NONFERROUS ALLOYS

Mg
8.5 Al
0.5 Zn

AZ 80 A

1. GENERAL

This heat treatable magnesium-aluminum-zinc alloy is one of the strongest alloys for forgings and solid extrusions for service up to 300 F. It is available in various conditions. It has limited ductility at room temperature. It is difficult to forge and its use, therefore, limited to press forging at a slow rate. Welds in this alloy require stress relief.

1.01 Commercial Designation. AZ 80 A.

1.02 Alternate Designations. AZ 80 X, Dowmetal O-1, Mazlo AMC 58 S (all obsolete).

1.03 Specifications. Table 1.03.

TABLE 1.03

AMS	Form	Federal
4360 C	Forgings (T5 Cond)	QQ - M - 40

1.04 Composition. Table 1.04.

TABLE 1.04

Source	AMS (1)	
	Percent	
	Min	Max
Aluminum	7.8	9.2
Zinc	0.20	0.8
Manganese	0.12 (a)	-
Silicon	-	0.30 (b)
Copper	-	0.05
Nickel	-	0.005
Iron	-	0.005
Other impurities (total)	-	0.30
Magnesium	Balance	

(a) Dow gives 0.15
(b) Dow gives 0.05

1.05 Heat Treatment.
1.051 Stress relief after forming or welding.
1.0511 F Condition. 500 F, 15 min.
1.0512 T5 Condition. 400 F, 1 hr.
1.0513 T6 Condition. 600 F, 1/4 hr.
1.052 Solution treat forgings to T4 Condition. 750 F, 2 to 4 hr, air cool.
1.053 Age F Condition to T5 Condition. 350 F, 24 hr.
1.054 Age T4 Condition of forgings to T6 Condition. 350 F, 24 hr.

1.06 Hardenability. Alloy hardens fully in all section sizes on aging either hot worked or solution treated material.

1.07 Forms and Conditions Available
1.071 Solid extrusions and forgings are available in all commercial sizes for magnesium alloys.
1.072 Solid extrusions are available in the F and T5 Conditions.
1.073 Forgings are available in the F, T5 and T6 Conditions.

1.08 Melting and Casting Practice. See AZ 31 B.

1.09 Special Considerations. See AZ 31 B also.
1.091 Stress relief is required after forming and welding to prevent stress cracking.
1.092 Forging this alloy is difficult.

2. PHYSICAL AND CHEMICAL PROPERTIES

2.01 Thermal Properties
2.011 Melting range. 800 to 1115 F.
2.012 Phase changes. Alloy is subject to precipitation.
2.013 Thermal conductivity. 29.0 Btu ft per (hr sq ft F).
2.014 Thermal expansion. See AZ 31 B.
2.015 Specific heat. 0.25 Btu per (lb F).
2.016 Thermal diffusivity. 1.08 sq ft per hr.

2.02 Other Physical Properties
2.021 Density. 0.0649 lb per cu in. 1.80 gr per cu cm.
2.022 Electrical resistivity. 5.71 microhm in.
2.023 Magnetic properties. Alloy is nonmagnetic.

2.03 Chemical Properties. Same as AZ 31 B.

2.04 Nuclear Properties. See AZ 31 B.

3. MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties
3.011 AMS and producers' specified mechanical properties, Table 3.011.

TABLE 3.011

Source	(2)										AMS (1)			
Alloy	AZ 80 A													
Form	Extrusions								Forgings		Die Forgings			Hand Forgings
Condition	F				T5				F	T5	T5			T5
Thickness - in	Under 0.250	0.250 to 1.499	1.500 to 2.499	2.500 to 5.000	Under 0.250	0.250 to 1.499	1.500 to 2.499	2.500 to 5.000	-	-	<2 <50 lb	≥2 (a)	≥50 lb (b)	-
F_{tu}, min - ksi	43	43	43	42	47	48	48	45	42	42	42	34	40	42
F_{cy}, min - ksi	28	28	28	27	30	33	33	30	26	28	30	22	26	28
e, min - percent	9	9	8	4	5	4	4	2	5	2	2	2	3	2
F_{cy}, min - ksi	-	17	17	17	-	28	27	26	18	25	-	-	-	-
F_{su}, min - ksi	19	19	19	19	-	21	21	-	20	20	-	-	-	-
F_{bu}, min - ksi														
(e/D=1.5)	48	48	48	48	-	-	-	-	-	50	-	-	-	-
(e/D=2.0)	56	56	56	56	-	-	-	-	-	70	-	-	-	-
F_{bry}, min - ksi														
(e/D=1.5)	36	36	36	36	-	-	-	-	-	42	-	-	-	-
(e/D=2.0)	40	40	40	40	-	-	-	-	-	50	-	-	-	-
Hardness (c)														
BHN, min	-	-	-	-	-	-	-	-	-	-	-	-	82	70

(a) Individual Specimen
(b) Average of 8 Specimen
(c) 1000 Kg 10mm.

3.02 Mechanical Properties at Room Temperature. See 3.03 also.
3.021 Typical mechanical properties, Table 3.021.

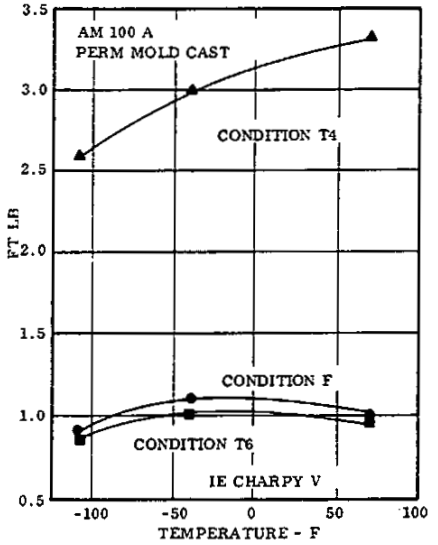

FIG. 3.0331 EFFECT OF LOW TEMPERATURES ON CHARPY V-NOTCH IMPACT ENERGY. (13)

	Mg
10	Al
0.1	Mn

AM 100 A

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Mg	
8.5	Al
0.5	Zn

AZ 80 A

TABLE 3.021

Source	(2)(3)						
Alloy	AZ 80 A						
Form	Extrusions		Forgings	Extrusions		Forgings	
Condition	F			T5		T5	T6
Thickness - in	≤ 1.500	1.500 to 5.000	-	≤ 1.500	1.500 to 5.000	-	-
F_{tu} - ksi	49	48	46	55	53 to 50	50	50
F_{ty} - ksi	36	35	31	38 to 40	39 to 38	34	34
e, percent	11	9	8	7	6	6	5
F_{cy} - ksi	-		25	35	32 to 31	28	27
F_{su} - ksi	22		22	24		23	-
F_{bru} - ksi (e/D = 2.0)	68		-	-		80	-
F_{bry} - ksi (e/D = 2.0)	48		-	-		-	-

3.022 Stress strain curves in tension and compression for forgings, Fig. 3.022.

3.023 Effect of exposure to elevated temperatures on tensile properties of extrusions, Fig. 3.023.

3.024 Effect of stress concentration on notch strength ratio of extrusions, Fig. 3.024.

3.03 Mechanical Properties at Various Temperatures

3.031 Short time tension properties

3.0311 Effect of exposure and test temperature on tensile properties of extrusions and forgings, Fig. 3.0311.

3.032 Short time properties other than tension

3.033 Static stress concentration effects

3.04 Creep and Creep Rupture Properties

3.041 Total strain curves for forgings at 200 and 300 F, Fig. 3.041.

3.05 Fatigue Properties

3.051 Fatigue properties of extrusions and forgings, Table 3.051.

TABLE 3.051

Source	(5, p. 4.115, 4.116)								
Form	(1) Extrusions (2) Forgings								
Cond	Temp F	Method	Stress Ratio A	Stress Ratio R	Stress Concentration	Fatigue Strength - ksi at Cycles 10^5	10^6	10^7	10^8
(1) F	RT	Rot beam	∞	-1	Smooth (K = 1)	25 to 30	23 to 28	21 to 26	20 to 24
(2) F						28 to 30	24 to 26	20 to 22	18 to 20
(2) T4						-	21 to 24	18 to 21	16 to 18
(2) T5						26 to 30	22 to 25	19 to 21	16 to 19
(2) T6						23 to 27	19 to 22	16 to 19	14 to 16
(1) F	RT	Rev bend	∞	-1	As extruded	19 to 21	13 to 16	12 to 14	-
(2) T6					As forged	16 to 20	13 to 16	12 to 15	-
Source	(6)								
(1) T5	RT	Rev bend	∞	-1	Smooth	20	15	12.5	-
(2) T5		Rot beam	∞	-1	Smooth	25	-	20	18
					Notched K = 2	16.5	-	9.5	9.5
	300				Smooth	20.5	-	11	10.5
					Notched K = 2	10.5	-	6.5	5

3.06 Elastic Properties

3.061 Modulus of elasticity, 6500 ksi.

3.062 Modulus of rigidity, 2400 ksi.

3.063 Tangent modulus curves in tension and compression for extrusions in T5 Condition, Fig. 3.063.

4. FABRICATION

4.01 Forming and Casting

4.011 Forming of extrusions in the F Condition can be best performed at 550 F, with the time at temperature limited to 1/2 hr.

4.012 Forming of extrusions in the T5 Condition can be best performed at 380 F, with the time at temperature limited to 1 hr.

4.013 Forging of this alloy is difficult and, therefore, limited to press forging simple designs. In addition, the rate of deformation should be low. Hammer forgings are not generally produced. Upset forging should be preceded by heating at 750 to 775 F, for 2 to 6 hr, to prevent hot shortness.

4.02 Machining. Same as AZ 31 B.

4.03 Welding. Extrusions and forgings can be welded in all conditions by the inert gas electric arc method. No flux is necessary. The preferred welding rod is AZ 92 A. Welded assemblies must be stress relieved to avoid cracking.

4.04 Heating and Heat Treating. See AZ 63 A.

4.05 Surface Treating. See AZ 63 A.

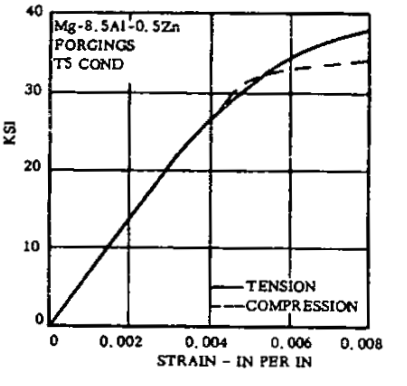


FIG. 3.022 STRESS STRAIN CURVES IN TENSION AND COMPRESSION FOR FORGINGS (2)

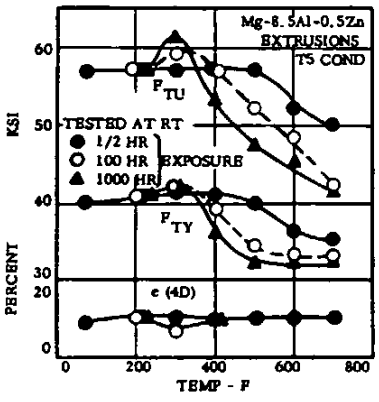
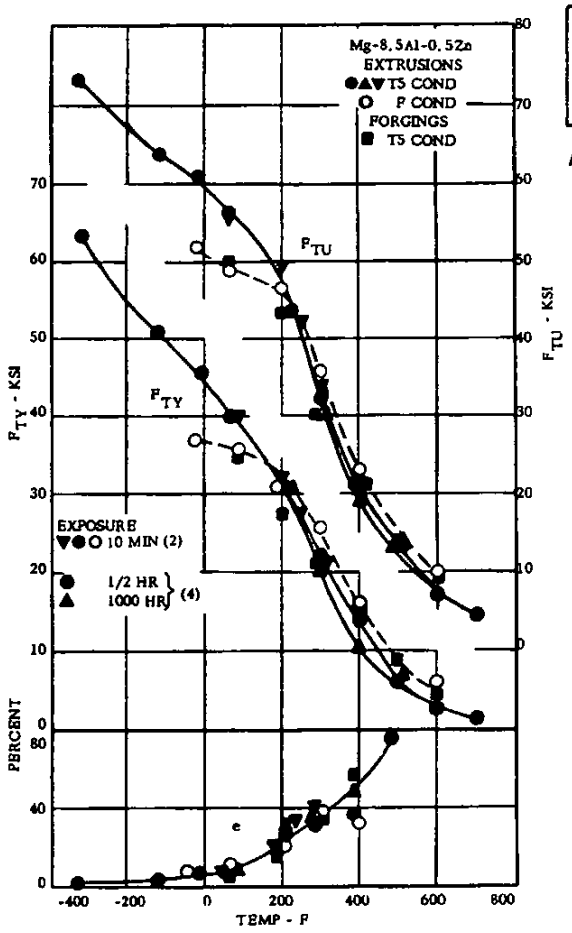


FIG. 3.023 EFFECT OF EXPOSURE TO ELEVATED TEMPERATURES ON TENSILE PROPERTIES OF EXTRUSIONS (4)



Mg	
8.5	Al
0.5	Zn

AZ 80 A

FIG. 3.0311 EFFECT OF EXPOSURE AND TEST TEMPERATURE ON TENSILE PROPERTIES OF EXTRUSIONS AND FORGINGS (2)(4)

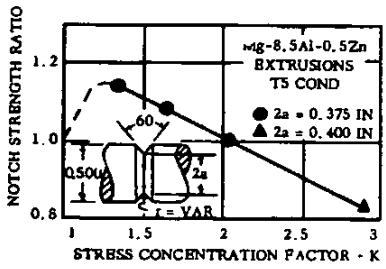


FIG. 3.024 EFFECT OF STRESS CONCENTRATION ON NOTCH STRENGTH RATIO OF EXTRUSIONS (2)

Mg
8.5 Al
0.5 Zn

AZ 80 A

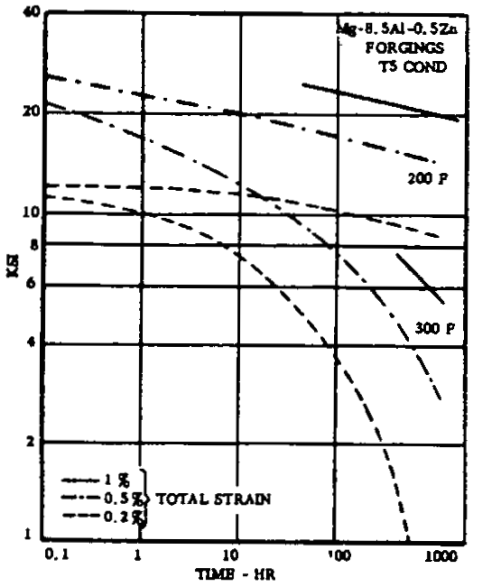


FIG. 3.041 TOTAL STRAIN CURVES FOR FORGINGS AT 200 AND 300 F (5)

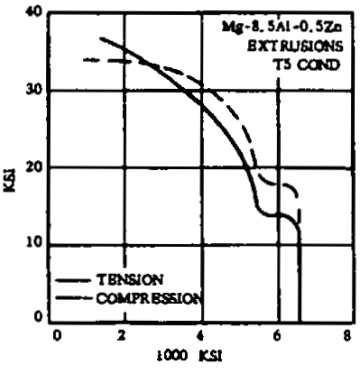


FIG. 3.063 TANGENT MODULUS CURVES IN TENSION AND COMPRESSION FOR EXTRUSIONS IN T5 CONDITION (5)

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