

AD-780 021

DYNAMIC PROPERTIES OF MATERIALS
PART II. ALUMINUM ALLOYS

BOSTON UNIVERSITY

PREPARED FOR
ARMY MATERIALS AND MECHANICS RESEARCH CENTER

APRIL 1974

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AMMRC CTR 74-23	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER AD-780 021
4. TITLE (and Subtitle) DYNAMIC PROPERTIES OF MATERIALS PART II - ALUMINUM ALLOYS		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. W. Jiang and M. M. Chen		8. CONTRACT OR GRANT NUMBER(s) DAAG46-73-C-0181
9. PERFORMING ORGANIZATION NAME AND ADDRESS Boston University-College of Engineering Aerospace Department 110 Cummington St., Boston, Mass. 02215		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS D/A Project: 1J562604A607 AMCMS Code: 5520.11.80700.01.0 Agency Accession:
11. CONTROLLING OFFICE NAME AND ADDRESS Army Materials and Mechanics Research Center Watertown, Massachusetts 02172		12. REPORT DATE April 1974
		13. NUMBER OF PAGES 55
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
Polymers Aluminum Alloys Steels		Stress-Strain Strain Rate Temperature
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
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strengths are plotted for 6061 and 7075 aluminum alloys.

It is shown that both the yield and ultimate strengths are higher under dynamic loads than under static loads. However, the aluminum alloys are not as strongly affected by strain rate as polymers and steels. It is also shown that the yield and ultimate strengths decrease with an increase of temperature.

CONTENTS

	<u>Page</u>
FOREWORD	<u>ii</u>
ABSTRACT	1
INTRODUCTION	2
RESULTS AND DISCUSSION	3
LIST OF INVESTIGATIONS	6
TABLES	8
FIGURES	32
ACKNOWLEDGEMENT	35
REFERENCES	36
BIBLIOGRAPHY	41

TABLES OF DYNAMIC PROPERTIES OF ALUMINUM ALLOYS

TABLE 1	Al-1100 or Equivalence
TABLE 2	Al-6061
TABLE 3	Al-7075
TABLE 4	Al-2014
TABLE 5	Al-2024
TABLE 6	Other Aluminum Alloys

FIGURES

1. Yield and Ultimate Strengths vs. Strain Rate for Al-6061-T6 in Tension
2. Yield Strengths vs. Strain Rate for Al-7075-0 in Tension
3. Yield and Ultimate Strengths vs. Strain Rate for Al-7075-T6 in Tension

FOREWORD

This report describes the work performed by the Department of Aerospace Engineering, Boston University, for the Army Materials and Mechanics Research Center (AMMRC), Watertown, Massachusetts, under Contract No. DAAG-46-73-C-0181. The Contracting Officer Representative at AMMRC was Dr. S. C. Chou. The program was supervised by Professor M. M. Chen at Boston University.

Dynamic Properties of Aluminum Alloys

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ABSTRACT

A literature survey on the mechanical properties of aluminum alloys under dynamic loadings has been made. The experimental data showing the variation of yield, ultimate strengths and elongation with strain rate and temperature are compiled and tabulated. The range of strain rate included in this report is from 10^{-5} in/in/sec to 10^4 in/in/sec, while the temperature range is from -300°F to 900°F . The variations of yield and ultimate strengths are plotted for 6061 and 7075 aluminum alloys.

It is shown that both the yield and ultimate strengths are higher under dynamic loads than under static loads. However, the aluminum alloys are not as strongly affected by strain rate as polymers and steels. It is also shown that the yield and ultimate strengths decrease with an increase of temperature.

INTRODUCTION

The mechanical behavior of aluminum alloys under dynamic loading conditions has been the subject of many researchers. The behavior has generally been studied in terms of the variance of yield and ultimate strengths with strain rate and temperatures. The dynamic properties presented in this report are based on a literature survey of experimental data for aluminum alloys. The data is usually limited to specific strain-rate ranges of particular interest. To cover a large range of strain rates, several test setups have been used by investigators. Both tension, compression and torsion results are included in this survey.

In this study, the elongation is reported as the percentage of elongation at break. In the case of compression, the sign of elongation in the tables should be considered as negative. All the pertinent information of this survey is shown in the List of Investigations. The methods of measuring strain rate are shown in the Remarks column for each reference. In some reports, the strain rates were calculated from the cross-head speed, in which the strain rate is obtained by dividing the cross-head speed by the gage length.

The yield strength of aluminum alloys is usually determined by one of the following two methods:

(1) Offset Method - In this method, it is necessary to secure the data for a stress-strain diagram. On the stress-strain diagram (See Fig. A), lay off OM equal to 0.2%, and draw MN parallel to OA which intersects the stress-strain curve at point r. The stress at r is called yield stress.

(2) Total-Extension-Under-Load Method - In this method, it is required to apply the load until a specified extension, which corresponds to a strain of 0.5%, is reached. The stress corresponding to this point is the yield point (see Fig. B).

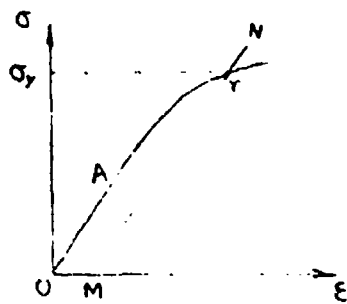


Fig. A

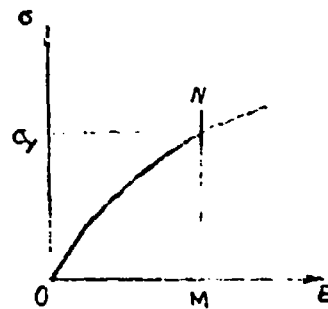


Fig. B

The ultimate strength is calculated by dividing the maximum load carried by the specimen during tension or compression tests by the original cross-section area of the specimen.

It is noticed that most of the experiments were done in the 1960's and they were carried out at room temperature. The strain rate in the survey ranges from 10^{-5} to 10^4 sec^{-1} . The temperature range varies from -320°F to 932°F , although most of the data were obtained at room temperature.

This document should serve as an information source for design and for future research work.

RESULTS AND DISCUSSION

The stress-strain curves obtained for aluminum alloys were monotonically increasing and showed no unusual features. The yielding point was not apparent for most aluminum alloys.

The strain rate has a relatively minor effect on the yield strength at room temperature (see e.g., Fig. 1). At higher temperatures, however, the effect of the strain rate on the yield strength becomes more pronounced (e.g., Fig. 2).

It is observed that high rates of strain hardening are found at low temperature, while little or no strain hardening is found at higher temperatures. In the intermediate temperature range, the slope of the stress-strain curve is strongly dependent upon the strain rate.

In general, the yield strength and ultimate strength varies linearly with $\log \dot{\epsilon}$, and the slope of the variation is larger at higher temperatures (see Figs. 2 and 3). The difference in the slopes of these two parameters indicates the degree of strain hardening of the material.

More recently, the concept of flow stress has been used to represent the dynamic property of aluminum alloys. For low temperature ranges, the relationship of flow stress and strain rate can be described as (see e.g., D-1, H-4)*:

$$\sigma_0 = C \dot{\epsilon}^m \quad (1)$$

where σ_0 is the stress for a given strain, $\dot{\epsilon}$ is the strain rate, C = constant for each temperature and m = the strain rate sensitivity coefficient for each temperature.

At high temperatures, the relationship between the flow stress, σ_0 , strain rate, $\dot{\epsilon}$, and temperature, T , can be

*Letter and number in parenthesis indicates the reference number.

represented by

$$\sigma_0 = f(\dot{\epsilon}) \exp \Delta H / RT \quad (2)$$

where ΔH is the apparent activation energy for deformation which can be considered as a constant in some temperature range, and \bar{R} is the universal gas constant. It is felt that more research work is needed in this area.

LIST OF INVESTIGATIONS

<u>Material</u>	<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>Type of Test</u>	<u>Ref.</u>	<u>Date</u>
1100	392~1112	$1 \times 10^{-2} \sim 1 \times 10^2$	torsion	B-3	1972
1100-0	room	$1 \times 10^{-4} \sim 8.9 \times 10^2$	torsion	F-2	1972
1100-0	68~392	$9.5 \times 10^{-2} \sim 2.13 \times 10^2$	compression	H-3&H-4	1967, 1970
1100-0	room	$1 \times 10^{-4} \sim 2.5 \times 10^1$	torsion	N-2	1971
1100	200~800	$0 \sim 1 \times 10^3$	tension	S-4	1969
Al-2S	room	$0, 3.75 \times 10^1 \sim 3 \times 10^2$	tension	C-3	1950
Al 2S	room~1112	$9 \times 10^{-7} \sim 1 \times 10^3$	tension	N-1	1941
Pure Al	482~1022	$6.6 \times 10^{-2} \sim 2.2 \times 10^3$	compression	S-1	1971
99.99% Al	room	$0, 2.66 \times 10^3$	compression	J-1	1963
Commercial Pure Al	572~932	$1 \times 10^0 \sim 3 \times 10^1$	compression	A-2	1959
Commercial Purity Al	-310~1022	4.38×10^0	compression	A-1	1954-5
S.P. Al	392~1112	$4 \times 10^{-1} \sim 3.11 \times 10^2$	compression	B-1	1963-6
Super-Purity Al	932	$4 \times 10^{-1} \sim 3.11 \times 10^2$	compression	B-2	1964
Commercial Purity Al	73.4	$0 \sim 1 \times 10^{-2}$	tension	B-4	1967
Al	room	$0, 1.32 \times 10^2$	tension	C-1	1938
Al	room	$0, 1.8 \times 10^3$	tension	C-2	1942
Super-Pure Al	383~896	5×10^{-1}	torsion	O-1	1960
7075-0	77~874.4	$2.5 \times 10^{-5} \sim 5 \times 10^{-1}$	tension	D-1	1968
7075-0	room	$2.5 \times 10^{-3} \sim 6 \times 10^2$	compression	H-6	1967
7075-0	room	$2.7 \times 10^{-5} \sim 6.7 \times 10^1$	tension	S-3	1960
Al-5.7% Zn	752~1022	$1 \times 10^{-1} \sim 3.11 \times 10^2$	compression	B-1	1963-6
Al-Cu-Si-Mg	572~842	$1 \times 10^0 \sim 3 \times 10^1$	compression	A-2	1959-6
7178-T651	room	$1.7 \times 10^{-4}, 1.92 \times 10^2$	tension	S-2	1963
7178-T6	room	$1.7 \times 10^{-4}, 1.92 \times 10^2$	tension	S-2	1963
5456-0	room	$3.1 \times 10^{-5} \sim 7 \times 10^1$	tension	S-3	1960
5456-H321	room	$1.7 \times 10^{-4}, 1.92 \times 10^2$	tension	S-2	1963
5456-H343	room	$1.7 \times 10^{-4}, 1.92 \times 10^2$	tension	S-2	1963
6351-T51	room	$1 \times 10^{-4} \sim 1 \times 10^3$	tension	L-1	1971
Al-Si-Mg	572~1022	$1 \sim 3 \times 10^1$	compression	A-2	1959-6
5454-0	room	$1 \times 10^{-4} \sim 9.8 \times 10^2$	tension	L-1	1971

<u>Material</u>	<u>T(°F)</u>	<u>(/sec)</u>	<u>Type of Test</u>	<u>Ref.</u>	<u>Date</u>
5454-H34	room	$9.9 \times 10^{-4} \sim 1.02 \times 10^3$	tension	L-1	1971
Al-2 1/4% Mg.	572~932	$1 \sim 3 \times 10^1$	compression	A-2	1959-60
Al-5% Mg.	572~932	$1 \sim 3 \times 10^1$	compression	A-2	1959-60
2R77	room	$1 \times 10^{-3} \sim 1.75 \times 10^3$	tension	H-1	1960
Al-Mn	572~1022	$1 \sim 3 \times 10^1$	compression	A-2	1959-60
5154-0	room	$4.1 \times 10^{-5} \sim 4 \times 10^1$	tension	S-3	1960
2024-0	-320~930	$1 \times 10^{-3} \sim 4 \times 10^{-1}$	torsion	F-1	1959
2024-T4	room	$1.7 \times 10^{-4}, 1.92 \times 10^2$	tension	S-2	1963
2024-T4	room	0, 6×10^4	tension	C-4	1958
2024	200~600	$0 \sim 1 \times 10^3$	tension	S-4	1969
7075-T6	room	0, 6×10^4	tension	C-4	1958
7075-T6	75~600	$3 \times 10^{-3} \sim 1 \times 10^1$	tension	G-1	1966
7075-T6	room	0, 6.6×10^3	compression	J-1	1963
7075-T6	80~600	$5 \times 10^{-5}, 1 \times 10^0$	tension	K-1	1961
7075-T6	room	$3 \times 10^{-2} \sim 5.6 \times 10^2$	compression	M-1	1966
7075-T6	room	$1.9 \times 10^{-5} \sim 4.3 \times 10^1$	tension	S-3	1960
7075-T651	72~550	$2 \times 10^{-3} \sim 1 \times 10^3$	compression	M-2	1969
5061-T6	room	$0 \sim 2.26 \times 10^4$	tension	A-3	1959
5061-T6	75~700	$1 \times 10^{-5} \sim 7 \times 10^2$	tension	H-5	1966
5061-T6	room	8×10^{-4}	tension	J-2	1972
5061-T6	72~600	$1 \times 10^{-3} \sim 1.8 \times 10^1$	tension	G-1	1966
5061-T6	room	$1.7 \times 10^{-4} \sim 1.92 \times 10^2$	tension	S-2	1963
5061-T6	room	$1.8 \times 10^{-5} \sim 6.9 \times 10^1$	tension	S-3	1960
5061-T6	room	$9 \times 10^{-3} \sim 9.1 \times 10^2$	compression	M-1	1966
5061	392~932	$1 \times 10^{-2} \sim 1 \times 10^2$	torsion	B-3	1972
5061-0	room	$3.4 \times 10^{-5} \sim 8 \times 10^1$	tension	S-3	1960
5061-T651	room	$1 \times 10^{-4} \sim 1 \times 10^3$	tension	L-1	1971
Al-2017	392~932	$1 \times 10^{-2} \sim 1 \times 10^2$	torsion	B-3	1972
24S-T	room	0, 1.77×10^3	tension	C-2	1942
24S-T Al	room	0, $3.75 \times 10^1 \sim 3 \times 10^2$	tension	C-3	1950
24S Annealed	room	0, $3.75 \times 10^1 \sim 3 \times 10^2$	tension	C-3	1950
Al-4.2%Cu	572~932	$4 \times 10^{-1} \sim 3.11 \times 10^2$	compression	B-1	1963-64
Al-Cu4-Mg1	-103, 68	$1 \times 10^{-3} \sim 1 \times 10^2$	tension	H-2	1972
2014-F	room	0, 6×10^4	tension	C-4	1958
1E15WP Al	room	0, $5 \times 10^2, 1 \times 10^3$	torsion	N-3	1972

TABLE 1 - DYNAMIC PROPERTIES OF Al-1100 OR EQUIVALENCE

Material: Al-1100, Si 0.32, Fe 0.70, Cu 0.20, Mn 0.05, Mg < 0.01,
Cr < 0.01, Zn 0.10, Ti < 0.01, Al Bal.

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
392	1×10^{-2}		10100		B-3 Torsion	Read from (σ, ϵ) curves, 0.2% offs for σ_y effective stress Strain & strain r 1 hr. at 662°F air cooled to am- bient temperature
	1×10^{-1}		11500			
	1.3×10^0		14100			
	8×10^0		15000			
	1×10^2		16650			
572	1×10^{-2}		6000			
	1×10^{-1}		7700			
	1.3×10^0		9500			
	8×10^0		10500			
	1×10^2		12600			
752	1×10^{-2}		3460			
	1×10^{-1}		4110			
	1.3×10^0		5340			
	8×10^0	4880	7250			
	1×10^2	5500	8750			
932	1×10^{-2}	1630	1750			
	1×10^{-1}	2000	2440			
	1.3×10^0	2550	4440			
	8×10^0	3250	5600			
	1×10^2	3880	5600			
1112	1×10^{-2}	810	880			
	1×10^{-1}	1000	1250			
	1.3×10^0	1690	2040			
	8×10^0	2500	3010			
	1×10^2	3000	4610			

Material: Al-1100-0

room	1×10^{-4}		7400	18.8	F-2	Annealed for 1 1/2 hrs. at 650°F and furnace cooled
	8.5×10^2	2530	5870	4.5	Torsion	
	8.7×10^2	2600	6000	4.7		
	8.9×10^2	2700	5940	5.0		

<u>T(°F)</u>	<u>ε̇ (/sec)</u>	<u>σ_Y(psi)</u>	<u>σ_U(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
<u>Material:</u> Al-1100-0						
68	1.35x10 ⁻¹	19700			H-3	Read from (σ _Y , ε̇) curves
	3.6x10 ⁰	20600			& H-4	
	1.1x10	19900			Comp.	
	3.9x10	20700				
	1.16x10 ²	19200				
	2.13x10 ²	20600				
134.6	1x10 ⁻¹	18200				
	1.1x10 ⁰	16900				
	2.14x10	19700				
	1x10 ²	18000				
	2.1x10 ²	20900				
392	9.5x10 ⁻²	14200				
	7.7x10 ⁻¹	15000				
	1.2x10 ⁰	15000				
	1.17x10 ¹	15900				
	9.2x10 ¹	17600				
	1.16x10 ²	16900				

Material: Al-1100-0

room	1x10 ⁻⁴	2400			N-2	0.5% strain for Torsion σ _Y , read from (σ, ε) curves, annealed at 650°F for 1 hr and furnace cooled
	1x10 ⁻³	2500				
	1x10 ⁻²	2700				
	2.5x10 ¹	2600				

Material: Al-2.5, 99.9% min normal

room	0		17200	4.6	C-3	Al-1100, 1/2 hard Tension
	3.75x10 ¹					
	~3x10 ²		22100	17.		
	0.		8700	23.		Al-1100 Annealed 720°F
	3.75x10 ¹					
	~3x10 ²		11600	30.		

Material: Al-1100

200	0		9400		S-4	Annealed 800°F Tension for 3 min.
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<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>G(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
	1×10^2 $\sim 1 \times 10^3$		10800			
350	0		4500			
	1×10^2 $\sim 1 \times 10^3$		7800			
550	0		2700			
	1×10^2 $\sim 1 \times 10^3$		6700			
800	0		1800			
	1×10^2 $\sim 1 \times 10^3$		4800			

Material: Al-2.5

room	9×10^{-7}		10960		N-1 Tension	Annealed 2hrs. a 752°F in vacuum Read from (G, ϵ curves
	3.4×10^{-5}		11350			
	9×10^{-4}		11540			
	5.5×10^{-1}		12540			
	1×10^2		15580			
	5.5×10^2		16230			
	1×10^3		16920			
392	3.4×10^{-5}		4620			
	1×10^{-2}		6920			
	1×10^2		11200			
	5.5×10^2		12300			
	1×10^3		12700			
752	9×10^{-4}		1210			
	5.5×10^{-1}		3650			
	1×10^2		6540			
	5.5×10^2		8080			
	1×10^3		8650			
1112	9×10^{-4}		440			
	5.5×10^{-1}		1540			
	1×10^2		4420			
	5.5×10^2		5500			
	1×10^3		6200			
room	0	20000	20000	14.8	C-2 Tension	Strain rate = sp /gage length condition unknow
	1.8×10^2	16950	21000	22.2		

<u>T(°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>G_v (psi)</u>	<u>G_u (psi)</u>	<u>Elong (%)</u>	<u>Ref.</u>	<u>Remarks</u>
	4.2×10^2	17400	22170	25.3		
	7.2×10^2	22430	25830	25.3		
	1.08×10^3	27570	22200	28.1		
	1.44×10^3	29000	22000	24.3		
	1.8×10^3	29650	23150	26.3		

Material: Pure Al

482	6.6×10^{-2}		6640		S-1 Comp.	Read from (σ, ϵ) curves
	5.2×10^2		16200			
	5.4×10^2		16600			
	1.2×10^3		16800			
	1.9×10^3		17100			
662	2.2×10^3		17500			
	6.6×10^{-2}		4270			
	5.2×10^2		12000			
	7.4×10^2		12300			
	1.2×10^3		12600			
842	1.9×10^3		12900			
	2.2×10^3		13300			
	6.6×10^{-2}		2950			
	5.2×10^2		8840			
	7.4×10^2		9040			
1022	1.2×10^3		9400			
	1.9×10^3		9540			
	2.2×10^3		9900			
	6.6×10^{-2}		2000			
	5.2×10^2		6600			
	7.4×10^2		6740			
	1.2×10^3		7100			
	1.9×10^3		7300			
	2.2×10^3		7540			

Material: 99.99%Al

room	0	3000			J-1 Comp.	Annealed to 2900psi yield Read from (σ, ϵ) curve
	2.66×10^3	6000				

<u>T(°F)</u>	<u>Ė(/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
<u>Material:</u> Al						
room	0	15920	18920	15.1	C-1 Tension	Strain rate = spe /gage length
	1.32x10 ²	24240	25030	24.6		

Material: Commercial Purity Al ; Cu 0.01, Si 0.02, Mn 0.02, Fe 0.46,
Zn 0.01, Al. Bal.

-310	4.38x10 ⁰		34290		A-1 Comp.	Annealed for 1 hr at 752°F Read from (σ, ε) curves
662	4.38x10 ⁰		8460			
842	4.38x10 ⁰		5000			
1022	4.38x10 ⁰		3080			

Material: Commercial Pure Al ; Cu 0.02, Si 0.12, Fe 0.31, Al Bal.

572	1x10 ⁰		7400		A-2 Comp.	Read from (σ, ε) curves
	1x10 ¹		9000			
	2x10 ¹		10000			
	3x10 ¹		10400			
752	1x10 ⁰		4600			
	1x10 ¹		5600			
	2x10 ¹		6400			
932	3x10 ¹		7000			
	1x10 ⁰		3200			
	1x10 ¹		3800			
	2x10 ¹		4400			
	3x10 ¹		5000			

Material: S.P. Al

932	4x10 ⁻¹		2170		B-2 Comp.	Read from (σ, ε) curves
	2x10 ⁰		2830			
	9x10 ⁰		3750			
	4.1x10 ¹		4500			
	1.01x10 ²		5660			
	2.03x10 ²		6330			
	3.11x10 ²		6670			

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>$\bar{\sigma}_y$(psi)</u>	<u>$\bar{\sigma}_u$(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
<u>Material: S.P. Al</u>						
383	5×10^{-1}	3000	8300		O-1	Yielding at 0.2% offset
536	5×10^{-1}	1470	5470		Torsion	Read from ($\bar{\sigma}, \bar{\epsilon}$) curves
734	5×10^{-1}	1180	3250			
896	5×10^{-1}	940	1530			

Material: S.P. Al; Cu 0.0017, Si 0.0026, Fe 0.0033, Mn 0.006, Al 99.99

392	4×10^{-1}		9700		B-1 Comp.	Heat treated for hr. at 1112°F Read from ($\bar{\sigma}, \bar{\epsilon}$) curves
	9×10^0		10450			
	1.01×10^2		11300			
	3.11×10^2		16000			
752	4×10^{-1}		3850			
	9×10^0		5300			
	1.01×10^2		8050			
	3.11×10^2		9150			
932	4×10^{-1}		2020			
	2×10^0		3000			
	9×10^0		3900			
	4.1×10^1		4060			
	1.01×10^2		5080			
	3.11×10^3		6900			
1022	4×10^{-1}		1250			
	2×10^0		1750			
	9×10^0		2020			
	4.1×10^1		3500			
	1.01×10^2		4000			
	3.11×10^2		5000			
1112	4×10^{-1}		1000			
	2×10^0		1500			
	9×10^0		2240			
	4.1×10^1		2900			
	1.01×10^2		3450			
	2.03×10^2		4000			
	3.11×10^2		4500			

TABLE 2 - DYNAMIC PROPERTIES OF Al-6061

Material: Al-6061-T6

<u>T(°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
room	0		50000	25.5	A-3 Tension	Strain Rate at fracture Impact tester Read from table True stress
	4.48×10^3		54000	19.9		
	5.13×10^3		64000	20.7		
	5.85×10^3		59000	20.0		
	6.89×10^3		58000	20.4		
	7.13×10^3			20.5		
	9.55×10^3		61000	21.8		
	1×10^4		69000	20.3		
	1.54×10^4		58000	20.3		
	2.26×10^4		68000	25.5		
75	4.8×10^{-5}	37900	43800	21.0	H-5 Tension	σ_y at 0.2% offset Method 211.1 Type R3 of Federal Test Method Standard No. 151a Dynapak metal working machine, strains and strain rate were calculated from the output of a velocity transducer attached to the specimen's threaded ends. Read from ($\sigma, \dot{\epsilon}$) curve and table.
	3×10^{-2}		44000	21.0		
	7×10^0		46000	19.0		
	1.9×10^1		48000	17.0		
	2.8×10^1	45050	52000	17.8		
	4.4×10^1		51000	16.5		
	6.5×10^1	48500	51000	19.0		
	7.2×10^1		53000	17.5		
	1.1×10^2		54000	15.5		
	100	1×10^{-5}	15100	19000		
3×10^{-2}			27600	13.0		
8×10^0			33000	13.0		
1.8×10^1		33100	37000	14.0		
5.8×10^1			43000	15.5		
7.5×10^1			44000	16.0		
1.3×10^2		41850	46000	15.0		
00		1×10^{-5}	4000	5500	15.0	
		3×10^{-5}		9500	15.0	
		1.3×10^1		25000	13.0	
	2.3×10^1	28250	30000	14.5		
	2.8×10^1		28000			
	5.4×10^1	31600	33000	12.5		
	8.2×10^1		34000	14.0		

<u>T (°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
662	1×10^{-2}	3000	4920			
	1×10^{-1}	4600	5300			
	1.3×10^0	5000	8000			
	8×10^0	5750	9000			
	1×10^2	7200	11500			
752	1×10^{-2}	2750	3320			
	1×10^{-1}	4000	4750			
	1.3×10^0	4920	6000			
	8×10^0	5600	7150			
	1×10^2	8000	9400			
842	1×10^{-2}	2000	3000			
	1×10^{-1}	3150	4000			
	1.3×10^0	4750	5250			
	8×10^0	5330	6050			
	1×10^2	6000	8400			
932	1×10^{-2}	1300	2000			
	1×10^{-1}	2000	3130			
	1.3×10^0	3300	4040			
	8×10^0	5200	5750			
	1×10^2	6000	7500			

Material: Al-6061-0

room	3.4×10^{-5}	7700	19800	23.5	S-3 Tension	Normal strain rate Charpy impact test- ing machine Read from table
	5.6×10^{-4}	9200	20200	22.5		
	5.5×10^{-2}	8500	20800	26.5		
	8×10^1	9000	21000	33.3		

Material: Al-6061-T651; Si 0.68, Fe 0.52, Cu 0.25, Mn 0.04, Mg 0.94,
Cr 0.24, Ti 0.02, Zn 0.05

room	1×10^{-4}	37300	40370	10.0	L-1 Tension	$\sigma_y = 0.2\%$ offset Read from table Instron .0001-.01S Hydraulic .0001- 10S-1 Hopkinson pressure bar 100-1000 S ⁻¹ Strain rate is deter- mined from relative velocity of two faces
	1.67×10^{-2}	40570	34500	18.2		
	1×10^{-1}	37500	40900	12.1		
	9.1×10^{-1}	40600	42500	22.9		
	9.2×10^{-1}	40200	42300	17.9		
	9.3×10^{-1}	40300	42200	18.9		
	6.6×10^0	39700	41900	18.8		

<u>T(°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>$\bar{\sigma}_Y$(psi)</u>	<u>$\bar{\sigma}_U$(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
	7.6×10^0	38000	40400	16.9		
	8.2×10^0	39500	42100	12.5		
	3.1×10^2	37300	40700	14.3		
	3.3×10^2	39200	42300	14.7		
	3.5×10^2	39800	42700	14.7		
	4.4×10^2	39800	42400	11.2		
	1×10^3	39600	41700	15.4		

TABLE 3 - DYNAMIC PROPERTIES OF Al-7075

Material: Al-7075-0; Zn 5.61, Mg 2.50, Cu 1.26, Fe 0.35, Mn 0.05, Ti 0.04, Si 0.02, Ni Trace, Al Bal.

<u>T(°F)</u>	<u>ε̇(/sec)</u>	<u>σ_y(psi)</u>	<u>σ_v(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
77	2.5x10 ⁻⁵	14300			D-1 Tension	σ _y = 0.2% offset Specimens were cut from a single heat of 7075-T6 Al. Annealed at 776± 18°F for 2 hrs., cooled to 468°F for 3 hrs. and air cooled to room temperature. Constant cross- head speeds Read from (σ _y , ε̇) curves
	5x10 ⁻⁵	14300				
	2.5x10 ⁻⁴	14300				
	5x10 ⁻⁴	14300				
	1.5x10 ⁻³	14300				
	2.5x10 ⁻³	14400				
	5x10 ⁻³	14300				
	1.5x10 ⁻²	14400				
	2.5x10 ⁻²	14300				
	5x10 ⁻²	18000				
600	1.5x10 ⁻¹	20000				
	2.5x10 ⁻⁵	6150				
	5x10 ⁻⁵	6200				
	2.5x10 ⁻⁴	7300				
	5x10 ⁻⁴	8150				
	1.5x10 ⁻³	8700				
	2.5x10 ⁻³	8300				
	5x10 ⁻³	9300				
	1.5x10 ⁻²	10150				
	2.5x10 ⁻²	11250				
700	1.5x10 ⁻¹	14300				
	5x10 ⁻¹	19000				
	2.5x10 ⁻⁵	4300				
	5x10 ⁻⁵	4600				
	2.5x10 ⁻⁴	5250				
	5x10 ⁻⁴	6000				
	1.5x10 ⁻³	6600				
	2.5x10 ⁻³	7500				
	5x10 ⁻³	8150				
	1.5x10 ⁻²	9150				
2.5x10 ⁻²	10150					
5x10 ⁻²	11000					

<u>T(°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>	
800	2.5×10^{-5}	3300					
	5×10^{-5}	3700					
	2.5×10^{-4}	4200					
	5×10^{-4}	4600					
	1.5×10^{-3}	5000					
	2.5×10^{-3}	5700					
	5×10^{-3}	6300					
	1.5×10^{-2}	7250					
	2.5×10^{-2}	8700					
	5×10^{-2}	9500					
	1.5×10^{-1}	12000					
	5×10^{-1}	13900					
	850	2.5×10^{-5}	2500				
		5×10^{-5}	3300				
2.5×10^{-4}		3400					
5×10^{-4}		3650					
1.5×10^{-3}		4000					
2.5×10^{-3}		4300					
5×10^{-3}		4700					
1.5×10^{-2}		5350					
2.5×10^{-2}		6400					
5×10^{-2}		7950					
1.5×10^{-1}		9150					
5×10^{-1}		12200					
875		2.5×10^{-5}	2200				
		5×10^{-5}	2900				
	2.5×10^{-4}	3200					
	5×10^{-4}	3600					
	1.5×10^{-3}	3950					
	2.5×10^{-3}	4150					
	5×10^{-3}	4550					
	1.5×10^{-2}	5000					
	2.5×10^{-2}	6150					
	1.5×10^{-1}	9400					
	5×10^{-1}	12000					

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_Y(psi)</u>	<u>σ_U(psi)</u>	<u>Elong.(%)</u>	<u>Ref.</u>	<u>Remarks</u>
<u>Material:</u> Al-7075-0; Zn 5.6, Mg 2.5, Cu 1.6, Cr 0.3, AlBal.						
Room	2.5×10^{-3}	18200			H-6	$\sigma_Y = 0.2\%$ offset Read from (σ, ϵ) curves
	6×10^{-2}	18600			Comp.	
<u>Material:</u> Al-7075--0						
Room	2.7×10^{-5}	19000	46400	15.6	S-3	Normal strain rate Charpy impact test ing machine Read from table
	5.3×10^{-4}	19500	45100	16.0	Tension	
	6×10^{-2}	23700	45000	19.0		
	6.7×10^{-1}	24500	46000	18.2		
<u>Material:</u> Al-5.7% Zn; Zn 5.75, Mg 2.21, Cu 1.31, Si 0.21, Fe 0.30, Mn 0.34, Pb 0.01, AlBal.						
52	4×10^{-1}	11450	14600		B-1	$\sigma_Y = 0.2\%$ offset ≈ 7075 A Read from (σ, ϵ) curves Solution-Treated for 1 hr. at 870° water-quenched overaged at 284°F for 16 hrs., furnace cooled to room tem- perature True stress Natural strain
	9×10^0	16550	20000		Comp.	
	1.01×10^2	19450	22620			
	3.11×10^2	21250	24650			
42	4×10^{-1}	10270	14040			
	9×10^0	16000	19600			
	1.01×10^2	19600	22600			
	3.11×10^2	22270	25940			
32	4×10^{-1}	5500	6600			
	9×10^0	9000	10600			
	1.01×10^2	13100	15200			
	3.11×10^2	16100	17500			
022	4×10^{-1}	3820	4640			
	9×10^0	6000	7640			
	1.01×10^2	9820	11180			
	3.11×10^2	12000	12980			
<u>Material:</u> Al-7075-T6						
Room	0	75400			J-1	Read from (σ, ϵ) curves Solution heat treated and aged
	6.6×10^3	131000			Comp.	
Room	3×10^{-2}	68000			M-1	$\sigma_Y = 0.2\%$ offset Read from (σ, ϵ) curve
					Comp.	

<u>F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>σ_Y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
						Medium strain rate machine and split Hopkinson bar apparatus
m	1.9×10^{-5}	64000	83000	10.2	S-3	Normal strain rate
	3.1×10^{-4}	67000	84700	12.9	Tension	Charpy impact testing
	6×10^{-2}	70000	80000	12.0		Read from table
	4.3×10^1	75000	85000	13.0		
	3×10^{-3}	77500	84600		G-1	
	8×10^0	77500	84600		Tension	
)	1×10^{-3}	64000	68500			
	8×10^0	68000	74000			
)	3×10^{-3}	16500	17500			
	1×10^1	28000	28500			

Serial: Al-7075-T6; Cu 1.6, Mg 2.5, Zn 5.6, Cr 0.3, Al Bal.

m	0	59000			C-4	Strain rate = speed of plastic wave/ gage length
	6×10^4	86500	100900	42	Tension	$\sigma_Y = 0.01\%$ offset Read from table Spring-powered impact machine
	5×10^{-5}	60770	75380		K-1	$\sigma_Y = 0.2\%$ offset
	1×10^0	67690	72150		Tension	Read from (σ, ϵ) curves
)	5×10^{-5}	48150	56000			
	1×10^0	58460	66150			
)	5×10^{-5}	22070	29230			
	1×10^0	29610	34610			
)	5×10^{-5}	5380	9230			
	1×10^0	17100	20850			

Serial: Al-7075-T651

	4×10^{-3}	72000			M-2	Read from (σ, ϵ) curves
)	2×10^{-3}	64500			Comp.	$\sigma_Y = 0.2\%$ offset
)	5×10^0	48500				
)	1.2×10^{-2}	12000				
	1×10^3	24260				

TABLE 4 - DYNAMIC PROPERTIES OF Al-2014 OR EQUIVALENCE

Material: Al-2014-F; Mn 0.8, Cu 4.4, Si 0.8, Mg 0.4

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_Y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong.(%)</u>	<u>Ref.</u>	<u>Remarks</u>
room	0	17000			C-4	Read from table
	6×10^4	28400			Tension	Strain rate = spec of slowest plastic wave/gage length Spring-powered im- pact machine $\sigma_Y = 0.01\%$ offset

Material: Al-4.2% Cu; Cu 4.17, Mg 0.89, Si 0.68, Fe 0.41, Mn 0.80,
Zn 0.052, Pb 0.01, Al Bal.

572	4×10^{-1}		15000		B-1 Comp.	Read from (σ, ϵ) curves True stress Heat-treated for 1/2 hr. at 1112°F Natural strain
	2×10^0		17000			
	9×10^0		20830			
	4.1×10^1		24000			
	2.03×10^2		26670			
662	4×10^{-1}		12800			
	9×10^0		17280			
	1.01×10^2		21540			
	3.11×10^2		23850			
752	4×10^{-1}		10610			
	9×10^0		14780			
	1.01×10^2		18260			
	3.11×10^2		21590			
842	4×10^{-1}		8700			
	9×10^0		14170			
	1.01×10^2		17500			
	3.11×10^2		21250			
932	4×10^{-1}		6780			
	9×10^0		12170			
	1.01×10^2		17250			
	3.11×10^2		20000			

Material: Al-Cu4-Mg1; Cu 4.6, Mg 1.46, Mn 0.74, Si 0.22, Zn 0.05, Fe 0.1,
Al Bal.

-103	1×10^{-3}	26050	52000	18.5	H-2	Read from ($\sigma_Y, \dot{\epsilon}$)
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<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_Y(psi)</u>	<u>σ_U(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
	1×10^{-2}	25000	49800	18.0		
	1×10^{-1}		49400			
	1×10^2	28400	53300	20		
68	1×10^{-3}	25500	56900	15		
	1×10^{-2}	24900	54000	17.7		
	1×10^{-1}	26200	49800	18.8		
	1×10^2	24900	45000	17.7		

Material: HE 15 WP Al \approx Al-2014-T6

room	0	17430			N-3	$\sigma_Y = 0.2\%$ offset
	5×10^2	19000			Torsion	Read from (σ, ϵ)
	1×10^3	19500				curves
						Torsional Hopkinson
						bar

Material: Al-Cu-Si-Mg Alloys \approx Al-2014; Cu 4.4, Mn 0.8, Mg 0.56, Si 0.9, Fe 0.36, Al Bal.

572	1×10^0		15400		A-2	Read from (σ, ϵ)
	1×10^1		16000		Comp.	curve
	2×10^1		17000			Annealed for 6 hr.
	3×10^1		18000			at 750°F and fur-
						nace-cooled to room
752	1×10^0		10800			temperature
	1×10^1		12800			Cam plastometer & $\dot{\epsilon}$
	2×10^1		14400			was computed by
	3×10^1		15700			dividing the decre-
						ment effected by
842	1×10^0		9400			the initial specimen
	1×10^1		11600			height & by the
	2×10^1		13200			associated test
	3×10^1		14400			period.

TABLE 5 - DYNAMIC PROPERTIES OF Al-2024

Material: Al-2024-0

<u>T(°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>σ_y (psi)</u>	<u>σ_u (psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
-320	1×10^{-3} $\sim 4 \times 10^{-1}$	25000			F-1	$\sigma_y = 0.2\%$ offset Read from (σ, ϵ) curves Constant strain rate
82	1×10^{-3} $\sim 4 \times 10^{-1}$	11900			Torsion	
390	1×10^{-3}	11000	15400			
	2.67×10^{-3}	11000	16150			
	4×10^{-1}	11000	17700			
660	1×10^{-3}	2850	3150			
	2.67×10^{-3}	3100	3670			
	1.6×10^{-2}	3850	4380			
	6.7×10^{-2}	4540	5310			
	4×10^{-1}	5600	6610			
930	1×10^{-3}	1050	1380			
	2.67×10^{-3}	1230	1620			
	1.67×10^{-2}	1780	2050			
	6.7×10^{-2}	2700	2890			
	4×10^{-1}		3850			

Material: Al-2024-T4

room	1.7×10^{-4}	54000	84400		S-2	Read from (σ, ϵ) Tension curves
	1.92×10^2	54000	86500		Tension	

Material: Al-2024-T4; Mn 1.5, Cu 4.5, Mg 0.6, Al Bal.

room	0	41000			C-4	Read from table Strain rate = speed of plastic wave/ gage length $\sigma_y = 0.01\%$ offset Spring-powered im- pact machine
	6×10^4	54800			Tension	

Material: Al-2024

200	0		28000		S-4	Annealed 600°F Tension for 3 min.
	$10^2 \sim 10^3$		20000		Tension	
450	0		14500			
	$10^2 \sim 10^3$		20500			

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
600	0		6000			
	$10^2 \sim 10^3$		20800			

TABLE 6 - DYNAMIC PROPERTIES OF OTHER Al-ALLOYS

Material: Al-2017; Si 0.83, Fe 1.00, Cu 4.18, Mn 0.46, Mg 0.30, Cr 0.10,
Zn 0.25, Ti < 0.01, Al Bal.

<u>°F)</u>	<u>$\dot{\epsilon}$ (/sec)</u>	<u>σ_Y (psi)</u>	<u>σ_U (psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
2	1×10^{-2}		31250		B-3 Torsion	2 hrs. at 752°F then furnace cooled at 54°F/hr. to 500°F and air cooled to ambient temperature Read from (σ, ϵ) curves
	1×10^{-1}		37750			
	1.3×10^0		37500			
	8×10^0		40000			
	1×10^2		41900			
2	1×10^{-2}		10000			Effective stress & strain & strain rate
	1×10^{-1}		12810			
	1.3×10^0		19700			
	8×10^0		21250			
	1×10^2		24250			
2	1×10^{-2}		7500			
	1×10^{-1}		9250			
	1.3×10^0		12050			
	8×10^0		15100			
	1×10^2		17800			
2	1×10^{-2}		5750			
	1×10^{-1}		7170			
	1.3×10^0		9850			
	8×10^0		12420			
	1×10^2		15250			
2	1×10^{-2}		4000			
	1×10^{-1}		5650			
	1.3×10^0		8050			
	8×10^0		11000			
	1×10^2		13850			
2	1×10^{-2}		2750			
	1×10^{-1}		4050			
	1.3×10^0		6500			
	8×10^0		9200			
	1×10^2		12000			

Material: 24S-T Al; Cu 4.5, Mn 0.6, Mg 1.5, Al Bal.

(°F)	$\dot{\epsilon}$ (/sec)	σ_Y (psi)	σ_u (psi)	Elong. (%)	Ref.	Remarks
room	0	46000	65600	20.0	C-2	Strain rate = speed Tension /gage length
	1.2×10^2	56000	73000	20.2		
	4.44×10^2	67100	77800	22.3		
	7.68×10^2	75000	81800	23.5		
	1.07×10^3	71300	76100	22.0		
	1.4×10^3	79600	78000	24.8		
	1.78×10^3	84800	78000	25.0		

Material: 24S Annealed Al; Mg 1.55, Cu 4.59, Mn 0.64, Si 0.20, Al Bal.

room	0		33950	6.7	C-3	Annealed 675°F, 20 Tension min., cooled in fur- nace at rate of 25°F/hr.
	3.75×10^1 $\sim 3 \times 10^2$		44980	9.9		

Material: 17S-T Al; Cu 4.5, Mn 0.6, Mg 1.5, Al Bal.

room	0	40000	55400	21.2	C-2	Strain rate = speed Tension /gage length
	1.8×10^2	43700	56350	23.3		
	5.4×10^2	37100	60330	25.1		
	9.6×10^2	66000	53570	27.8		
	1.44×10^3	72400	57500	29.2		
	1.8×10^3	61330	57930	29.2		

Material: 17S-T Al; Mg 0.25, Cu 4.20, Si 0.13, Al Bal.

room	0		57900	14.2	C-3	Tension
	3.75×10^1 $\sim 3 \times 10^2$		63800	17.0		

Material: Al-5154-0

room	4.1×10^{-5}	19300	35400	19.7	S-3	Normal strain rate Tension Charpy impact test- ing machine Read from table
	5.1×10^{-4}	19500	35200	24.4		
	5.3×10^{-2}	22600	34000	23.0		
	4×10^1	22800	35000	27.0		

Material: Al-5454-0; Si 0.08, Fe 0.22, Cu 0.03, Mn 0.68, Mg 2.56, Cr 0.08,
Ti 0.01, Al Bal.

room	1×10^{-4}	17000	34800	17.0	L-1	$\sigma_Y = 0.2\%$ offset
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<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>G_Y(psi)</u>	<u>G_U(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
	1.1×10^{-4}	17700	35100	18.2	Tension	Read from table Instron .0001- .01 S ⁻¹ Hydraulic .0001- 10 S ⁻¹ Hopkinson pressur bar 100~1000 S ⁻¹ Strain rate is d mined from relat velocity of two faces
	1.54×10^{-4}	16600	33600	16.8		
	1.66×10^{-4}	18030	37230	21.2		
	1×10^{-2}	17900	33700	22.8		
	1.03×10^{-2}	17700	33400	23.5		
	1.66×10^{-2}	16970	35200	27.9		
	3.5×10^{-2}	17100	33400	19.6		
	9.8×10^{-1}	19600	32900	20.4		
	1×10^0	18200	33150	19.8		
	1×10^1	18870	33130	25.3		
	1.3×10^2	17600				
	1.5×10^2	18300				
	9.2×10^2	22200	35200	36.4		
	9.6×10^2	23000	35200	35.8		
	9.8×10^2	23200	37500	36.6		

Material: Al-5454-H34; Si 0.08, Fe 0.22, Cu 0.03, Mn 0.68, Mg 2.56,
Cr 0.08, Ti 0.01, Al Bal.

room	9.9×10^{-5}	36200	42400	11.3	L-1 Tension	$G_Y = 0.2\%$ offset Read from table Instron .0001~.01 S ⁻¹ Hydraulic .0001~ 10 S ⁻¹ Hopkinson pressur bar 100~1000 S ⁻¹ Strain rate is determined from r lative velocity o two faces
	1.01×10^{-4}	36100	42400	13.8		
	1.6×10^{-4}	34400	41200	9.6		
	1.66×10^{-4}	39000	44530	11.9		
	9.7×10^{-3}	34400	39600	12.6		
	9.9×10^{-3}	34800	39900	11.0		
	1.66×10^{-2}	37550	43700	11.8		
	3.5×10^{-2}	35600	40100	9.8		
	1×10^0	35970	40700	14.9		
	1×10^1	35800	40700	15.6		
	3×10^2	36370	35530			
	1.02×10^3	39130	43100	24.2		

Material: Al-2 1/4% Mg Alloy (\approx 5450); Cu 0.06, Mn 0.17, Mg 2.35, Si 0.22,
Fe 0.32, Al Bal.

572	1×10^0		20800		A-2 Comp.	Annealed for -6 hr at 750°F & cooled in air to room ten perature.
	1×10^1		21600			
	2×10^1		22400			

(°F)	$\dot{\epsilon}$ (/sec)	σ_T (psi)	σ_V (psi)	Elong. (%)	Ref.	Remarks
52	3×10^1		23000			Read from (σ, ϵ) curves Cam Plastometer, $\dot{\epsilon}$ was computed by dividing the decrement effected by the initial specimen height & by the associated test period
	1×10^0		11200			
	1×10^1		13800			
	2×10^1		14600			
32	3×10^1		15200			
	1×10^0		6600			
	1×10^1		8600			
	2×10^1		9600			
	3×10^1		10200			

Material: Al-5% Mg Alloy (≈ 5450); Cu 0.10, Mn 0.19, Mg 5.11, Si 0.21, Fe 0.29, Al Bal.

72	1×10^0		28200		A-2 Comp. Annealed for -6 hrs. at 750°F & furnace cooled to room temperature. Read from (σ, ϵ) curves Cam Plastometer, $\dot{\epsilon}$ was computed by dividing the decrement effected by the initial specimen height & by the associated test period.
	1×10^1		29200		
	2×10^1		30400		
	3×10^1		31800		
52	1×10^0		19000		
	1×10^1		20000		
	2×10^1		21200		
	3×10^1		22900		
32	1×10^0		9600		
	1×10^1		12000		
	2×10^1		13800		
	3×10^1		14800		

Material: Al-5456-0

room	3.1×10^{-5}	22200	48000	16.9	S-3 Tension Normal strain rate Charpy impact testing machine Read from table
	3.8×10^{-4}	22600	48200	18.2	
	4.6×10^{-2}	22000	47000	17.8	
	7×10^1	22500	42500	21.0	

Material: Al-5456-H321

room	1.7×10^{-4}	33000	57200	11.0	S-2 Tension True stress & Strain
	1.92×10^2	33700	65000	17.0	

Material: Al-5456-H343

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong.(%)</u>	<u>Ref.</u>	<u>Remarks</u>
room	1.7×10^{-4}	50000	62730	11.9	S-2 Tension	True stress & st
	1.92×10^{-2}	56970	72730	9.3		

Material: Al-6351-T51; Si 0.94, Fe 0.32, Cu 0.07, Mn 0.65, Mg 0.58, Cr 0.01, Ti 0.05, Zn 0.03, Al Bal.

room	1×10^{-4}	44130	46330	7.06	L-1 Tension	$\sigma_y = 0.2\%$ offset Read from table Instron .0001-.0 S ⁻¹ Hydraulic .0001- 10 S ⁻¹ Hopkinson pressu bar 100-1000 S ⁻¹ Strain rate is d etermined from re tative velocity of two faces
	1.7×10^{-4}	51330	53030	15.0		
	1×10^{-2}	45800	47800	7.7		
	3.7×10^{-1}	48900	50300	9.68		
	9.1×10^{-1}	48800	50500	13.1		
	9.5×10^{-1}	46700	48600	13.1		
	7.3×10^0	47000	49200	7.4		
	1.01×10^1	48300	49900	7.06		
	1.16×10^1	49100	50900	9.18		
	1×10^2	49600	51400			
	3.6×10^2	47700	50600	10.5		
	1×10^3	51100	51800	11.0		

Material: Al-Si-Mg Alloy (\approx 6354); Cu 0.07, Mn 0.53, Mg 0.73, Si 1.04, Fe 0.36, Al Bal.

572	1×10^0		9600		A-2 Comp.	Read from (σ , ϵ curves Annealed for ~6 at 750°F & furnace cooled to room t perature.
	1×10^1		11200			
	2×10^1		12200			
	3×10^1		12600			
752	1×10^0		7000		Cam Plastometer $\dot{\epsilon}$ was computed by dividing the dec rement effected by initial specimen height & by the associated test period.	
	1×10^1		9000			
	2×10^1		10000			
	3×10^1		10800			
932	1×10^0		4900			
	1×10^1		6600			
	2×10^1		7300			
	3×10^1		7500			
1022	1×10^0		3200			
	1×10^1		4900			
	2×10^1		5600			
	3×10^1		5900			

<u>T(°F)</u>	<u>$\dot{\epsilon}$(/sec)</u>	<u>σ_y(psi)</u>	<u>σ_u(psi)</u>	<u>Elong. (%)</u>	<u>Ref.</u>	<u>Remarks</u>
<u>Material:</u> Al-7178-T651						
room	1.7×10^{-4}	87500	100000		S-2	Read from (σ , ϵ)
	1.92×10^2	106000	150000		Tension	curves
<u>Material:</u> Al-7178-T6						
room	1.7×10^{-4}	87500	101200		S-2	Read from (σ , ϵ)
	1.92×10^2	100000	138500		Tension	curves
<u>Material:</u> Al-RR77						
room	1×10^{-3}	80000		7.9	H-1	$\sigma_y = 0.2\%$ offset
	8×10^2	114200		11.7	Tension	Constant true str rate
	1.75×10^3	122000		12.9		Impact machine Read from table
<u>Material:</u> Al-Mn Alloy (≈ 3003); Cu 0.04, Mn 1.36, Si 0.30, Fe 0.33						
572	1×10^0		10000		A-2	Read from (σ , ϵ)
	1×10^1		11000		Comp.	curves
	2×10^1		11800			Annealed for ~6 h
	3×10^1		12400			at 930°F & cooled
752	1×10^0		6200			in air to room te
	1×10^1		7400			perature
	2×10^1		8000			Cam Plastometer
	3×10^1		8400			$\dot{\epsilon}$ was computed by
932	1×10^0		5200			dividing the decr
	1×10^1		5700			ment effected by
	2×10^1		6200			the initial speci
	3×10^1		6900			men height & by t
1022	1×10^0		3700			associated test
	1×10^1		4500			period
	2×10^1		5000			
	3×10^1		5200			

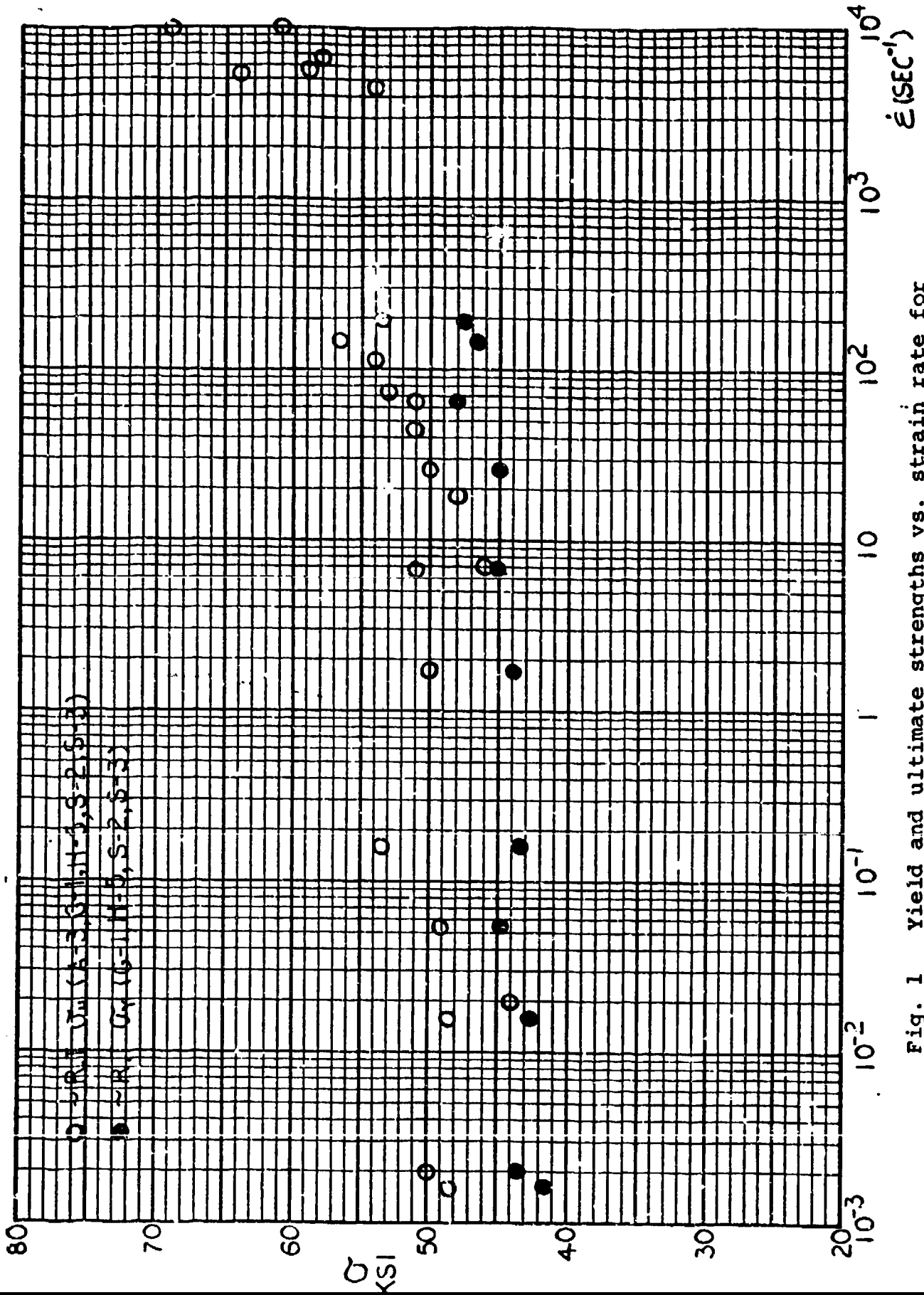


Fig. 1 Yield and ultimate strengths vs. strain rate for

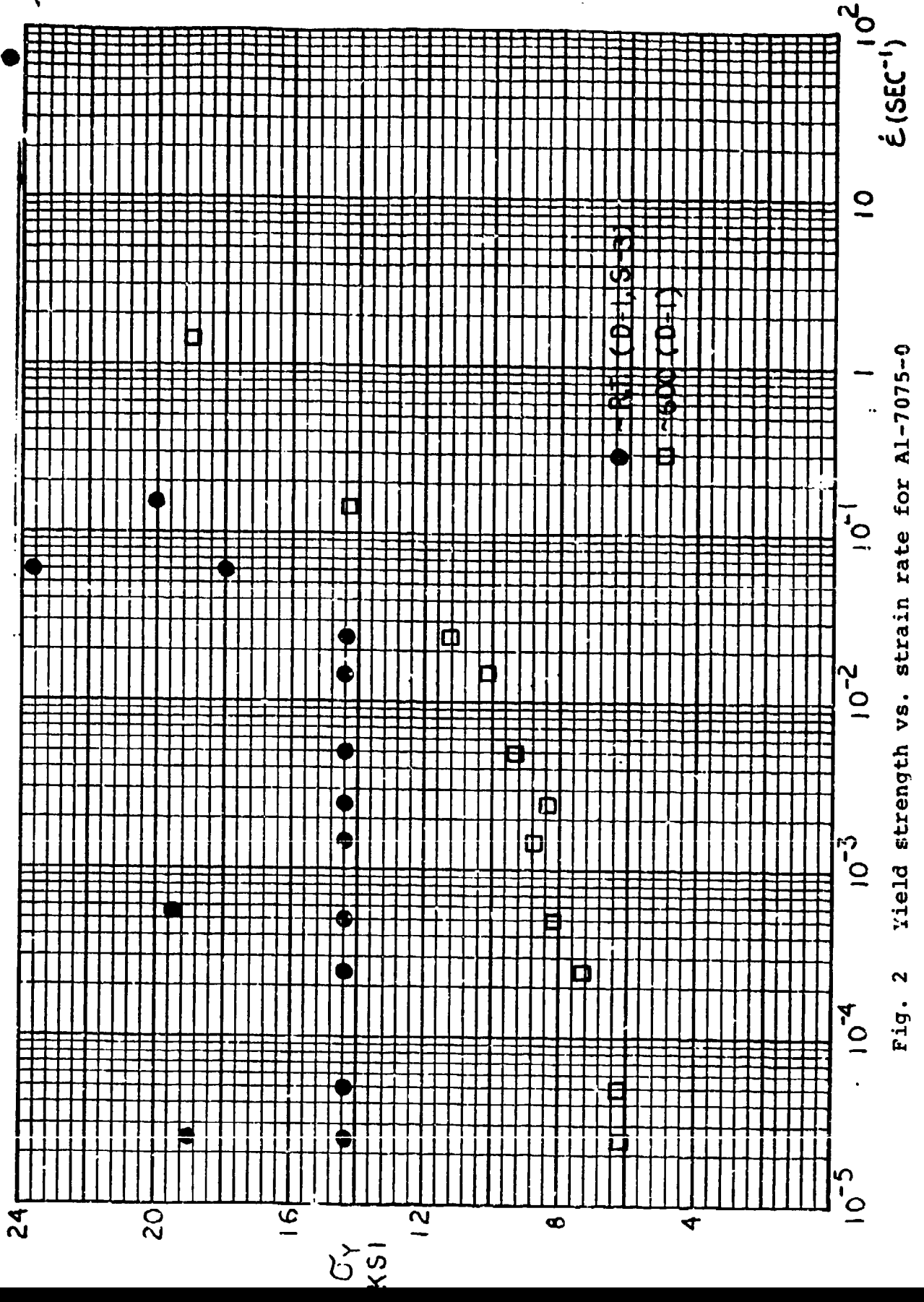


Fig. 2 Yield strength vs. strain rate for Al-7075-T6

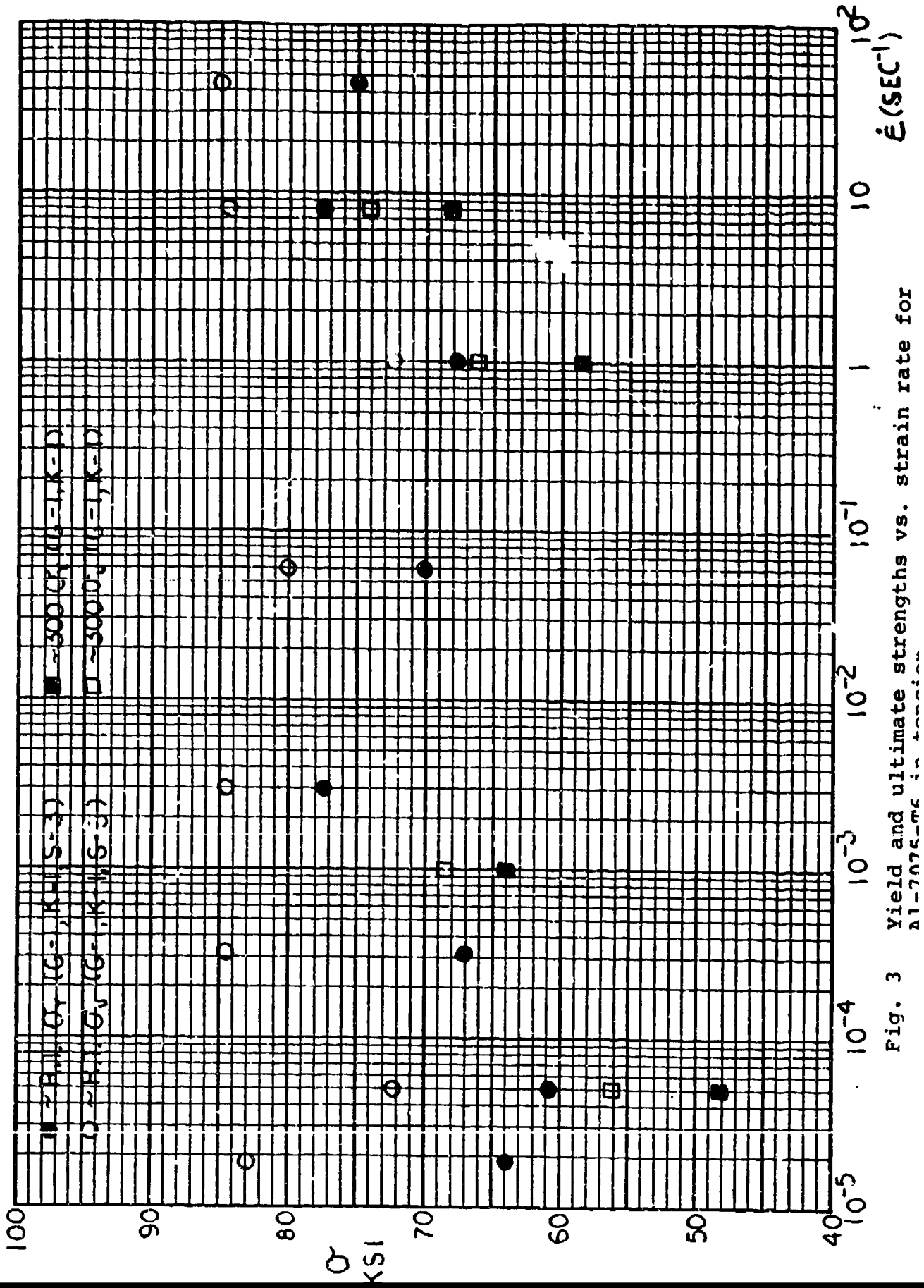


Fig. 3 Yield and ultimate strengths vs. strain rate for Al-7075-T6 in tension


ACKNOWLEDGEMENT

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The authors are indebted to Dr. Edward M. Lenoë of the Army Material and Mechanics Research Center for his guidance and to Miss Beverly Wright for typing the final manuscript for reproduction.

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