2-4	35.0	51,000	A143A2-8	25.0	18,000
A143A2-1	30.5	67,000	A146A2-2	25.0	21,000
A150A2-2	30.0	62,000	A146A2-6	20.0	38,000
A149A2-7	25.0	156,000	A150A2-7	20.0	132,000
A150A2-6	25.0	797,000	A145A2-6	20.0	140,000
A149A2-4	24.6	446,000	A144A2-7	19.8	44,000
A149A2-8	23.0	144,000	A143A2-4	15.0	240,000
A143A2-3	23.0	501,000	A148A2-3	15.0	356,000
A146A2-7	21.0	309,000	A150A2-1	15.0	532,000
A144A2-1	21.0	596,000	A145A2-8	12.0	2,586,000
A144A2-6	20.0	11,741,000	A144A2-2	12.0	3,256,000
A148A2-8	20.0	21,709,000	A149A2-1	11.0	3,685,000
A146A2-8	20.0	28,123,000	A143A2-2	11.0	14,177,000
A148A2-2	20.0	36,422,000	A148A2-5	11.0	27,267,000
			A144A2-4	10.6	15,482,000
			A146A2-1	10.0	35,480,000
			A148A2-6	10.0	48,582,000
			A149A2-6	9.9	5,219,000
			A143A2-6	9.0	[b]103,533,000
			A148A2-4	9.0	[b]112,484,000

[a]Failed at grip line.
[b]Did not fail.

TABLE II.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

2024-T3 ALUMINUM-ALLOY-SHEET SPECIMENS - Concluded

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 1/2 in.; d = 1/8 in.					
A149A4-7	69.5	Static			
A145A4-2	39.5	23,000	A150A4-8	30.0	8,000
A145A4-4	35.0	39,000	A143A4-4	30.0	9,000
A149A4-3	35.0	131,000	A148A4-7	25.0	16,000
A143A4-2	30.0	108,000	A146A4-7	25.0	21,000
A144A4-5	30.0	154,000	A143A4-1	20.0	118,000
A146A4-5	30.0	302,000	A144A4-1	20.0	124,000
A145A4-3	25.0	127,000	A148A4-2	15.0	859,000
A150A4-7	25.0	176,000	A150A4-5	15.0	1,526,000
A146A4-2	25.0	5,218,000	A150A4-2	15.0	4,426,000
A148A4-8	23.0	4,125,000	A144A4-4	14.0	1,920,000
A148A4-5	23.0	6,994,000	A144A4-8	14.0	4,157,000
A144A4-7	20.0	35,869,000	A144A4-2	13.0	2,174,000
A143A4-5	20.0	[b]52,276,000	A145A4-5	13.0	2,410,000
			A148A4-1	12.0	31,663,000
			A150A1-3	12.0	33,589,000
			A150A4-4	11.0	28,099,000
			A146A4-3	11.0	117,588,000
			A144A4-3	9.5	[b]128,510,000
W = 1/2 in.; d = 1/4 in.					
A145A8-8	68.2	Static			
A150A8-2	35.0	62,000	A146A8-4	25.0	16,000
A146A8-3	35.0	107,000	A150A0-3	25.0	30,000
A148A8-3	30.0	228,000	A144A8-8	20.0	70,000
A145A8-4	30.0	278,000	A144A8-7	20.0	71,000
A143A0-3	28.0	451,000	A146A8-8	20.0	117,000
A143A8-7	28.0	546,000	A148A8-6	15.0	988,000
A144A8-2	25.0	2,890,000	A145A8-5	15.0	1,384,000
A148A8-8	25.0	13,889,000	A145A8-7	15.0	2,906,000
A150A0-1	25.0	22,233,000	A145A8-3	15.0	8,002,000
A143A8-5	23.0	10,064,000	A144A8-6	14.0	140,000
A148A8-7	23.0	10,204,000	A150A0-5	14.0	265,000
A150A0-4	22.0	11,309,000	A144A8-3	14.0	398,000
A146A8-1	22.0	49,987,000	A148A8-1	14.0	837,000
			A148A8-2	14.0	8,608,000
			A144A8-1	12.0	24,876,000
			A150A8-8	12.0	31,873,000
			A150A8-6	11.0	32,599,000
			A146A8-7	11.0	43,669,000

[b]Did not fail.

TABLE III.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

7075-T6 ALUMINUM-ALLOY-SHEET SPECIMENS

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 4 in.; d = 1/8 in.					
B78S1-1	79.8	Static			
B58S1-1	30.0	16,000	B53S1-1	25.0	9,000
B70S1-1	30.0	19,000	B93S1-2	25.0	9,000
B72S1-2	25.0	39,000	B68S1-2	20.0	41,000
B69S1-1	25.0	68,000	B80S1-2	20.0	67,000
B93S1-1	20.0	81,000	B70S1-2	18.0	81,000
B63S1-1	20.0	107,000	B64S1-1	15.0	91,000
B72S1-1	18.0	136,000	B73S1-2	15.0	96,000
B90S1-2	18.0	300,000	B75S1-1	13.0	221,000
B67S1-2	17.0	1,783,000	B74S1-1	13.0	719,000
B93S1-3	16.5	2,404,000	B67S1-1	12.0	1,054,000
B54S1-1	16.0	[a]33,008,000	B62S1-1	12.0	1,475,000
B60S1-2	16.0	[a]33,943,000	B64S1-2	10.0	541,000
B80S1-3	16.0	[b]51,448,000	B61S1-1	10.0	[a]4,325,000
B78S1-3	15.0	[b]67,386,000	B65S1-1	10.0	6,244,000
			B56S1-1	10.0	[a]6,725,000
			B90S1-3	10.0	8,668,000
			B71S1-2	9.0	22,947,000
			B73S1-3	9.0	[a]35,834,000
			B71S1-1	9.0	[b]57,279,000
W = 4 in.; d = 1/4 in.					
B61S1-3	80.5	Static			
B56S1-2	30.0	17,000	B90S1-1	25.0	8,000
B65S1-3	30.0	27,000	B62S1-3	25.0	9,000
B86S1-2	25.0	41,000	B57S1-1	20.6	24,000
B75S1-3	25.0	55,000	B71S1-3	20.0	28,000
B53S1-3	20.0	168,000	B69S1-3	15.0	84,000
B64S1-3	20.0	228,000	B62S1-2	15.0	125,000
B60S1-1	18.0	15,458,000	B70S1-3	12.0	314,000
B55S1-3	18.0	16,786,000	B52S1-3	12.0	2,769,000
B59S1-3	17.0	311,000	B60S1-3	10.0	6,719,000
B84S1-3	17.0	6,704,000	B80S1-1	10.0	11,235,000
B87S1-1	17.0	[a]6,986,000	B54S1-3	9.0	8,614,000
B74S1-3	17.0	[a]13,042,000	B58S1-3	9.0	[a]20,248,000
B61S1-2	17.0	[a]19,321,000	B86S1-3	9.0	26,620,000
B87S1-3	17.0	[a]22,207,000			
B73S1-1	17.0	35,536,000			

[a]Failed at grip line.

[b]Did not fail.

TABLE III.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

7075-T6 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 4 in.; d = 2 in.					
B77S1-3	81.9	Static			
B77S1-1	35.0	14,000	B91S1-3	25.0	18,000
B89S1-2	35.0	16,000	B95S1-1	25.0	21,000
B79S1-1	30.0	25,000	B94S1-2	20.0	38,000
B92S1-1	30.0	64,000	B84S1-2	20.0	42,000
B84S1-1	25.0	40,000	B79S1-2	18.0	68,000
B52S1-2	25.0	82,000	B95S1-3	15.0	338,000
B77S1-2	23.0	117,000	B91S1-1	15.0	592,000
B54S1-2	23.0	140,000	B69S1-2	12.0	2,929,000
B94S1-1	21.0	692,000	B92S1-2	12.0	22,552,000
B94S1-3	21.0	4,605,000	B55S1-2	10.0	332,000
B95S1-2	20.0	11,791,000	B66S1-1	10.0	710,000
B87S1-2	20.0	[b]51,880,000	B89S1-1	10.0	[b]100,325,000
			B76S1-3	10.0	[b]107,947,000
W = 2 in.; d = 1/16 in.					
B94S1-6	81.4	Static			
B73S1-4	35.0	15,000	B73S1-6	25.0	16,000
B92S1-4	35.0	43,000	B91S1-7	25.0	18,000
B79S1-7	30.0	32,000	B89S1-5	20.0	43,000
B95S1-6	30.0	37,000	B52S1-6	20.0	53,000
B70S1-4	25.0	66,000	B77S1-7	15.0	153,000
B91S1-5	25.0	124,000	B92S1-3	15.0	177,000
B69S1-4	23.0	107,000	B74S1-5	13.0	250,000
B53S1-5	20.0	257,000	B61S1-4	13.0	398,000
B89S1-6	20.0	[a]2,457,000	B65S1-5	12.0	392,000
B60S1-8	20.0	7,333,000	B77S1-5	12.0	3,644,000
B60S1-6	20.0	7,677,000	B90S1-5	11.0	8,626,000
B67S1-7	19.0	22,111,000	B93S1-5	11.0	19,460,000
B99S1-7	18.0	[a]30,650,000	B64S1-4	10.0	15,738,000
B95S1-7	18.0	43,894,000	B77S1-6	10.0	56,618,000

[a]Failed at grip line.

[b]Did not fail.

TABLE III.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

7075-T6 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 2 in.; d = 1/8 in.					
B56S1-7	77.7	Static			
B84S1-6	35.0	12,000	B78S1-6	25.0	12,000
B58S1-7	35.0	12,000	B90S1-6	25.0	13,000
B55S1-4	30.0	17,000	B53S1-7	20.0	40,000
B93S1-7	30.0	46,000	B65S1-6	20.0	62,000
B60S1-4	25.0	30,000	B86S1-6	15.0	85,000
B73S1-5	25.0	68,000	B62S1-7	15.0	97,000
B73S1-7	20.0	164,000	B87S1-7	15.0	1,052,000
B72S1-7	20.0	283,000	B59S1-6	12.0	243,000
B78S1-7	19.0	175,000	B55S1-6	12.0	381,000
B57S1-7	19.0	242,000	B75S1-7	12.0	575,000
B54S1-4	18.0	293,000	B61S1-6	11.0	368,000
B72S1-6	18.0	526,000	B54S1-6	11.0	10,482,000
B68S1-6	18.0	17,583,000	B66S1-6	10.0	9,109,000
B74S1-6	18.0	[a]27,633,000	B75S1-6	10.0	45,207,000
B90S1-7	18.0	[b]30,304,000			
B71S1-6	18.0	[a]32,620,000			
W = 2 in.; d = 1 in.					
B84S1-5	82.2	Static			
B86S1-4	38.2	12,000	B72S1-4	26.1	15,000
B89S1-4	35.0	13,000	B87S1-4	25.0	15,000
B66S1-5	35.0	16,000	B76S1-4	20.0	33,000
B55S1-5	30.0	26,000	B77S1-4	20.0	39,000
B94S1-4	30.0	26,000	B71S1-5	18.0	72,000
B54S1-5	25.0	68,000	B57S1-4	15.0	154,000
B74S1-4	25.0	70,000	B72S1-5	15.0	212,000
B75S1-4	23.0	63,000	B68S1-5	14.0	2,764,000
B70S1-5	23.0	287,000	B62S1-5	14.0	2,879,000
B58S1-4	23.0	5,251,000	B91S1-4	13.0	10,162,000
B62S1-4	22.0	138,000	B75S1-5	13.0	14,077,000
B53S1-4	22.0	411,000	B93S1-4	12.0	12,309,000
B59S1-5	21.0	434,000	B78S1-4	12.0	27,850,000
B63S1-5	21.0	13,374,000	B86S1-5	11.0	78,111,000
B63S1-6	20.0	28,164,000			
B60S1-5	20.0	[b]54,277,000			
B61S1-5	20.0	[b]90,287,000			
B56S1-5	18.0	[b]75,512,000			
B65S1-4	15.0	[b]80,746,000			

[a]Failed at grip line.

[b]Did not fail.

TABLE III.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

7075-T6 ALUMINUM-ALLOY-SHEET SPECIMENS - Continued

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 1/2 in.; d = 1/32 in.					
B89S1-12	82.7	Static			
B68S1-13	35.0	23,000	B55S1-12	30.0	11,000
B89S1-11	35.0	26,000	B87S1-11	30.0	12,000
B68S1-11	30.0	85,000	B73S1-12	25.0	21,000
B76S1-12	30.0	95,000	B86S1-4	25.0	51,000
B69S1-12	27.0	61,000	B95S1-11	20.0	182,000
B61S1-13	27.0	254,000	B95S1-12	20.0	239,000
B91S1-12	25.0	2,699,000	B70S1-11	18.1	262,000
B94S1-11	25.0	5,792,000	B62S1-12	15.0	543,000
B93S1-11	24.0	152,000	B89S1-13	15.0	2,013,000
B56S1-12	24.0	8,588,000	B86S1-13	13.0	[a]2,906,000
B59S1-11	24.0	29,000,000	B94S1-12	13.0	[a]3,543,000
B77S1-11	23.0	145,000	B76S1-11	13.0	26,767,000
B75S1-13	23.0	227,000	B77S1-12	13.0	36,235,000
B55S1-13	23.0	[b]59,879,000	B80S1-13	12.0	51,922,000
B92S1-11	22.0	23,393,000	B92S1-5	12.0	[b]59,056,000
B71S1-13	20.0	[b]54,531,000			
W = 1/2 in.; d = 1/8 in.					
B66S1-11	83.9	Static			
B95S1-13	35.0	21,000	B69S1-11	25.0	20,000
B63S1-13	35.0	26,000	B57S1-12	25.0	25,000
B75S1-12	30.0	38,000	B80S1-12	20.0	70,000
B78S1-13	30.0	83,000	B64S1-11	20.0	90,000
B92S1-6	25.0	144,000	B64S1-12	17.0	352,000
B57S1-11	25.0	9,095,000	B62S1-11	17.0	1,195,000
B61S1-12	25.0	18,344,000	B55S1-11	15.0	1,001,000
B77S1-13	22.0	1,855,000	B72S1-11	15.0	2,727,000
B90S1-11	22.0	2,381,000	B72S1-13	13.0	9,298,000
B60S1-13	20.0	25,969,000	B54S1-11	13.0	53,314,000
B84S1-13	20.0	45,156,000	B76S1-13	12.0	8,806,000
B52S1-11	20.0	[b]54,478,000	B67S1-13	12.0	64,530,000

[a]Failed at grip line.

[b]Did not fail.

TABLE III.- AXIAL-LOAD FATIGUE-TEST RESULTS FOR

7075-T6 ALUMINUM-ALLOY-SHEET SPECIMENS - Concluded

Specimen	R = 0		Specimen	R = -1	
	S_{max}, ksi	N, cycles to failure		S_{max}, ksi	N, cycles to failure
W = 1/2 in.; d = 1/4 in.					
B54S1-13	79.4	Static			
B65S1-11	35.0	23,000	B60S1-12	30.0	10,000
B79S1-13	35.0	33,000	B68S1-12	30.0	11,000
B84S1-11	30.0	57,000	B73S1-11	25.0	28,000
B63S1-12	30.0	233,000	B65S1-13	25.0	54,000
B53S1-13	25.0	1,731,000	B52S1-13	20.0	84,000
B70S1-13	25.0	19,810,000	B71S1-12	20.0	176,000
B62S1-13	24.0	2,016,000	B60S1-11	15.0	231,000
B70S1-12	24.0	5,210,000	B93S1-13	15.0	3,585,000
B58S1-11	23.0	26,620,000	B78S1-11	13.0	3,437,000
B74S1-11	23.0	59,714,000	B84S1-12	13.0	50,106,000
			B61S1-11	12.0	19,417,000
			B74S1-13	12.0	[b]54,651,000

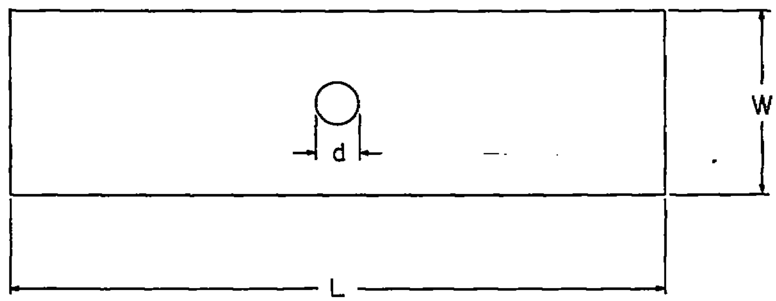
[b]Did not fail.

TABLE IV.- AVERAGE VALUES OF STRESS AT VARIOUS FATIGUE LIVES FOR UNNOTCHED-SHEET SPECIMENS OF 2024-T3 AND 7075-T6 FROM REFERENCE 8

N, cycles	Average stress, ksi		
	R = -1	R = 0	
	2024-T3 and 7075-T6	2024-T3	7075-T6
10^8	20.5	33.0	35.0
10^7	21.0	33.5	35.3
10^6	25.0	34.0	36.0
10^5	36.0	47.4	44.2
10^4	54.0	61.6	65.6

TABLE V.- EXPERIMENTAL VALUES OF K_F AT VARIOUS FATIGUE LIVES

W, in.	d, in. \ N, cycles	K_F, R = 0, 10^8	10^7	10^6	10^5	10^4	K_F, R = -1, 10^8	10^7	10^6	10^5	10^4
2024-T3											
4	1/8	2.20	2.10	1.79	1.76	----	2.28	2.10	2.00	2.00	2.00
	1/4	----	2.24	2.00	1.82	1.47	----	2.34	2.08	2.12	2.16
	1/2	----	2.24	2.00	1.89	1.40	----	2.34	2.27	2.30	2.25
	1	----	2.23	1.89	1.69	1.28	----	2.19	2.19	2.19	2.16
	2	1.94	1.81	1.62	1.75	----	2.28	2.00	1.99	2.02	1.93
2	1/16	1.94	1.81	1.62	1.72	1.37	2.06	2.00	1.98	2.02	1.93
	1/8	2.20	1.97	1.79	1.90	1.47	2.16	2.10	2.17	2.18	2.12
	1/4	2.36	2.10	1.89	1.98	1.40	2.18	2.19	2.19	2.32	2.16
	1/2	2.20	2.13	2.00	2.11	1.34	2.10	2.10	2.12	2.18	2.16
	1	1.89	1.76	1.62	1.86	----	2.05	1.97	2.00	2.08	1.93
1/2	1/32	1.83	1.64	1.42	1.50	----	2.05	1.86	1.71	1.80	1.64
	1/16	1.65	1.68	1.58	1.58	----	2.05	2.00	1.92	1.85	1.83
	1/8	1.65	1.60	1.42	1.50	----	2.05	1.86	1.72	1.85	1.97
	1/4	----	1.43	1.28	1.39	----	1.83	1.72	1.79	1.85	1.80
7075-T6											
4	1/8	2.19	2.14	2.10	2.21	2.05	2.16	2.10	2.18	2.18	2.16
	1/4	2.12	2.08	2.00	1.97	1.93	2.28	2.28	2.27	2.25	2.19
	2	1.75	1.72	1.71	1.77	1.64	2.05	2.00	2.08	2.08	1.80
2	1/16	1.92	1.88	1.80	1.80	----	2.05	1.98	2.06	2.12	1.86
	1/8	2.00	1.96	1.94	2.06	1.64	2.16	2.16	2.17	2.17	2.04
	1	1.71	1.71	1.67	1.84	----	1.90	1.91	1.84	2.00	2.00
1/2	1/32	1.59	1.56	1.50	1.61	----	1.71	1.61	1.67	1.67	1.72
	1/8	1.67	1.61	1.50	1.58	----	1.71	1.68	1.72	1.80	1.86
	1/4	1.56	1.52	1.44	1.47	----	1.71	1.71	1.71	1.76	1.77



Material	Hole diameter, d, in.		
	W = 4 in. L = 20 in.	W = 2 in. L = 20 in.	W = $\frac{1}{2}$ in. L = 12 in.
2024-T3 aluminum alloy	1/8 1/4 1/2 1 2	1/16 1/8 1/4 1/2 1	1/32 1/16 1/8 1/4
7075-T6 aluminum alloy	1/8 1/4 2	1/16 1/8 1	1/32 1/8 1/4

Figure 1.- Specimen configurations. All specimens were 0.091-inch thick.

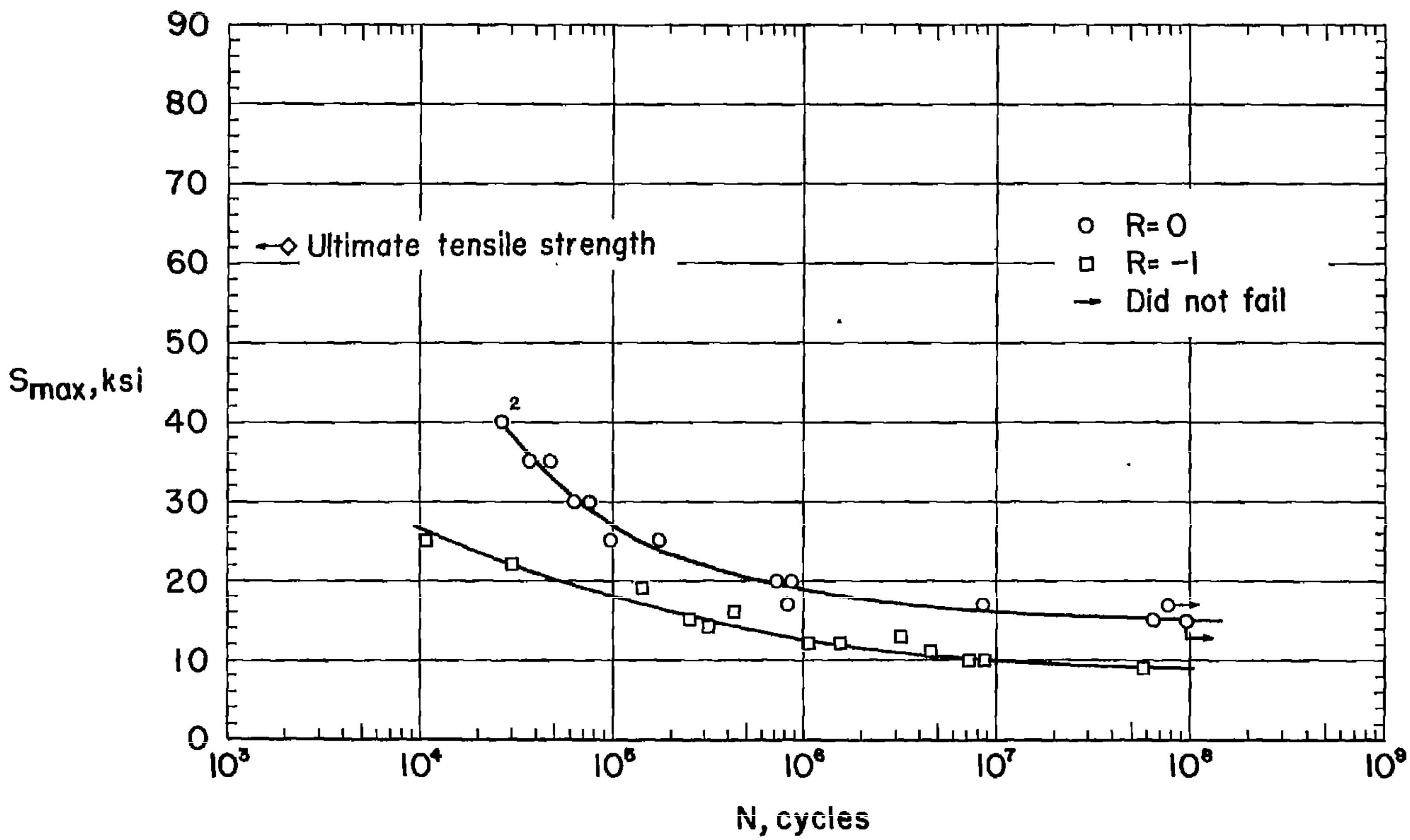


Figure 2.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 4 inches; $d = \frac{1}{8}$ inch.

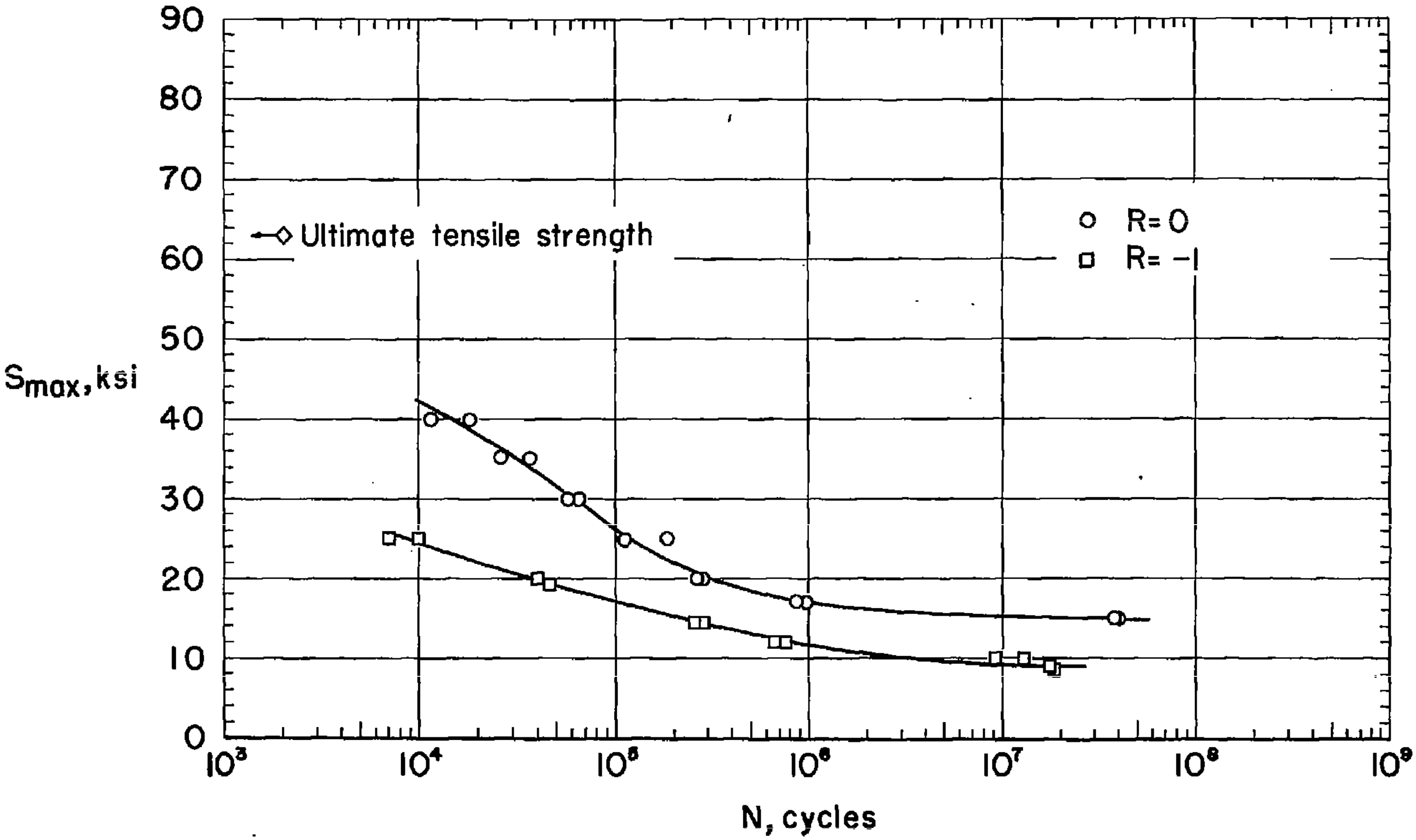


Figure 3.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 4 inches; $d = \frac{1}{4}$ inch.

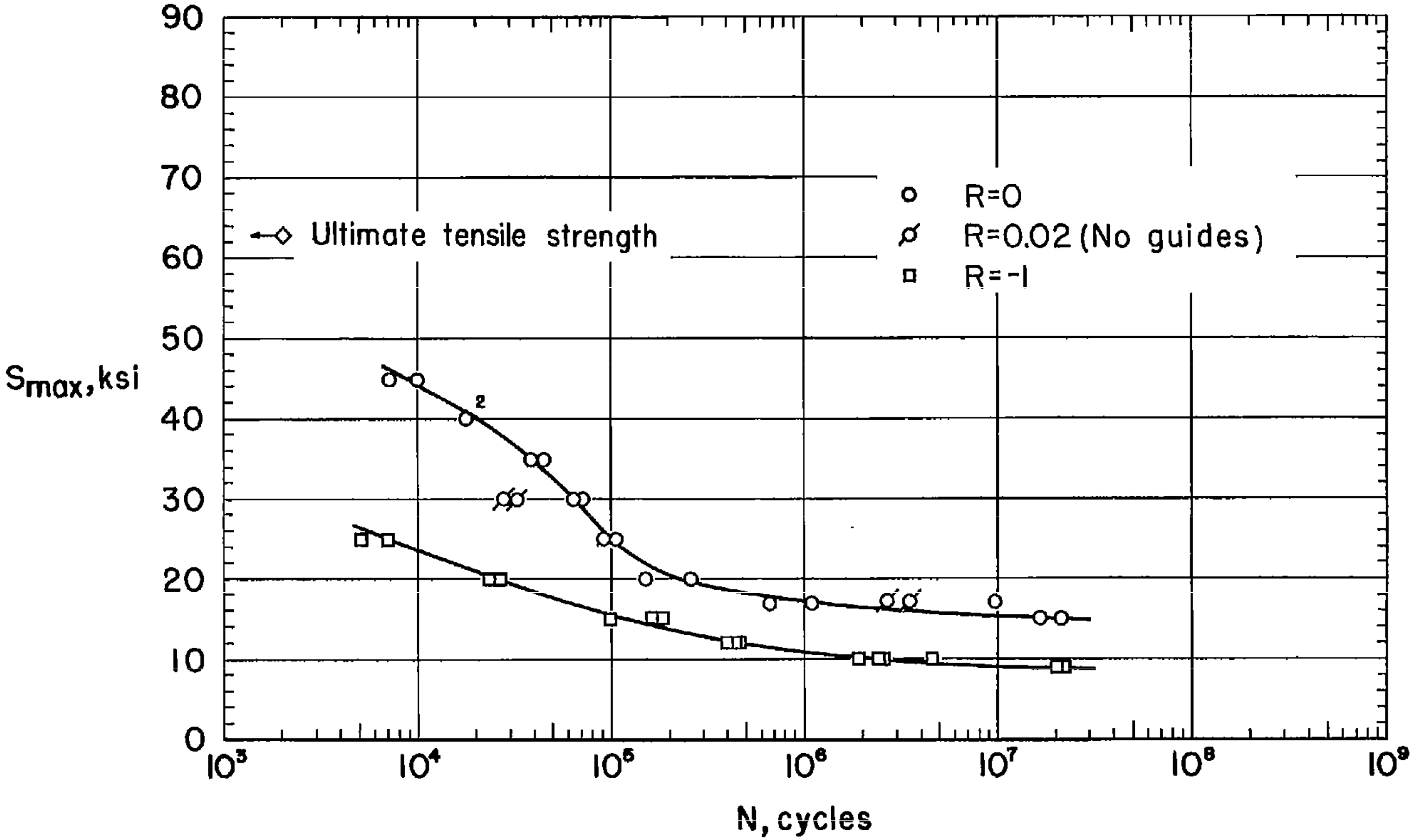


Figure 4.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 4 inches; $d = \frac{1}{2}$ inch.

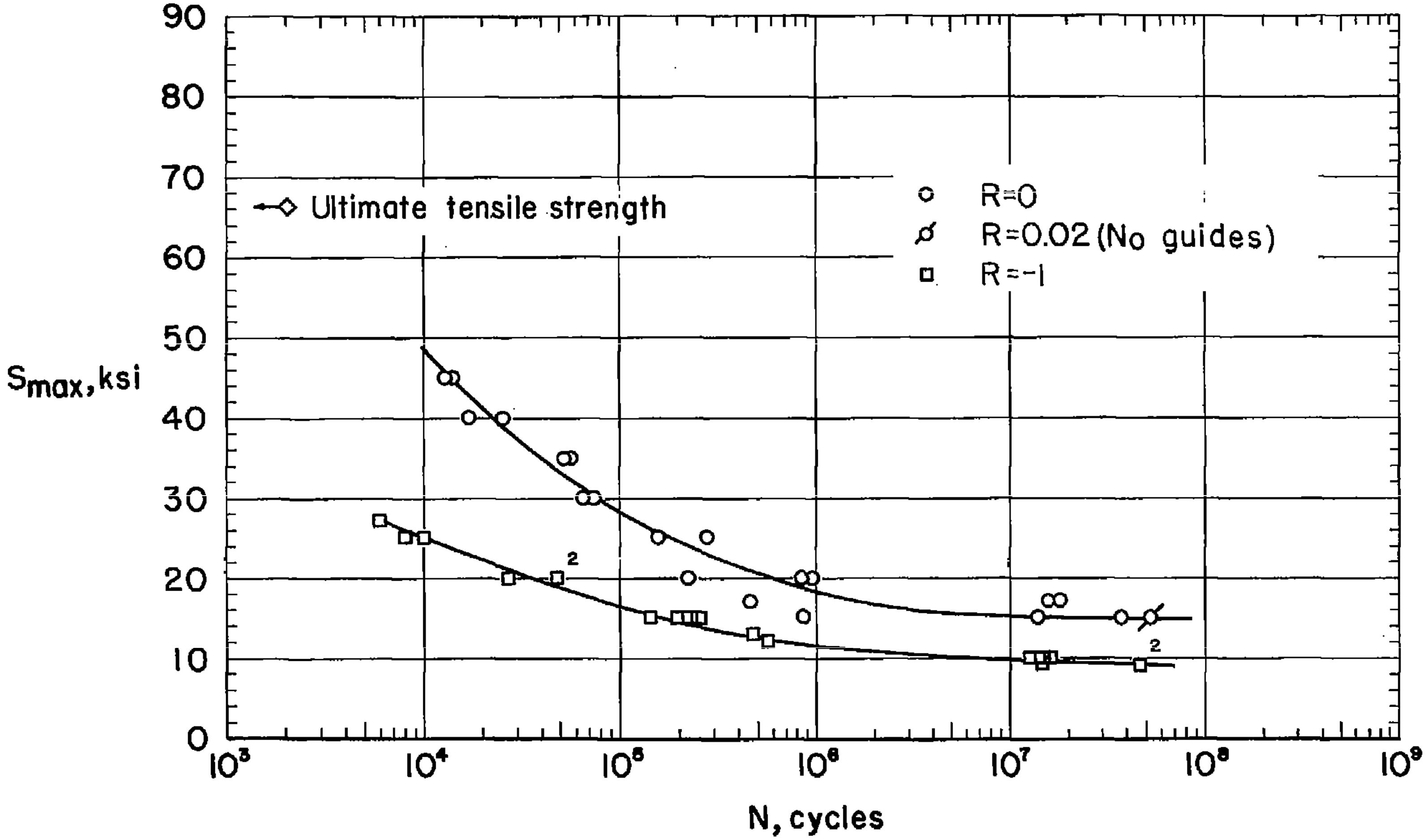


Figure 5.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 4 inches; d = 1 inch.

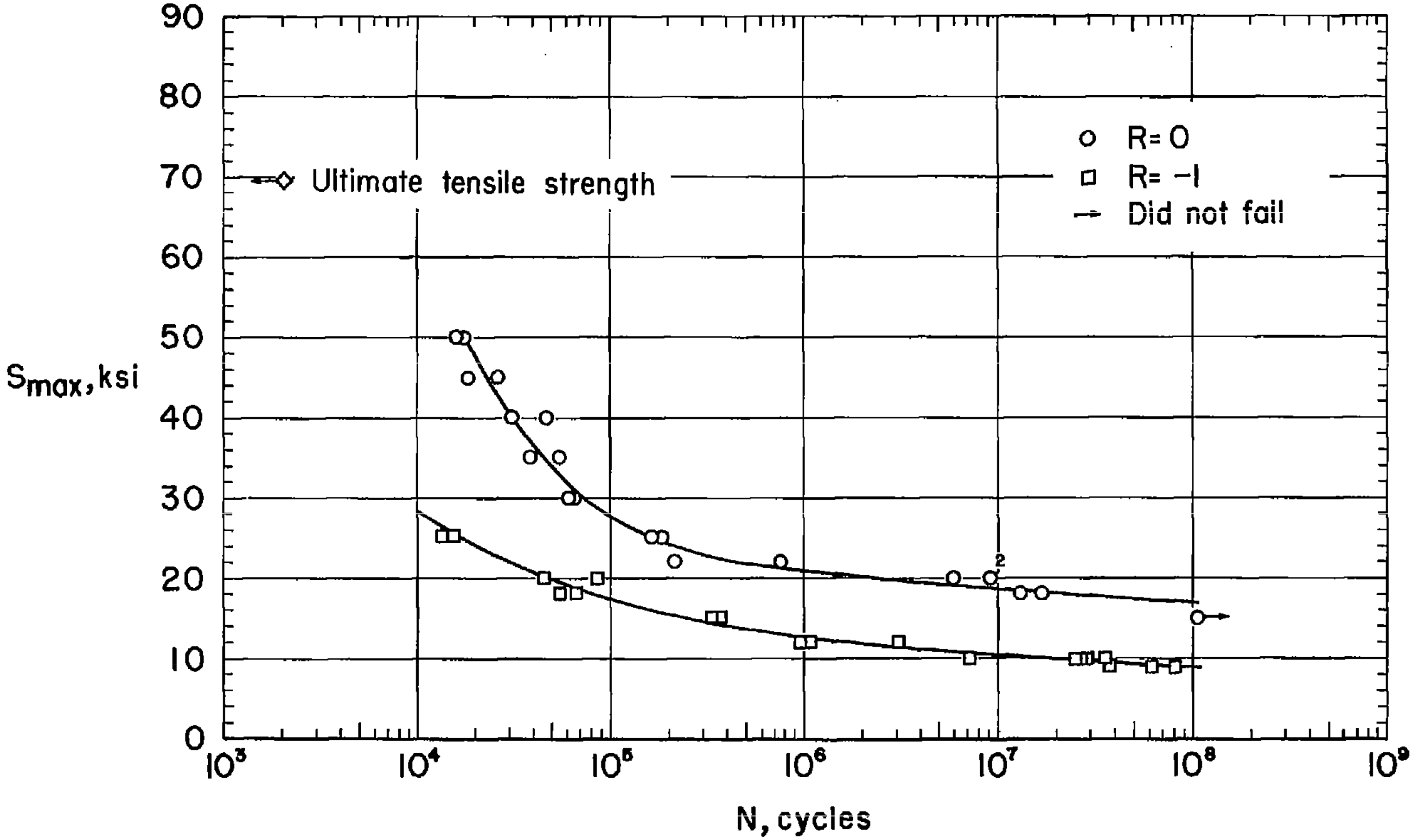


Figure 6.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 4 inches; d = 2 inches.

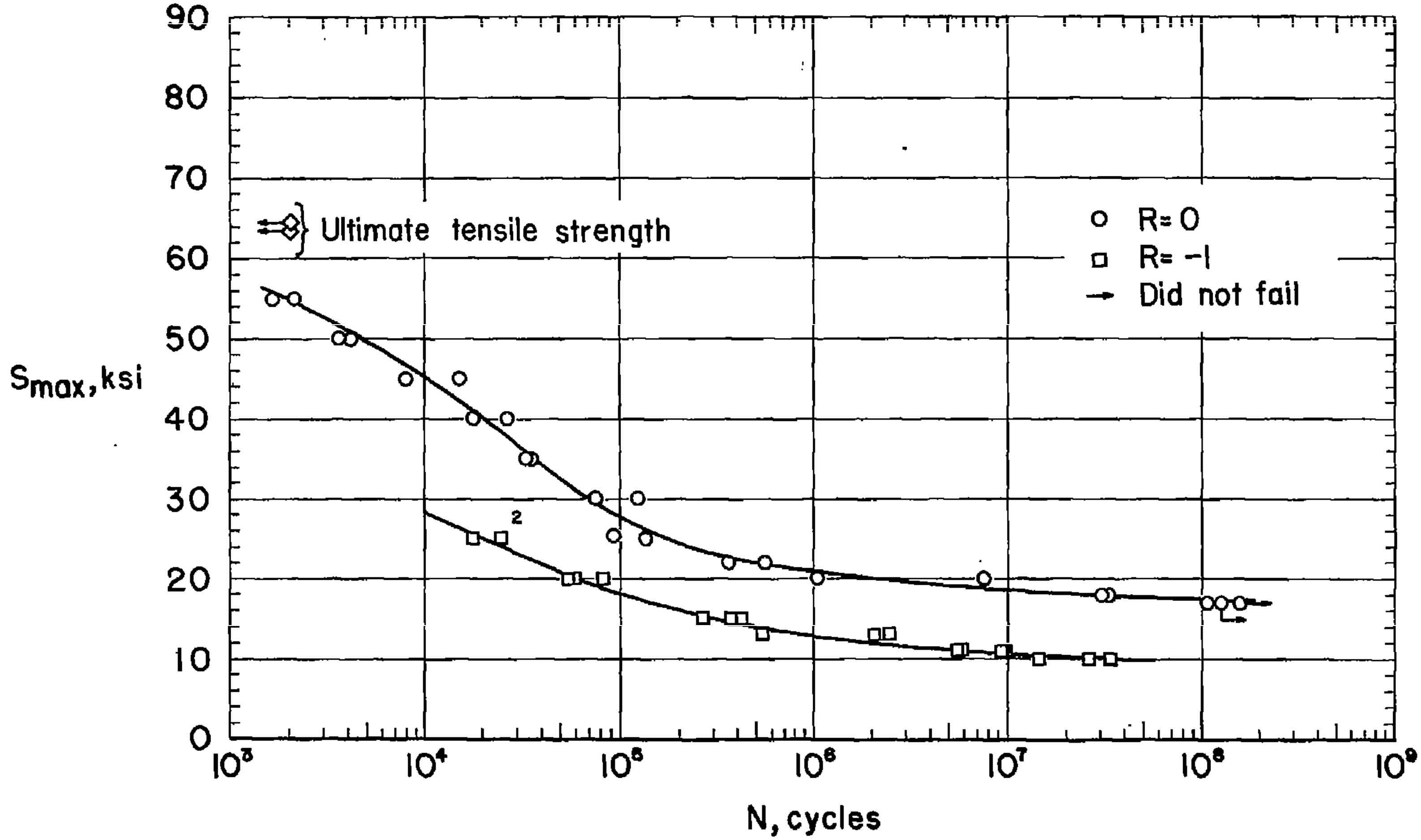


Figure 7.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 2 inches; $d = \frac{1}{16}$ inch.

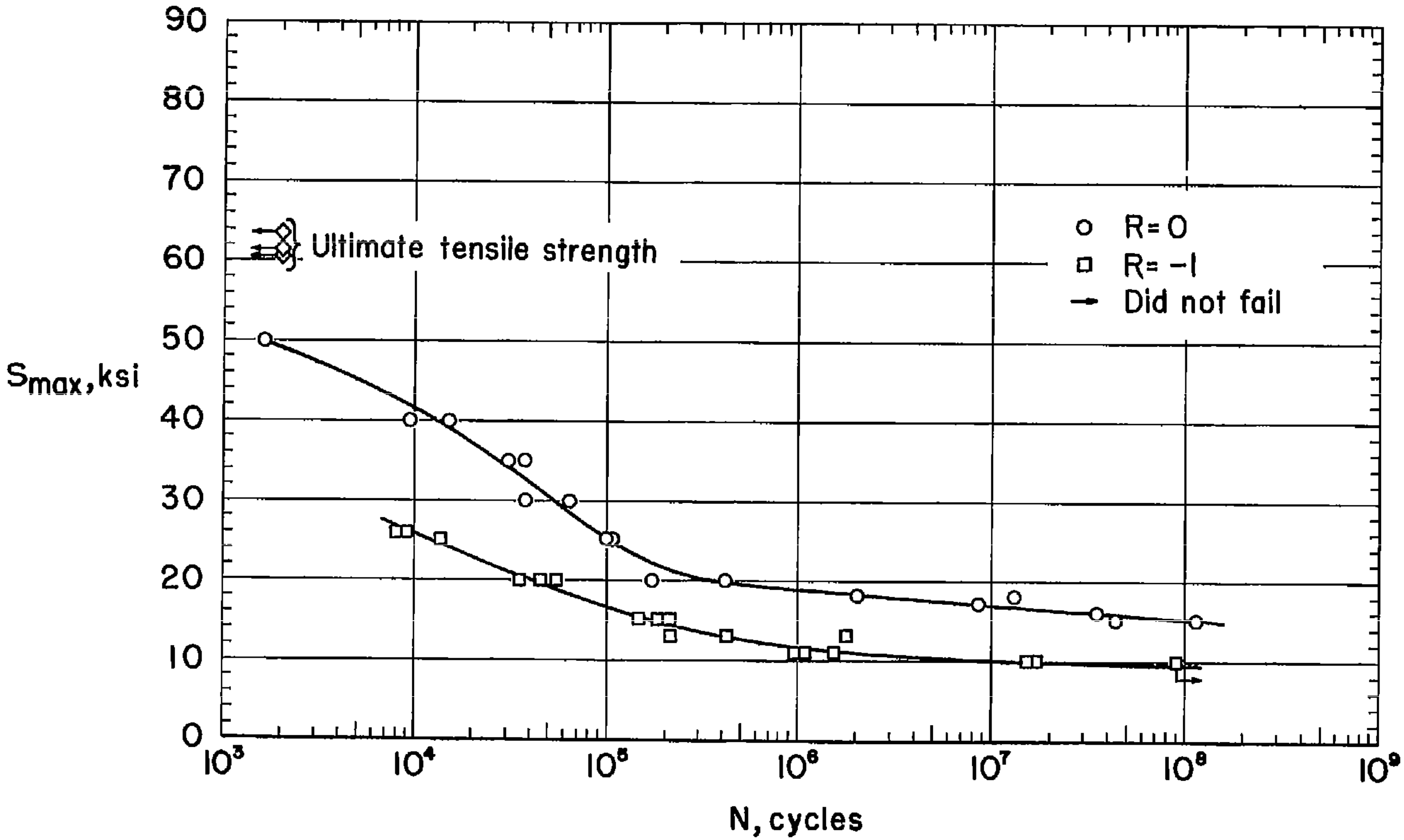


Figure 8.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 2 inches; $d = \frac{1}{8}$ inch.

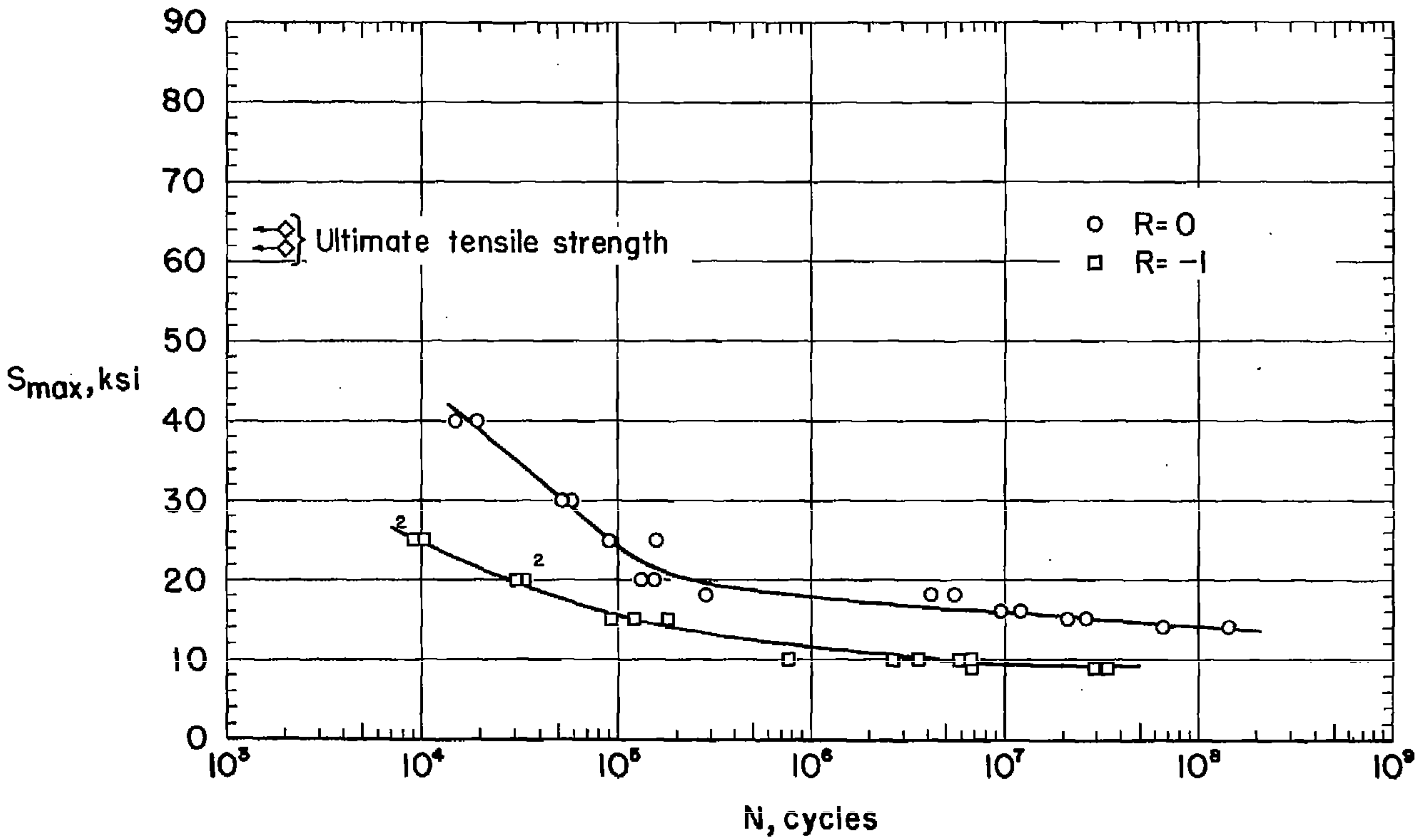


Figure 9.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 2 inches; $d = \frac{1}{4}$ inch.

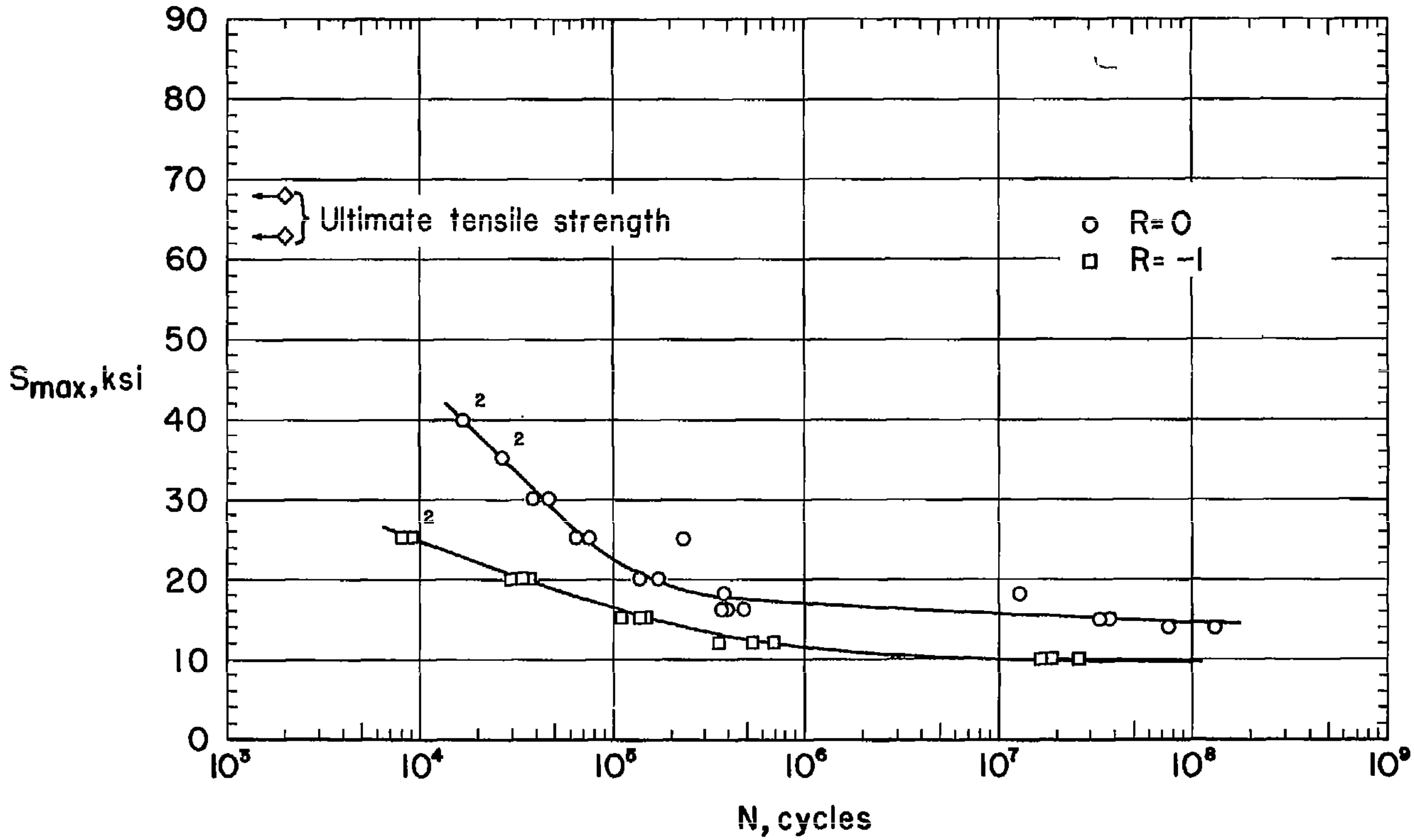


Figure 10.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 2 inches; $d = \frac{1}{2}$ inch.

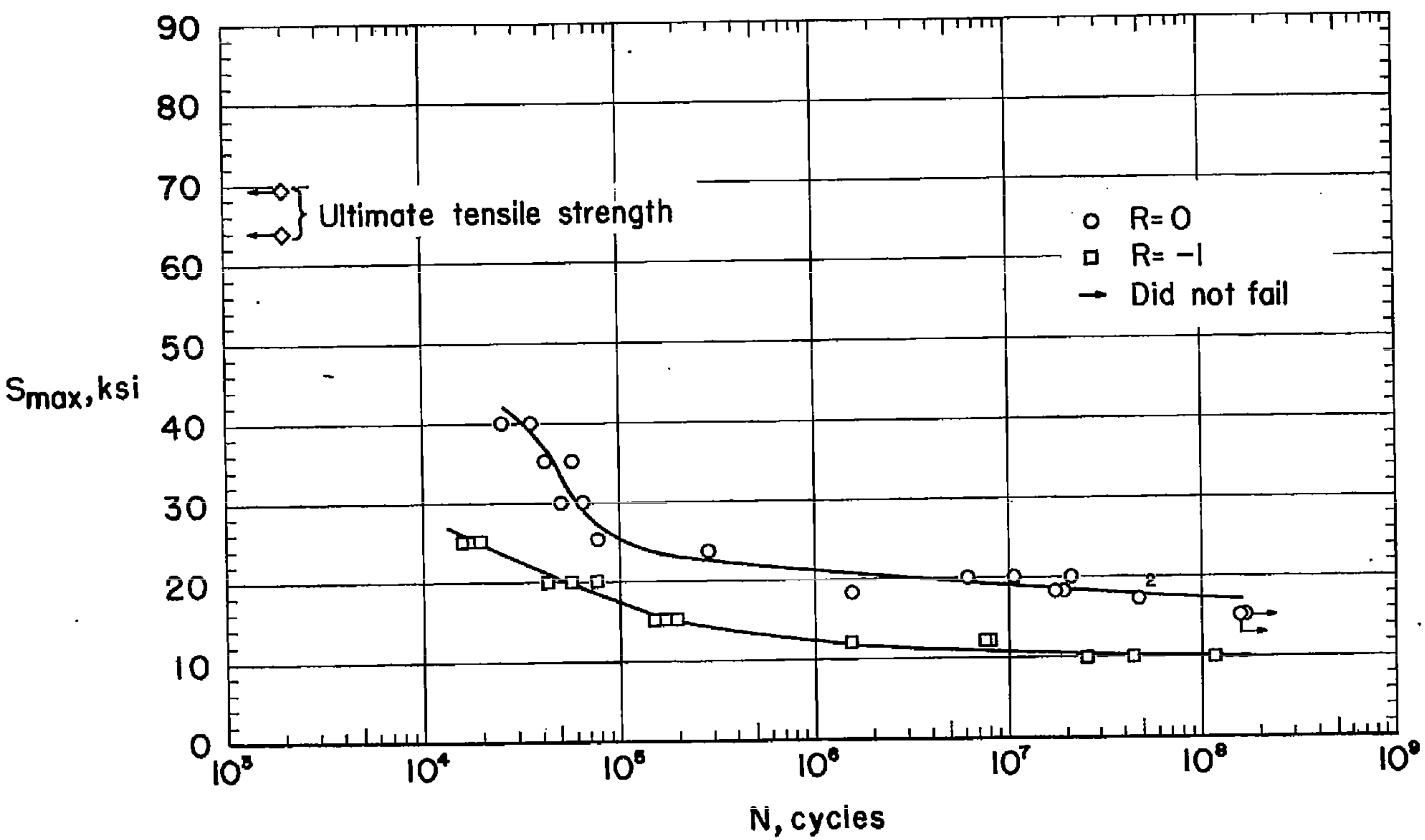


Figure 11.- S-N diagram for 2024-T3 aluminum-alloy sheet. W = 2 inches; d = 1 inch.

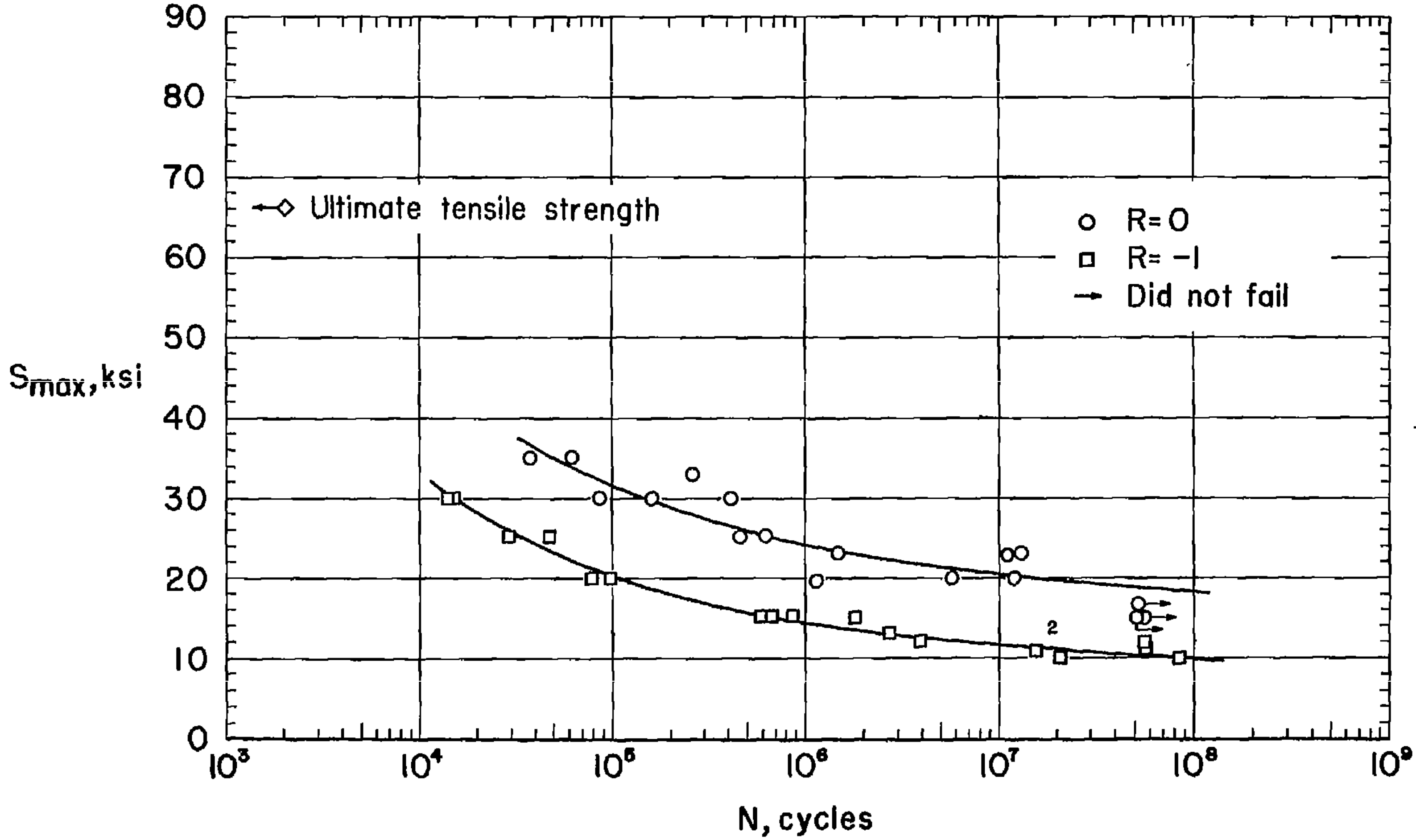


Figure 12.- S-N diagram for 2024-T3 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{32}$ inch.

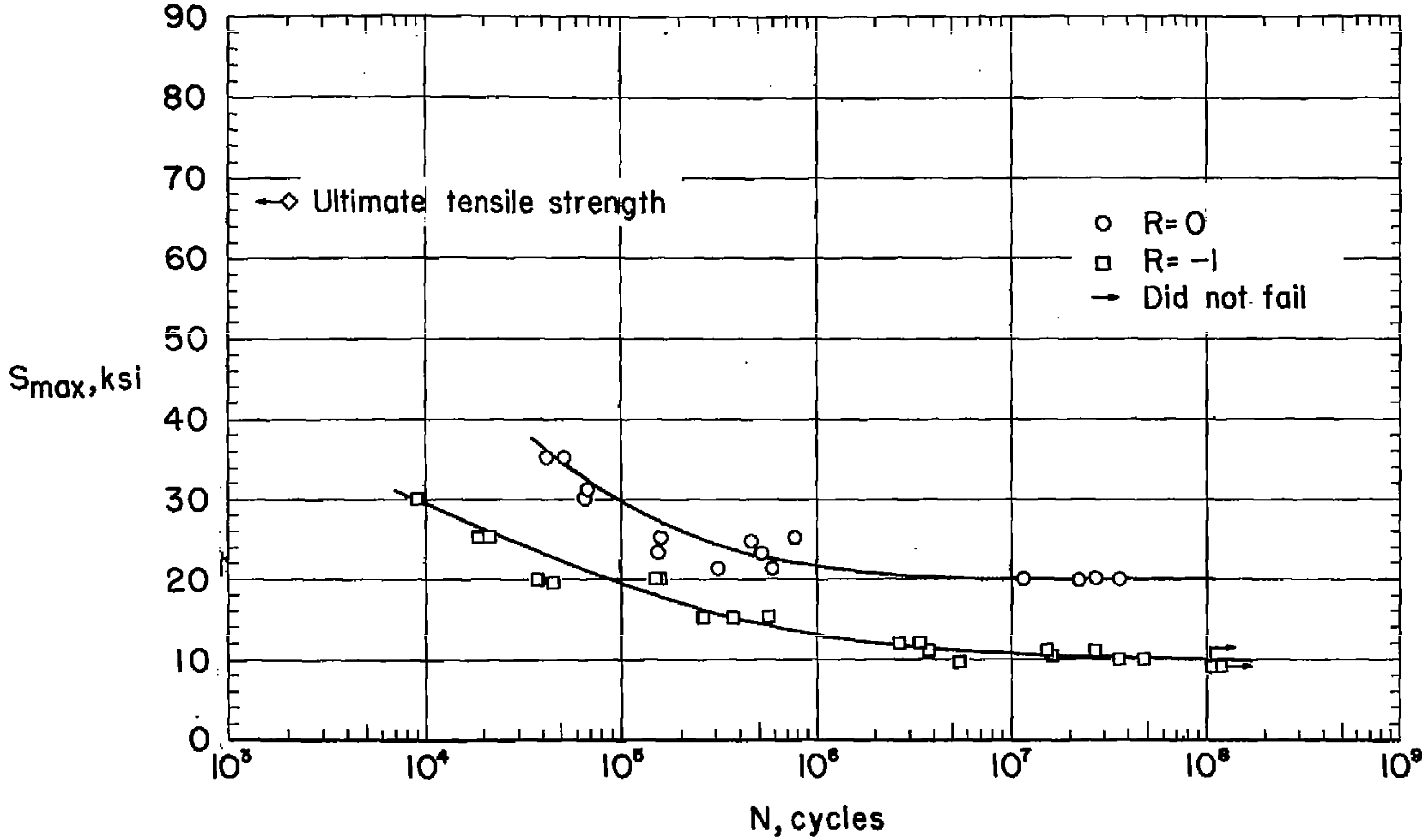


Figure 13.- S-N diagram for 2024-T3 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{16}$ inch.

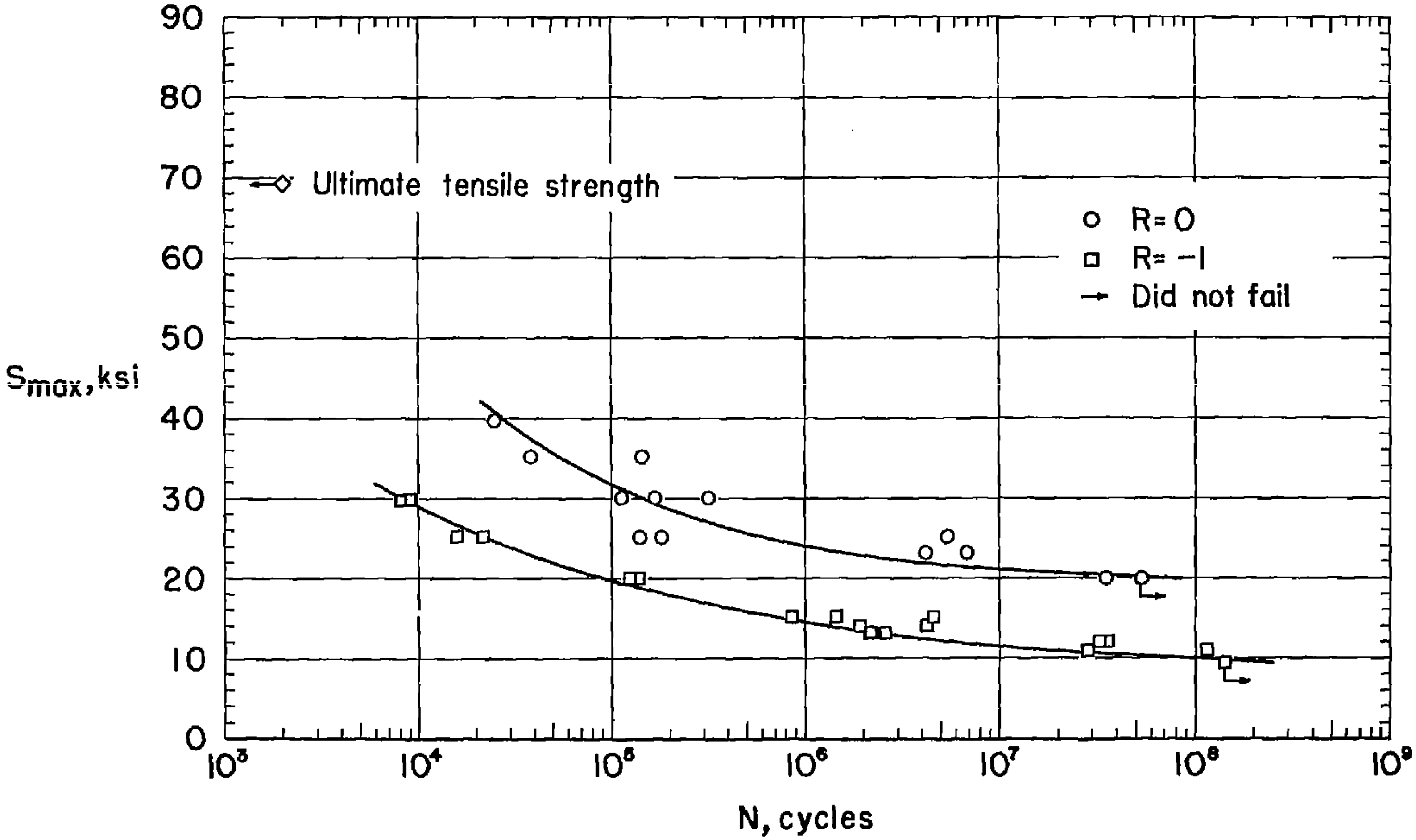


Figure 14.- S-N diagram for 2024-T3 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{8}$ inch.

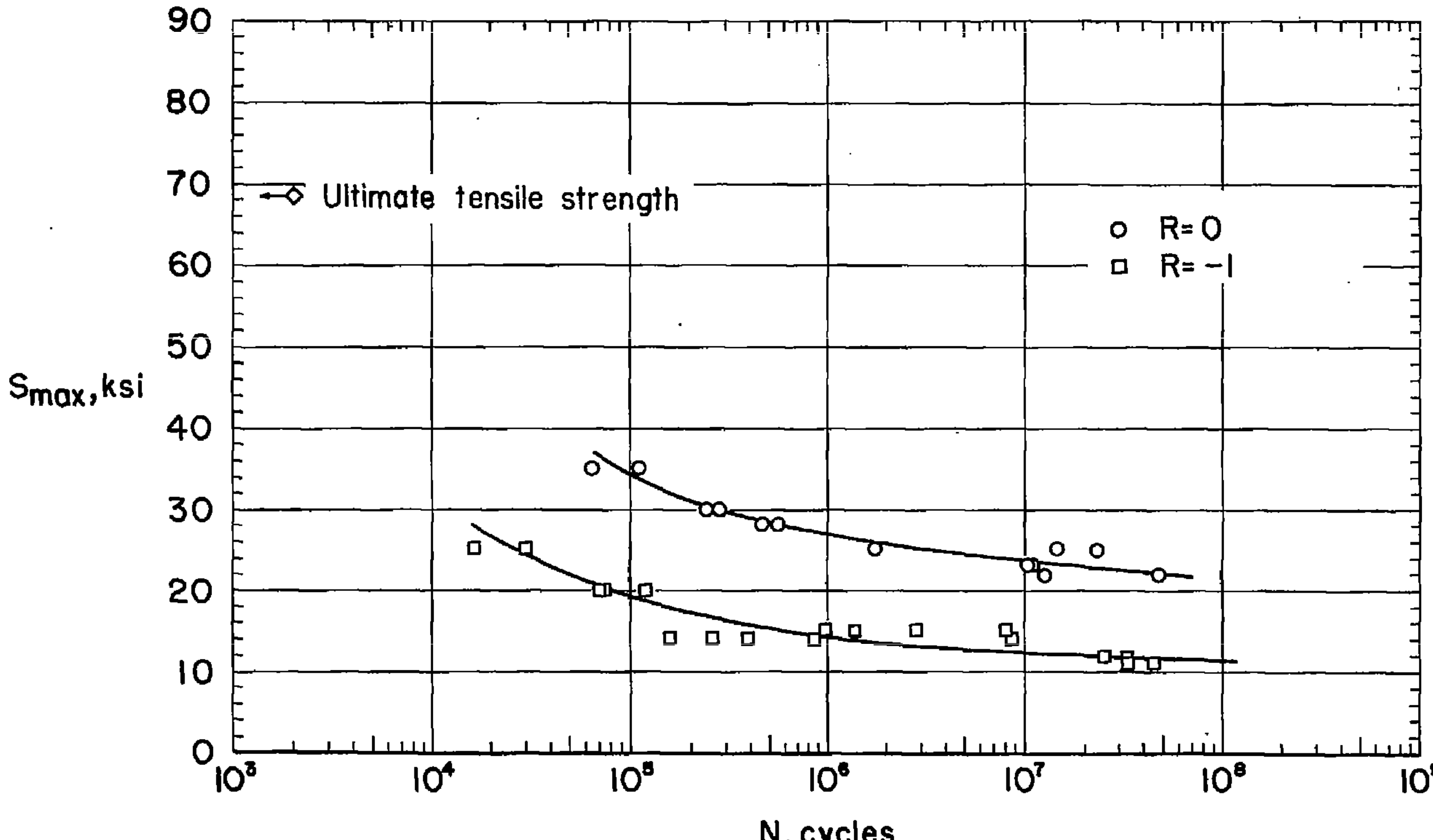


Figure 15.- S-N diagram for 2024-T3 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{4}$ inch.

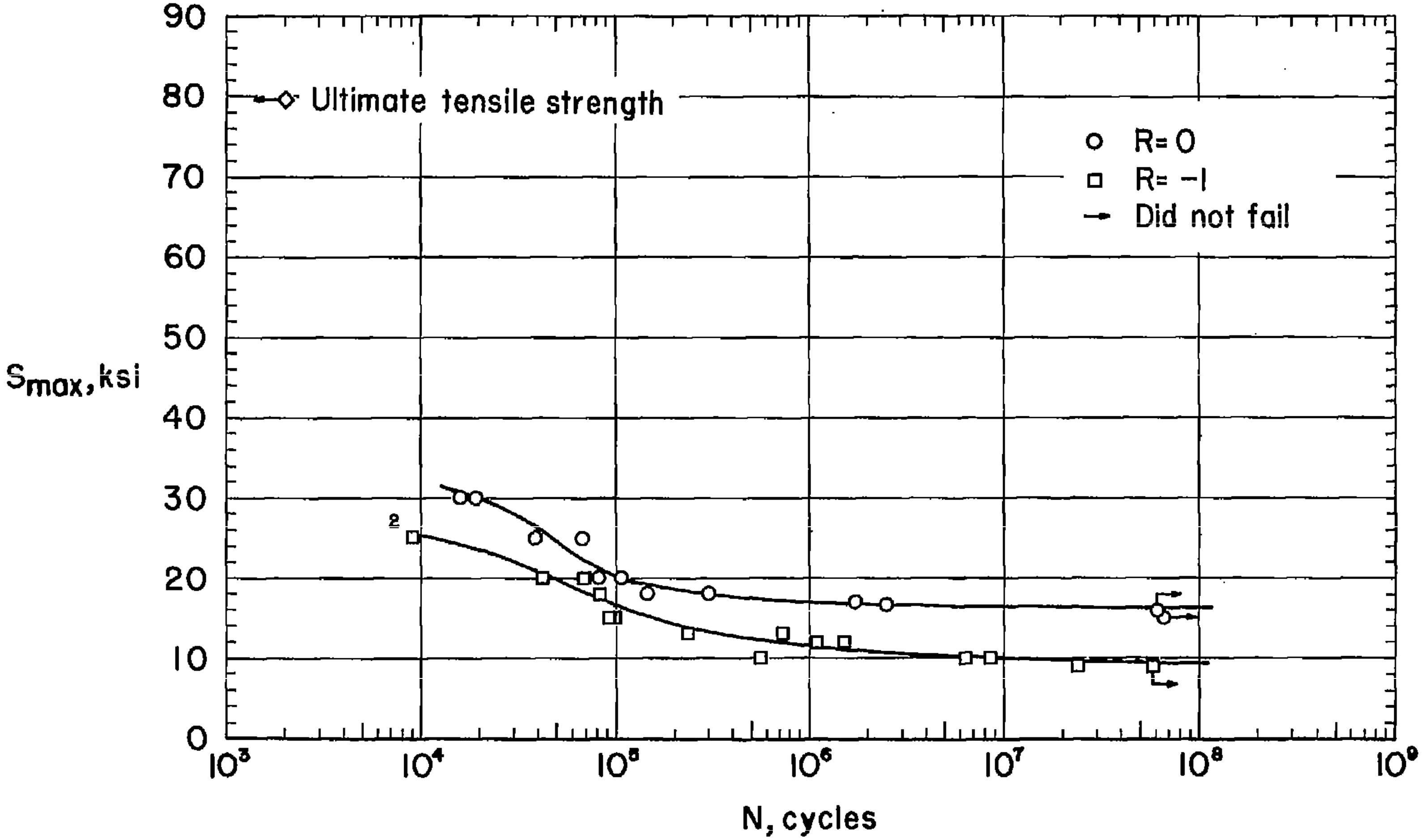


Figure 16.- S-N diagram for 7075-T6 aluminum-alloy sheet. W = 4 inches; $d = \frac{1}{8}$ inch.

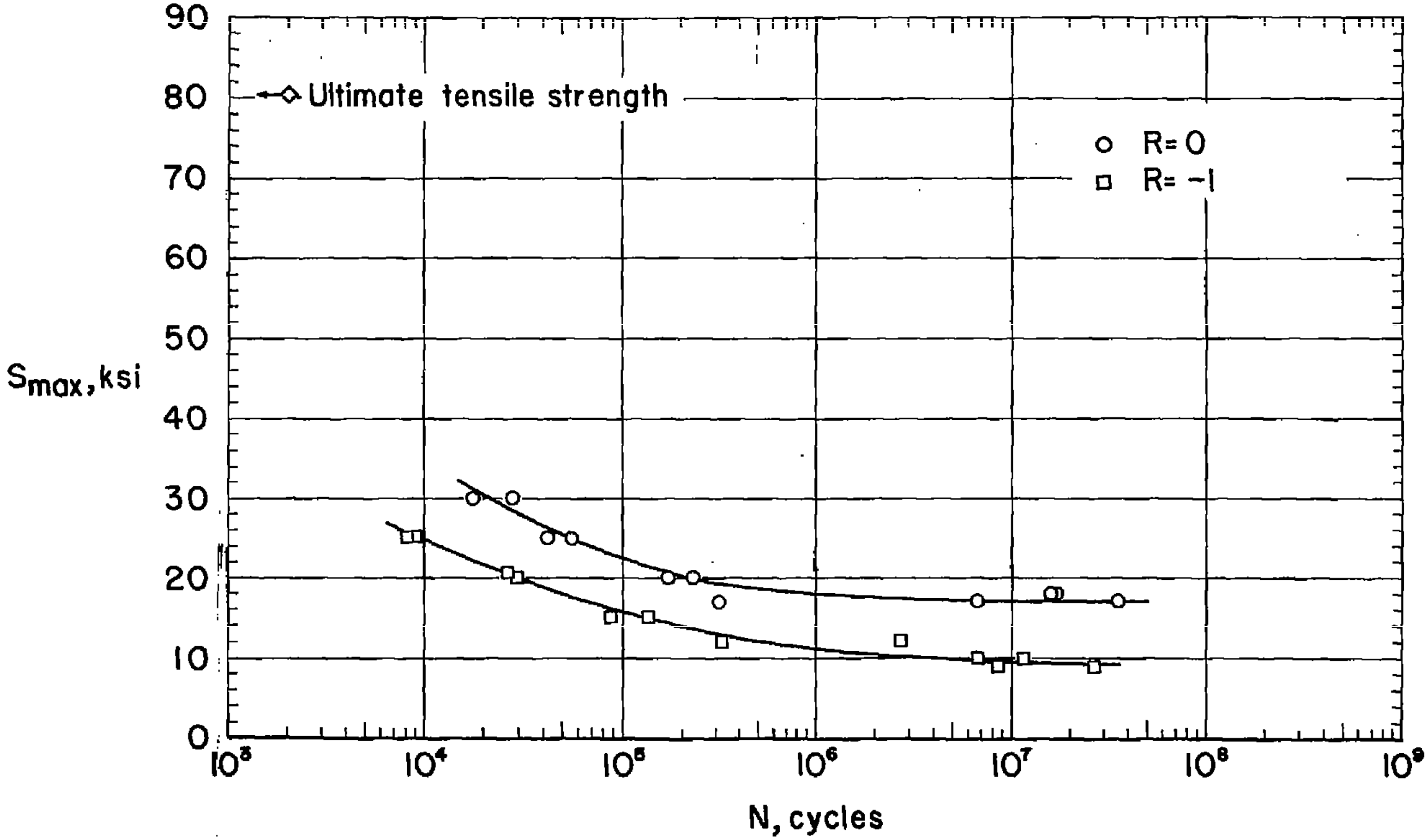


Figure 17.- S-N diagram for 7075-T6 aluminum-alloy sheet. W = 4 inches; $d = \frac{1}{4}$ inch.

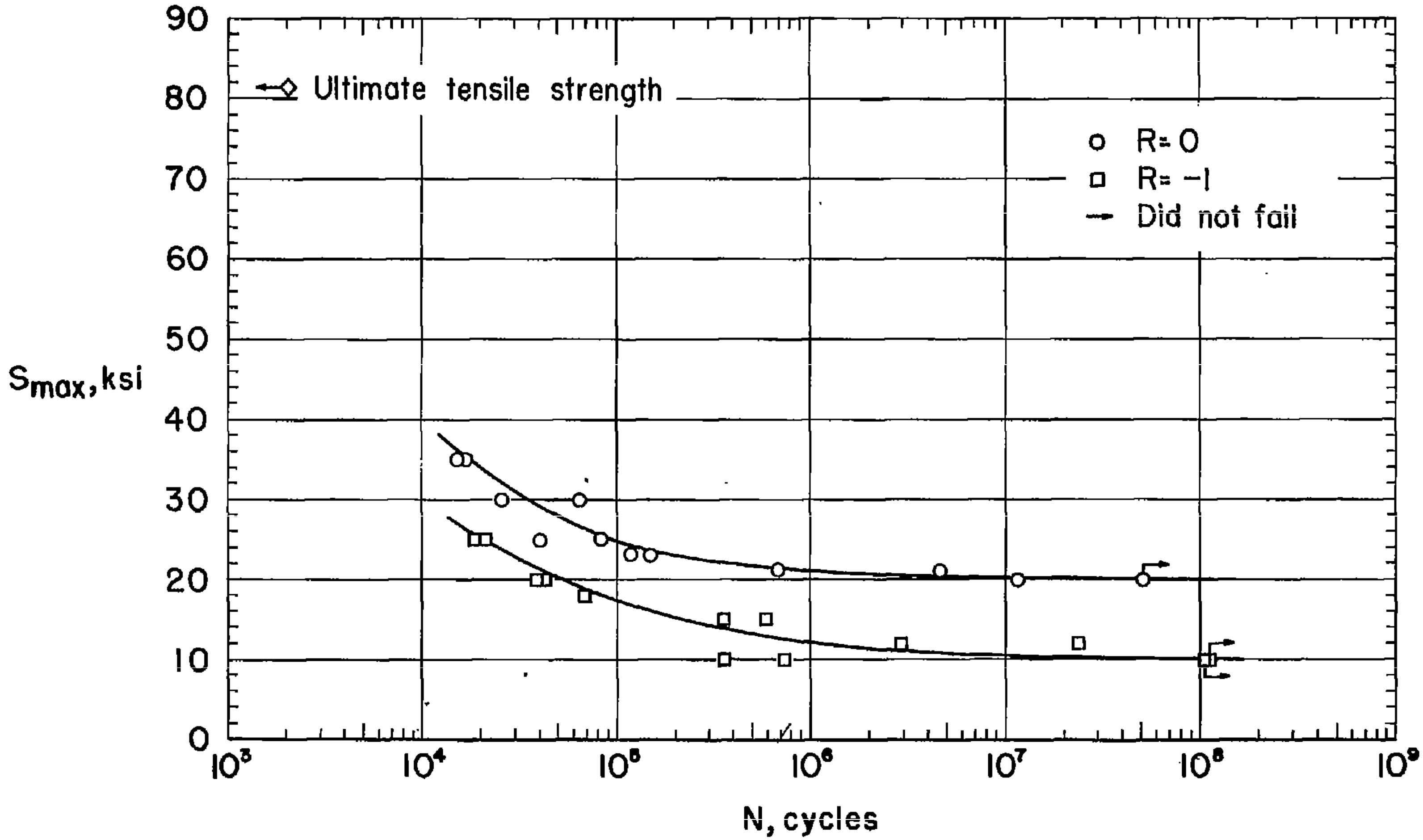


Figure 18.- S-N diagram for 7075-T6 aluminum-alloy sheet. W = 4 inches; d = 2 inches.

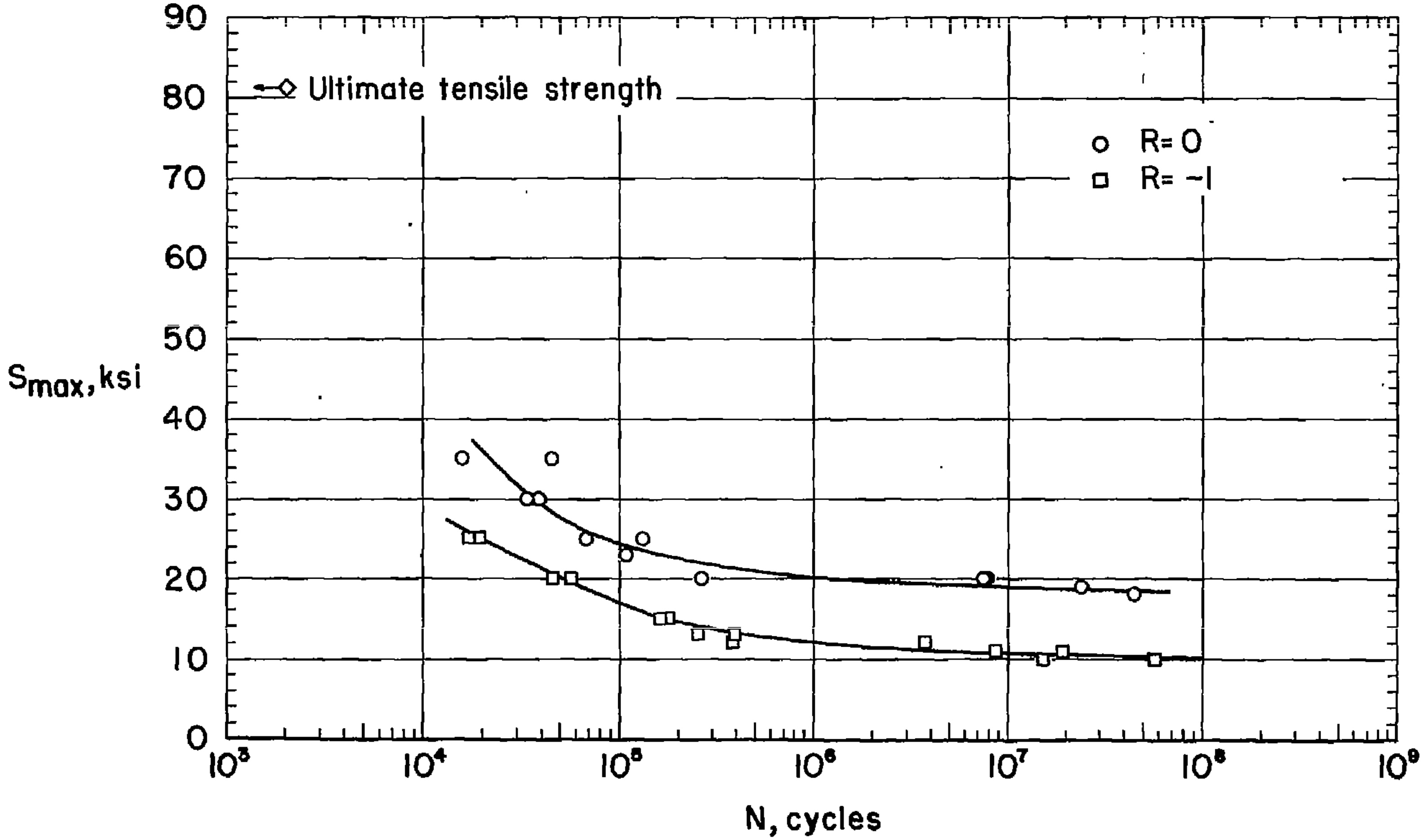


Figure 19.- S-N diagram for 7075-T6 aluminum-alloy sheet. W = 2 inches; $d = \frac{1}{16}$ inch.

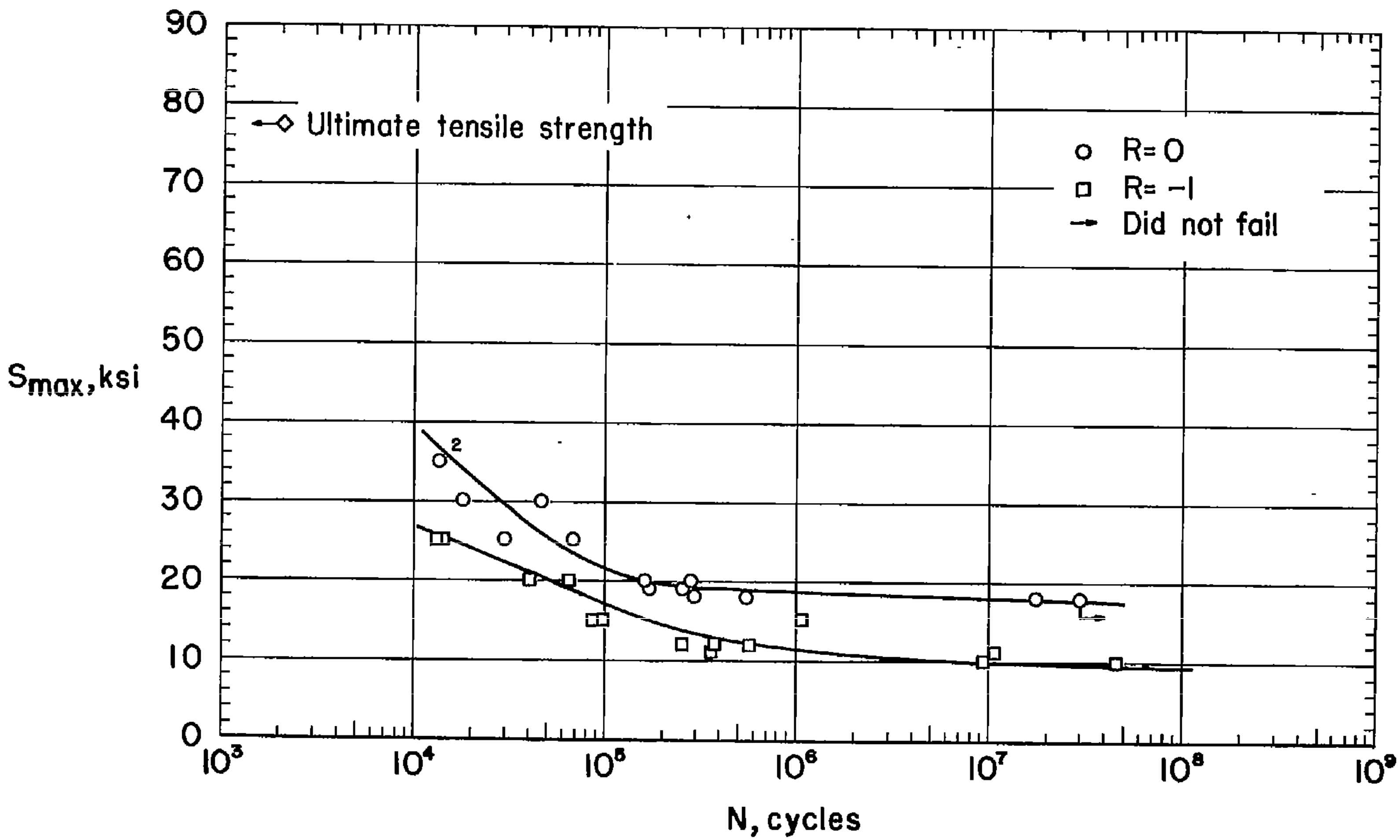


Figure 20.- S-N diagram for 7075-T6 aluminum-alloy sheet. W = 2 inches; $d = \frac{1}{8}$ inch.

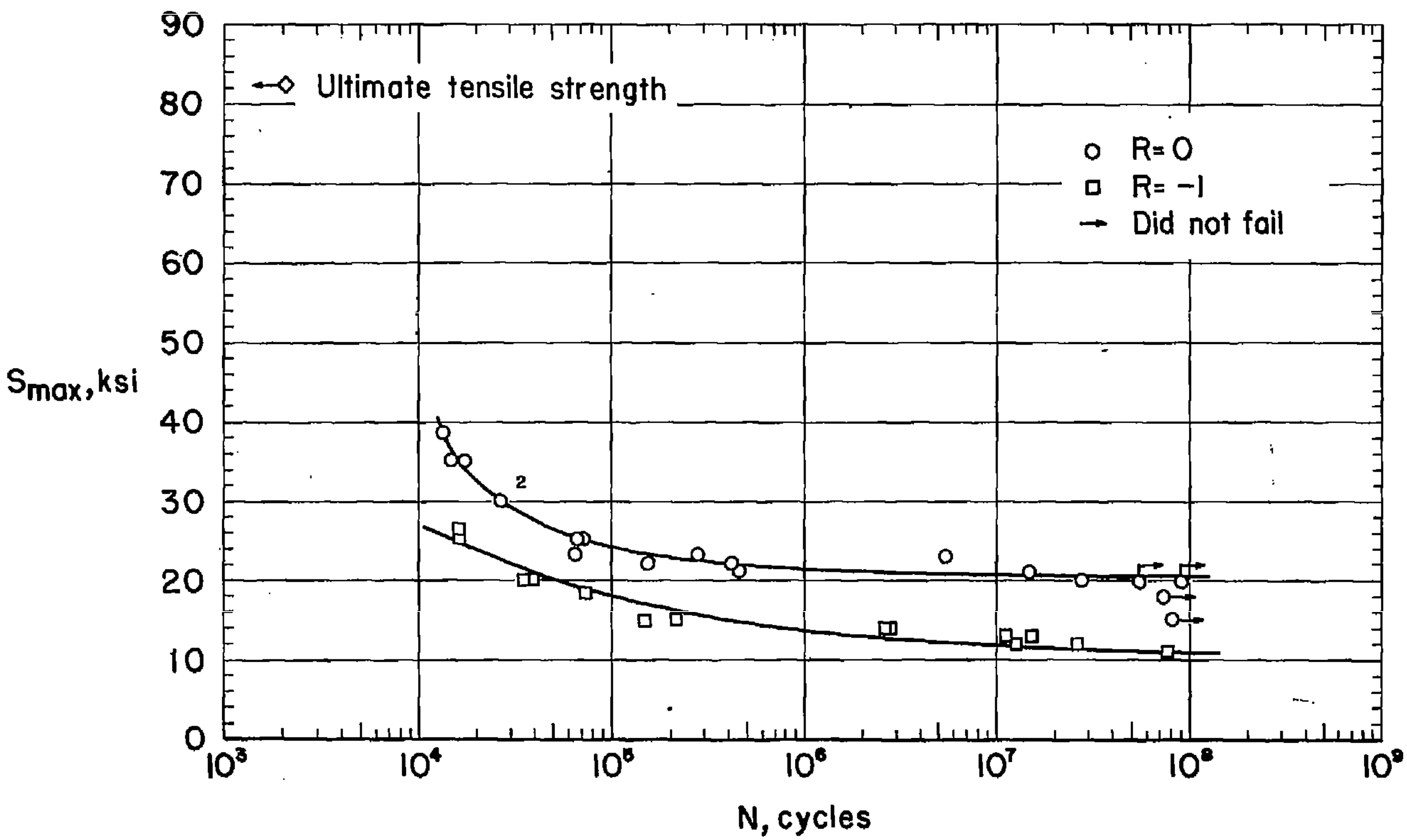


Figure 21.- S-N diagram for 7075-T6 aluminum-alloy sheet. W = 2 inches; d = 1 inch.

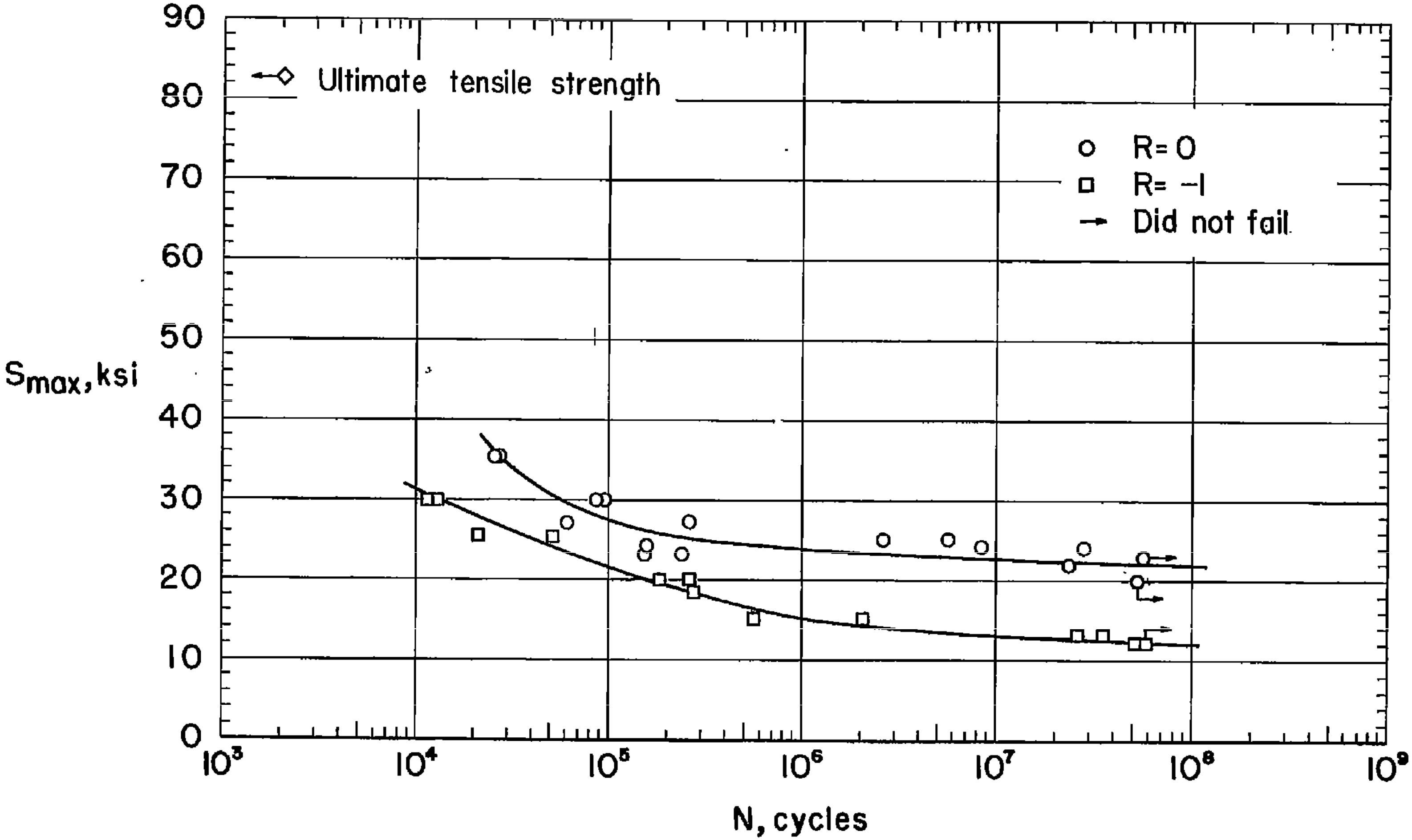


Figure 22.- S-N diagram for 7075-T6 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{32}$ inch.

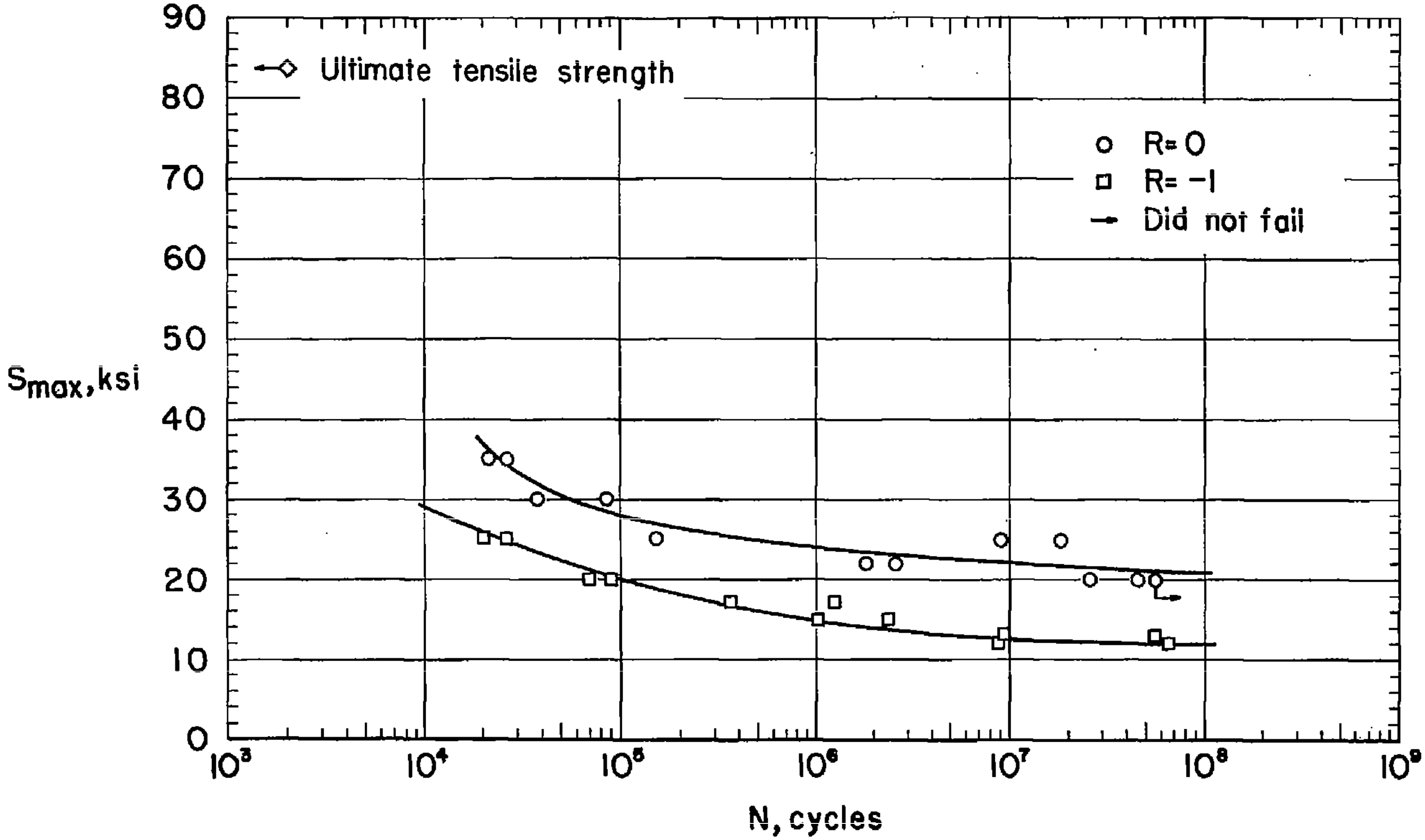


Figure 23.- S-N diagram for 7075-T6 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{8}$ inch.

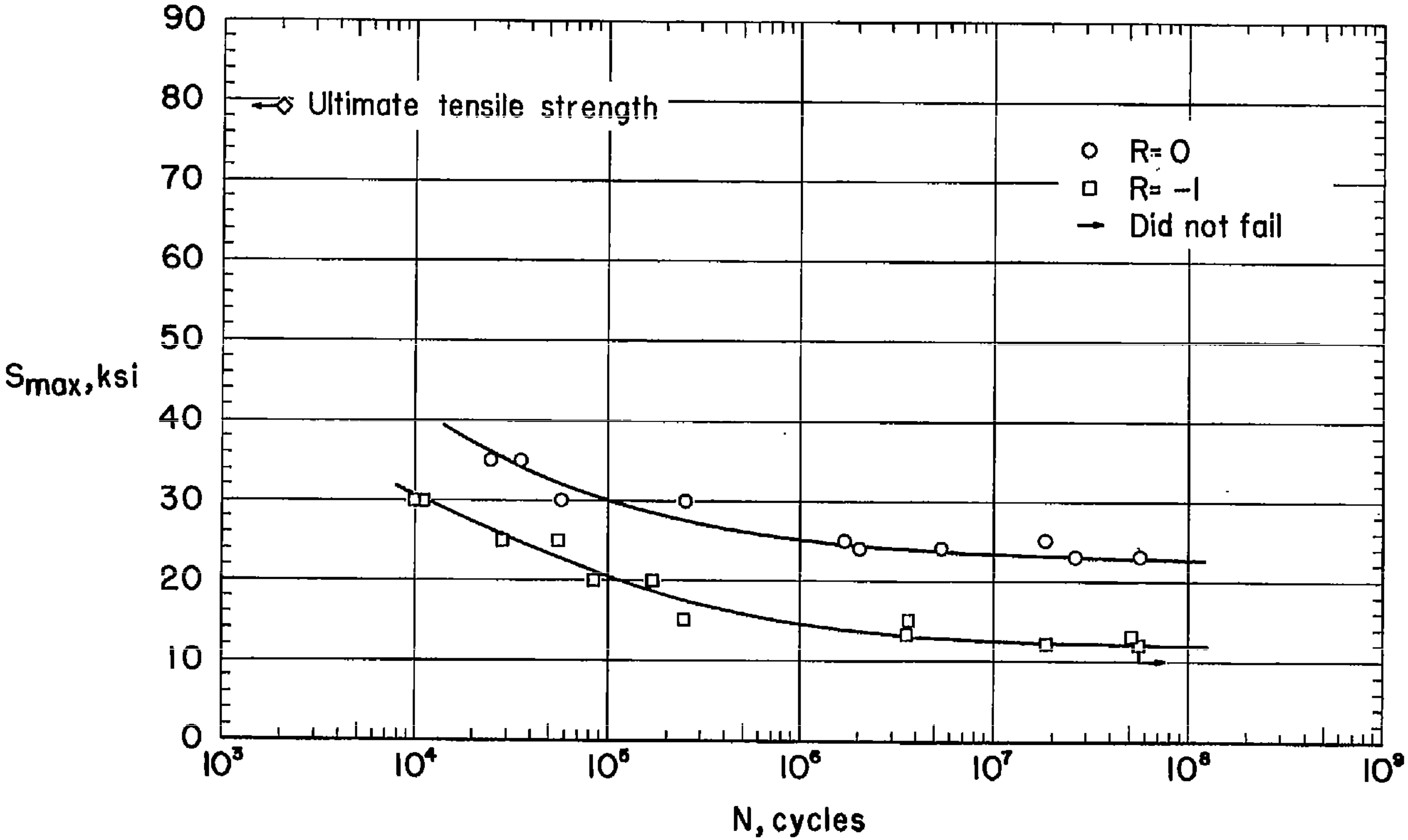
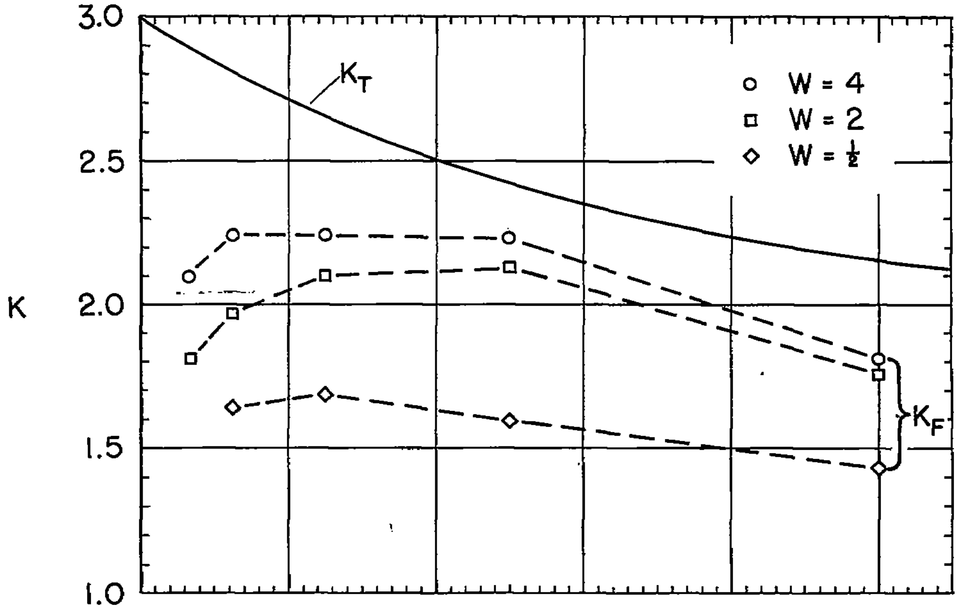
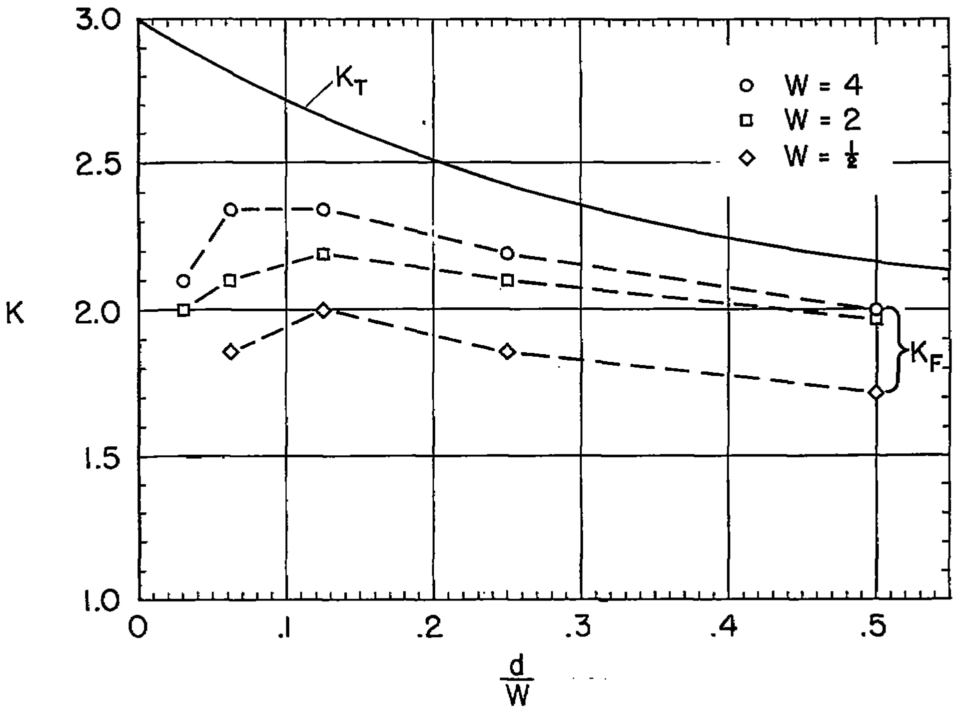


Figure 24.- S-N diagram for 7075-T6 aluminum-alloy sheet. $W = \frac{1}{2}$ inch; $d = \frac{1}{4}$ inch.

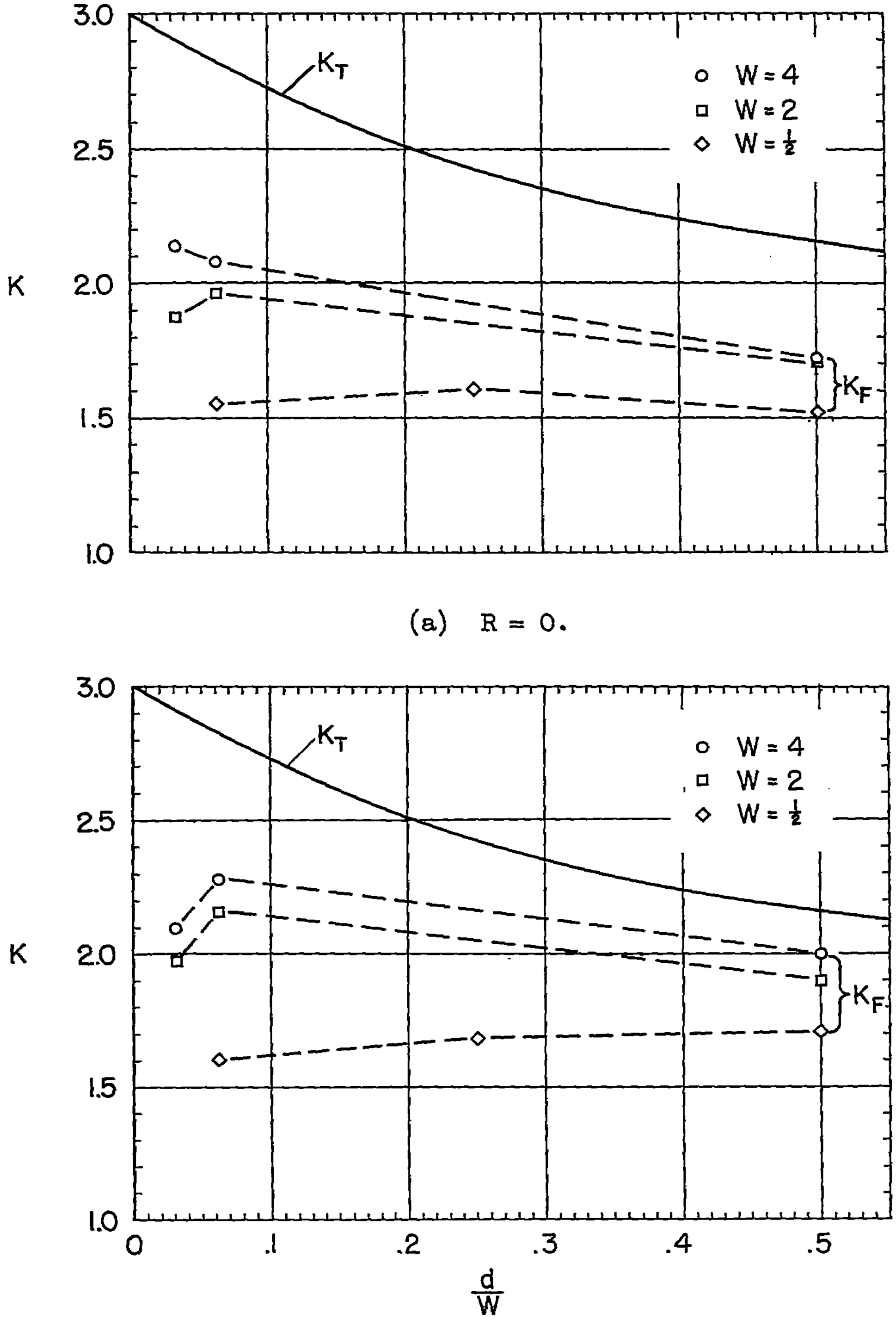


(a) R = 0.



(b) R = -1.

Figure 25.- Fatigue stress concentration factor K_F at $N = 10^7$ for 2024-T3 aluminum-alloy sheet.



(b) R = -1.

Figure 26.- Fatigue stress concentration factor K_F at $N = 10^7$ cycles for 7075-T6 aluminum-alloy sheet.