

NONFERROUS ALLOYS

1. GENERAL  
 This magnesium alloy, which is normally used in the T6 condition (solution treated and artificially aged), is produced primarily in the form of castings, but it is also suitable for at least limited applications as forgings. It combines good mechanical properties with excellent foundry characteristics, that is, fluidity with little tendency toward porosity and hot cracking. At room temperature its strength is slightly lower than that of ZK61A, but at elevated temperatures up to 540F, its tensile strength is superior to that of any other magnesium casting alloy. Above 540F, HK31A is somewhat stronger. It has good creep properties at temperatures up to 400F, but long time strength and stability are not good at higher temperatures. The alloy is weldable by inert-gas-arc techniques. It should be considered for any aerospace or other applications where good short time mechanical properties are required up to 540F and good creep properties up to 400F (5)(6).

1.01 Commercial Designation  
 QE22A

1.02 Alternate Designations  
 QE22, MSR

1.03 Specifications  
 Table 1.03.

TABLE 1.03

Alloy	QE22A
Forms	Specifications
Sand Castings	AMS 4418C
	ASTM B80
	MIL-M-46062 (MR) Federal QQ-M-56b (1)
Permanent Mold Casting	ASTM B199
	MIL-M-46062A Federal QQ-M-46062A
Investment Castings	ASTM B403

1.04 Composition  
 Table 1.04.

TABLE 1.04

Alloy	QE22A			
	(1)		(2)(3)(4)	
	Percent		Percent	
Source	Minimum	Maximum	Minimum	Maximum
Composition				
Silver	2.0	3.0	2.0	3.0
Didymium (a)	1.75	2.5	1.8	2.5
Zirconium, total	0.40	1.0	0.40	1.0
Zirconium, soluble (b)	0.40	-	-	-
Copper	-	0.10	-	0.10
Nickel	-	0.01	-	0.01
Others, total	-	0.30	-	0.30
Magnesium	Balance		Balance	
(a) A rare-earth alloy consisting of 85 percent neodymium and 15 percent praseodymium.				
(b) Soluble zirconium is that portion of the zirconium that is soluble in 1:4 hydrochloric acid held below its boiling point.				

1.05 Heat Treatment(7)  
 1.051 Solution treatment: 970 to 980F, 8 hours in furnace atmosphere containing 1 percent SO<sub>2</sub> minimum, quench in water at 140F minimum within maximum delay time of 30 seconds.  
 1.052 Artificially age to T6 condition: 400F, 8 hours, air cool.  
 1.06 Hardness (1)  
 T6 condition: BHN 62-85 with 500 kg load and 10 mm ball or 1000 kg load and 9/16 inch ball; BHN 67-90 with 1000 kg load and 10 mm ball.  
 1.07 Forms and Conditions Available  
 Produced primarily as castings; limited production of roll-forged rings. Used in the T6 (solution treated and artificially aged) condition.

1.08 Melting and Casting Practice  
 QE22A is melted and cast similarly to other zirconium containing magnesium casting alloys (see HZ32A, Code 3408, Section 1.08). The silver, which is added as pure metal, and didymium, which is added as a magnesium-didymium hardener, are handled in the same manner as zinc. Zinc and silver losses are negligible for each melting cycle, but a loss of one fourth percent (of total melt weight) of rare earths (didymium) for each melt cycle is typical although this will vary with local foundry conditions (8).

1.09 Special Considerations  
 1.091 It is essential that contamination with aluminum, iron, manganese, and silicon be prevented, as these elements prevent zirconium from performing its desired grain refining function (9).  
 1.092 This alloy has relatively low section sensitivity, that is, with good foundry practice, its mechanical properties are not drastically reduced with increasing section size (see Figure 3.0213)(10).  
 1.093 Rate of quenching from the solution treatment temperature is critical, and castings should be quenched in hot water within 30 seconds of their removal from the furnace (6).

2. PHYSICAL AND CHEMICAL PROPERTIES

2.01 Thermal Properties  
 2.011 Melting range. 1020-1190F (8).  
 2.012 Phase changes. Solution treatment results in partial solution of the magnesium-rare earth compounds that normally appear at the grain boundaries in the as-cast condition. Very finely divided precipitates form within the grains during artificial aging. These precipitates have not been fully identified, but are believed to be silver-rare earth magnesium compounds and also possibly zirconium compounds (6)(11).  
 2.0121 Time-temperature-transformation diagrams.  
 2.013 Thermal conductivity.  
 2.0131 T6 condition: 59.5 Btu ft per (ft<sup>2</sup> hr F)(12) - 65.34 Btu ft per (ft<sup>2</sup> hr F)(6).  
 2.0132 F condition (as forged): 55.6 Btu ft per (ft<sup>2</sup> hr F) at 68F (12).  
 2.014 Thermal expansion. 14.85 x 10<sup>-6</sup> per F from 68F to 392F (13).  
 2.015 Specific heat. 0.245 Btu per (lb F).  
 2.016 Thermal diffusivity.  
 2.02 Other Physical Properties  
 2.021 Density. 0.066 lb per cu in (8).  
 2.022 Electrical properties, Table 2.022.

TABLE 2.022

Alloy	QE22A		
	T6		
	(14)		
Source	Electrical Conductivity		Electrical Resistivity
	Percent IACS	Megmhos per in <sup>3</sup>	
Temperature - F			microhm - in
68	27.0	0.397	2.52
113	25.2	0.370	2.70
212	22.3	0.328	3.05

2.023 Magnetic properties. Nonmagnetic.  
 2.024 Emission.  
 2.025 Damping capacity.  
 2.03 Chemical Properties  
 2.031 Corrosion resistance.  
 2.0311 QE22A, like other magnesium alloys, is subject to general and pitting corrosion in industrial, marine, and moist environments. With suitable surface treatment and painting, it performs satisfactorily in all types of natural environments with the exception of continuous immersion in water (15).

	Mg
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2.0	Di
0.4	Zr
QE22A	

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	Mg
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2.0	Di
0.4	Zr
QE22A	

Mg
2.5 Ag
2.0 Di
0.4 Zr

QE 22 A

- 2.0312 This alloy has low susceptibility to stress corrosion cracking (6).
- 2.0313 For a discussion of galvanic corrosion, see AZ31B, Code 3601, Section 2.0312.
- 2.032 Safety precautions should be directed to the prevention of fires, burns, and explosions (see H232A, Code 3408, Section 2.032).
- 2.04 Nuclear Properties
- 3. MECHANICAL PROPERTIES
- 3.01 Specified Mechanical Properties
- 3.011 AMS and ASTM specifications, Table 3.011.

TABLE 3.011

Alloy	QE22A									
	T6*									
Condition	T6*									
Form	Roll Forged									
Source	(20)									
Type Casting	(1) Sand			(3) Permanent Mold			(4) Investment			
Specimen	Temp F	F <sub>tu</sub> ksi	F <sub>ty</sub> ksi	e(2 in) min	F <sub>tu</sub> ksi	F <sub>ty</sub> ksi	e(2 in) min	F <sub>tu</sub> ksi	F <sub>ty</sub> ksi	e(2 in) min
Separately cast	75 600	35 11.5	25 9.0	2 -	35 -	25 -	2 -	35 -	25 -	2 -
Cut from casting single average 4 or more single	75 600	28 10	20 8	1 -	- -	- -	- -	- -	- -	- -

- 3.012 MIL-M-46062 (MR) specifications, Table 3.012.

TABLE 3.012

Alloy	QE22A		
	T6		
Condition	Castings		
Form	Castings		
Source	(17)		
Section *	Tensile Properties in Designated Sections of Castings		
	F <sub>tu</sub> - ksi Minimum	F <sub>ty</sub> - ksi Minimum	e(2 in) Minimum
1	40	28	4
2	37	26	2
3	33	23	2
X	28	20	2

\* Sections 1, 2, and 3 are designated critical sections of castings and would be specified for the particular casting in question; section X covers unspecified sections.

- 3.02 Mechanical Properties at Room Temperature
- 3.021 Tension. Typical for sand-cast test bars in T6 condition F<sub>tu</sub> = 40.0 ksi F<sub>ty</sub> = 30.0 ksi e(2 in) = 4 percent (7) (8) (16).
- 3.0211 Stress-strain diagrams (see Figure 3.0311).
- 3.0212 Effect of end chill on tensile properties of cast plates of two thicknesses, Figure 3.0212.
- 3.0213 Effect of section thickness on tensile properties, Figure 3.0213.
- 3.0214 Effect of overaging on tensile properties, Figure 3.0214.
- 3.0215 Effect of cold work on tensile properties, Figure 3.0215.

- 3.0216 Effect of orientation and forging reduction on tensile properties of roll-forged rings, Table 3.0216.

TABLE 3.0216

Alloy	QE22A			
	T6*			
Condition	T6*			
Form	Roll Forged			
Source	(20)			
Specimen Orientation	Forging Reduction percent	F <sub>tu</sub> ksi	F <sub>ty</sub> ksi	e(2 in) percent
Tangential	20	43	33	8
	40	45	36	6
	60	44	37	6
Axial	20	40	27	11
	40	40	29	10
	60	40	30	9
Radial	20	40	26	9

\* Heat treated after roll forging.

- 3.022 Compression. Typical for sand-cast test bars in T6 condition. F<sub>cy</sub> = 30 ksi (7). Stress-strain diagrams.
- 3.0221 Stress-strain diagrams.
- 3.0222 Effect of orientation and forging reduction on compressive properties of roll-forged rings, Table 3.0222.

TABLE 3.0222

Alloy	QE22A	
	T6*	
Condition	T6*	
Form	Roll Forged	
Source	(20)	
Specimen Orientation	Forging Reduction percent	F <sub>cy</sub> ksi
Tangential	20	26
	40	26
	60	25
Axial	20	26
	40	26
	60	25
Radial	20	28
	40	28
	60	28

\*Heat treated after roll forging.

- 3.023 Impact (see Figure 3.0331).
- 3.024 Bending.
- 3.025 Torsion and shear. Typical shear strength for sand-cast test bars in T6 condition. F<sub>su</sub> = 21.5 ksi (7)(16).
- 3.026 Bearing.
- 3.027 Stress concentration.
- 3.0271 Notch properties.
- 3.02711 Effect of crack length on breaking load of fatigue cracked specimens as percent of breaking load of uncracked specimen, Figure 3.02711.
- 3.02712 Effect of fatigue crack size on total stress to fracture in bending, Figure 3.02712.
- 3.0272 Fracture toughness. A small amount of data on cracked specimens appears in Reference 22. However the specimen is not sufficiently well described to make the information useful for the purposes of this Handbook.
- 3.028 Combined properties.
- 3.03 Mechanical Properties at Various Temperatures
- 3.031 Tension.
- 3.0311 Stress-strain diagrams, Figure 3.0311.
- 3.0312 Effect of temperature on tensile properties of castings, Figure 3.0312.
- 3.0313 Elevated temperature tensile properties of roll forgings, Figure 3.0313.
- 3.032 Compression.
- 3.0321 Stress-strain diagrams.
- 3.033 Impact.
- 3.0331 Effect of temperature on notched and unnotched Charpy impact properties, Figure 3.0331.
- 3.034 Bending.
- 3.035 Torsion and shear.
- 3.0351 Effect of temperature on shear strength, Figure 3.0351.
- 3.036 Bearing.

REVISED: JUNE 1971

## NONFERROUS ALLOYS

- 3.037 Stress concentration.  
 3.0371 Notch properties.  
 3.0372 Fracture toughness.  
 3.038 Combined properties.
- 3.04 Creep and Creep Rupture Properties  
 3.041 Effects of temperature and stress on the times to various amounts of creep extension, Figure 3.041.  
 3.042 Creep rupture time at 392 F, Figure 3.042.
- 3.05 Fatigue Properties  
 3.051 S-N fatigue curves at room and elevated temperatures, Figure 3.051.
- 3.06 Elastic Properties  
 3.061 Poisson's ratio. 0.35 (13).  
 3.062 Modulus of elasticity, Figure 3.062.  
 3.063 Modulus of rigidity.  $2.4 \times 10^3$  ksi (13).
4. FABRICATION
- 4.01 Formability
- 4.02 Machining and Grinding  
 4.021 This alloy, like other magnesium alloys, has exceptionally good machinability, which enables it to be machined at high speeds and feeds. For further details, see HZ32A, Code 3408, Section 4.021.  
 4.022 The alloy can be chem milled with sulfuric, nitric, or hydrochloric acid of 5 percent strength or greater (13).
- 4.03 Welding  
 4.031 QE22A is weldable by gas tungsten-arc and gas metal-arc techniques with either helium or argon gas shielding. E233A filler metal should be used when welded joints will be used at high temperatures, whereas AZ92A and AZ61A filler metals are satisfactory for room-temperature service. Preheating to about 500 F is recommended if needed to minimize distortion or prevent cracking. If possible, the welded part should be fully heat treated to the T6 condition after welding (6)(23).
- 4.04 Surface Treatment  
 See HZ32A, Code 3408, Sections 4.041, 4.042, and 4.043.

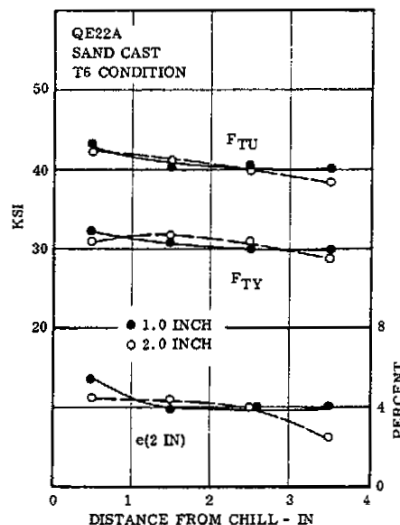


FIG. 3.0212 EFFECT OF END CHILL ON TENSILE PROPERTIES OF CAST PLATES OF TWO THICKNESSES. (18)

Mg
2.5 Ag
2.0 Di
0.4 Zr
QE 22 A

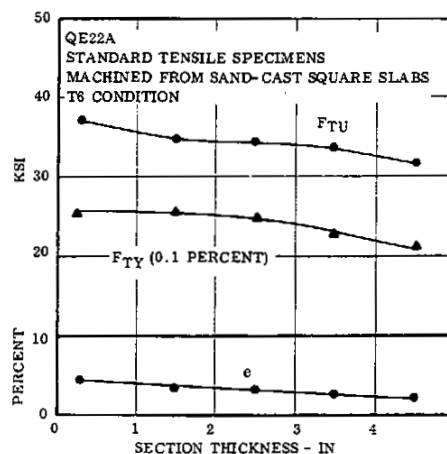


FIG. 3.0213 EFFECT OF SECTION THICKNESS ON TENSILE PROPERTIES. (6)

CODE 3406

PAGE 3

	Mg
2.5	Ag
2.0	Di
0.4	Zr

QE 22 A

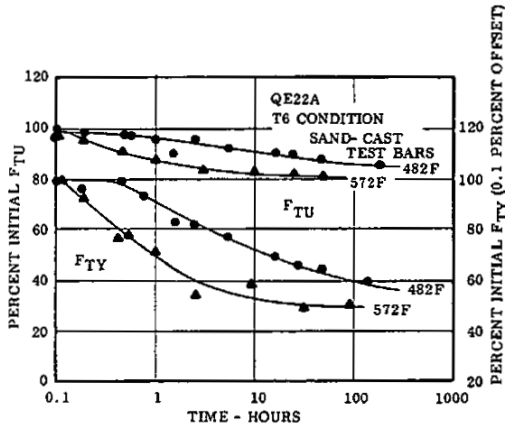


FIG. 3.0214 EFFECT OF OVERAGING ON TENSILE PROPERTIES. (6)

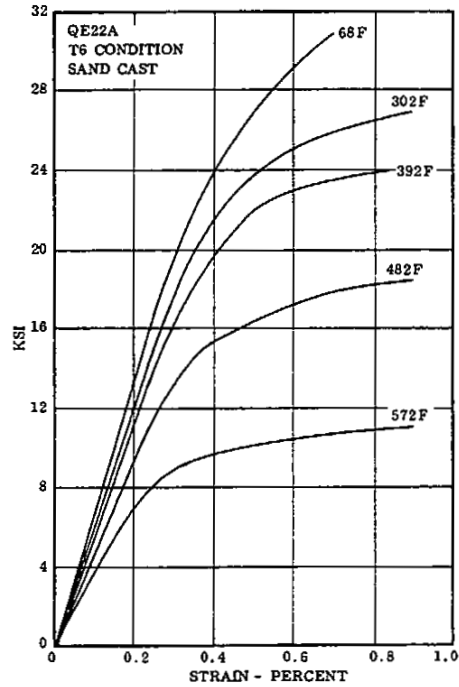


FIG. 3.0311 STRESS-STRAIN DIAGRAMS. (13)

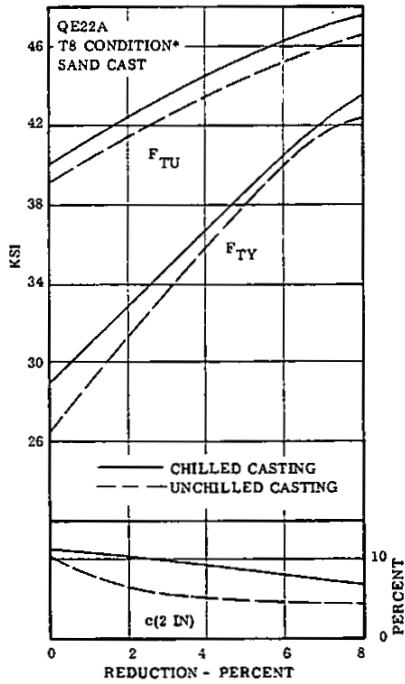


FIG. 3.0215 EFFECT OF COLD WORK ON TENSILE PROPERTIES. (19)

\* T8 condition in this case means that the metal was cold worked the given amount between the solution and aging treatments specified for the T6 condition.

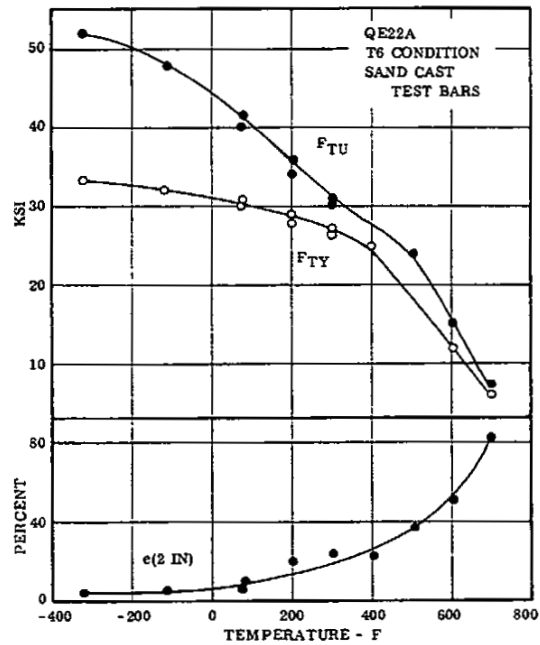


FIG. 3.0312 EFFECT OF TEMPERATURE ON TENSILE PROPERTIES OF CASTINGS. (12)

Mg
2.5 Ag
2.0 Di
0.4 Zr

QE22A

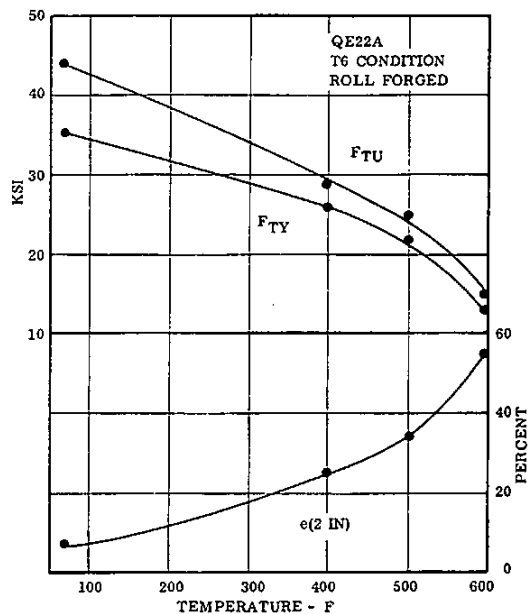


FIG. 3.0313 ELEVATED TEMPERATURE TENSILE PROPERTIES OF ROLL FORGINGS. (20)

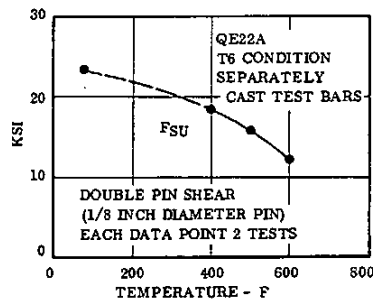


FIG. 3.0351 EFFECT OF TEMPERATURE ON SHEAR STRENGTH. (6)

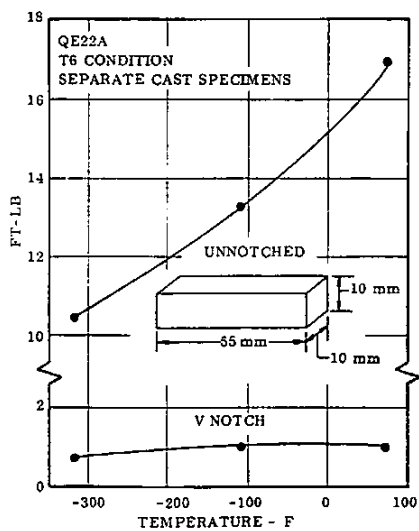


FIG. 3.0331 EFFECT OF TEMPERATURE ON NOTCHED AND UNNOTCHED CHARPY IMPACT PROPERTIES. (21)

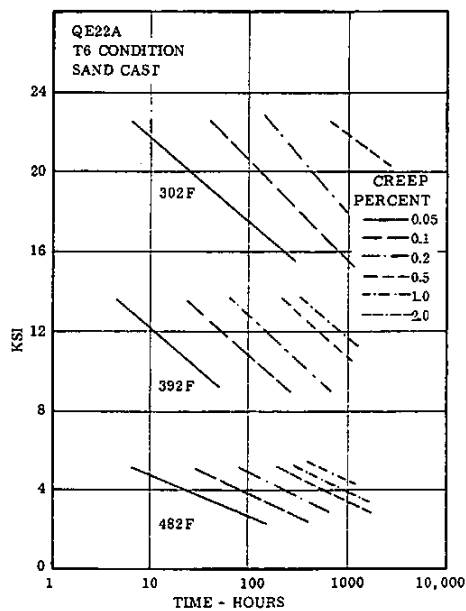


FIG. 3.041 EFFECTS OF TEMPERATURE AND STRESS ON THE TIMES TO VARIOUS AMOUNTS OF CREEP EXTENSION. (6)

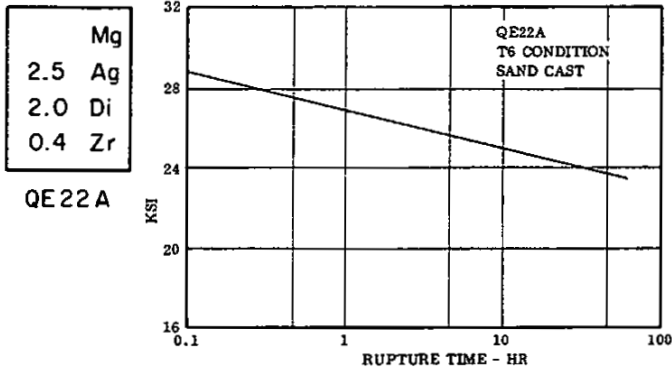


FIG. 3.042 CREEP RUPTURE TIME AT 392F. (5)

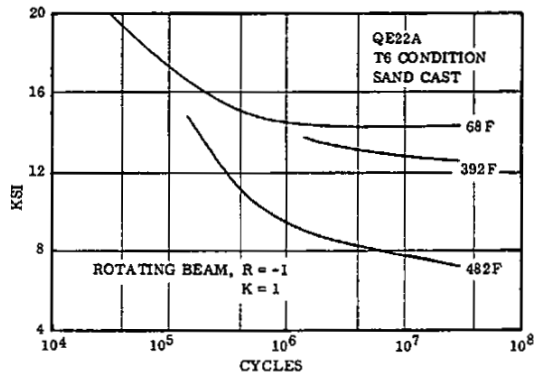


FIG. 3.051 S-N FATIGUE CURVES AT ROOM AND ELEVATED TEMPERATURES. (5)

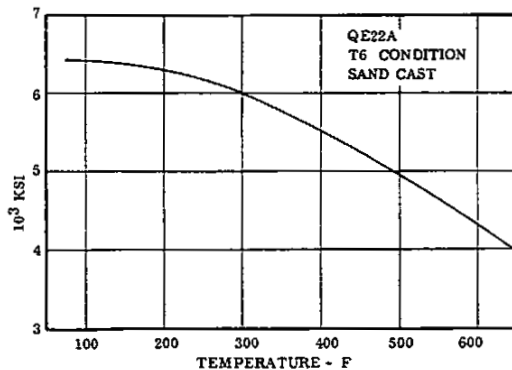


FIG. 3.062 MODULUS OF ELASTICITY. (13)

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NONFERROUS ALLOYS

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Zn62A is a magnesium-base casting alloy which combines a reasonable degree of castability with excellent strength up to 300F. Its strength properties drop sharply at temperatures above 300F. Its castability is rated above that of ZK51A and ZK61A but below that of QE22A, which are other high-strength magnesium casting alloys; however, the ductility of Zn62A is considerably better than that of QE22A. Zn62A has excellent weldability and machinability. Like other magnesium alloys, coatings are recommended to prevent corrosion in humid, salt-spray, and marine environments. It is used only in the artificially aged (T-5) condition and should be considered for any aerospace or other applications requiring a high strength-to-weight ratio at temperatures up to 300F.

1.01 Commercial Designation  
Zn62A

1.02 Alternate Designations  
Zn62XA, TZ6 (British)

1.03 Specifications  
AMS 4438B  
ASTM B80-68  
U.S. Federal QQ-M-56b (1)  
SAE 508  
MIL-M-46062A

1.04 Composition  
Table 1.04.

TABLE 1.04

Alloy	Zn62A			
	Composition			
	AMS 4438B (18)		ASTM B80-68	
	Percent		Percent	
Source	Minimum	Maximum	Minimum	Maximum
Zinc	5.2	6.2	5.2	6.2
Thorium	1.4	2.2	1.4	2.2
Zirconium				
total	0.50	1.0	0.50	1.0
soluble*	0.50			
Copper		0.10		0.10
Nickel		0.01		0.01
Others		0.30		0.30
Magnesium	Balance		Balance	

\* Soluble zirconium is that portion of the zirconium that is soluble in 1:4 hydrochloric acid held below its boiling point.

1.05 Heat Treatment  
Artificially age 470 to 490F, 12 to 16 hours, AC to Condition T-5 (1).

1.051 Alternative age treatment for Condition T-5, 615 to 635F 2 hours, AC, plus 340 to 360F, 16 hours (1)(2).

1.06 Hardness

1.061 BHN 65-80 with 1000 kg load and 10 mm ball (18).  
1.062 BHN 60-75 with 500 kg load and 10 mm ball or 1000 kg load and 9/16 inch ball (18).

1.07 Forms and Conditions Available

Produced as castings and used in the T-5 (artificially aged) condition.

1.08 Melting and Casting Practice (2)  
(see HZ32A cast magnesium alloy)

1.09 Special Considerations

1.091 Contamination of the alloy with more than 0.005 percent aluminum should be avoided to prevent the formation of aluminum-zirconium compounds, which are detrimental to mechanical properties (5).

1.092 The alloy has excellent dimensional stability at service temperatures up to at least 300F (6).

2. PHYSICAL AND CHEMICAL PROPERTIES

2.01 Thermal Properties

2.011 Melting range.  
2.0111 The liquidus temperature is 1169F (2).  
2.012 Phase changes. One or more zinc-zirconium phases are formed during artificial aging. Optimum mechanical properties are dependent upon a uniform distribution of these phases in finely divided form (4).  
2.0121 Time-temperature-transformation diagrams.  
2.013 Thermal conductivity. 63.0 Btu ft per (hr sq ft F) at 68F (2)(5).  
2.014 Thermal expansion.  $15.1 \times 10^{-6}$  per F from 68 to 392F (5)(6).  
2.015 Specific heat. 0.23 Btu per (lb F) from 68 to 212F (5)(6).  
2.016 Thermal diffusivity.

2.02 Other Physical Properties

2.021 Density. 1.86 g/cc (2)(5). 0.0675 lb/cubic inch (6).  
2.022 Electrical properties.  
2.0221 Electrical conductivity. 0.39 megmhos/in<sup>3</sup> at 68F (6). 25.5 percent IACS at 68F (5).  
2.0222 Electrical resistivity. 2.56 microhm-inch at 68F (5).  
2.023 Magnetic properties.  
2.024 Emission.  
2.025 Damping capacity. At a stress equal to 0.1 F<sub>ty</sub> the specific damping capacity is 0.14, which is relatively low in comparison with most other magnesium alloys (7).

2.03 Chemical Properties

2.031 Zn62A, like other magnesium alloys, will corrode in industrial, marine, and moist environments. With suitable surface treatment and painting, it will perform satisfactorily in all types of natural environments, with the exception of continuous immersion in water (17). For a discussion of galvanic corrosion see Code 3601, Section 2.0312.  
2.032 Safety precautions should be directed to the prevention of fires, burns, and explosions. See HZ32A, Code 3408, Section 2.032.

2.04 Nuclear Properties

2.041 Thorium metal is radioactive, but the amount contained in this alloy is not sufficient to constitute a hazard in normal handling. For precautions during melting and welding, see HZ32A, Code 3408, Section 2.041.  
2.042 The slight radioactivity of the alloy causes no interference in the sending and receiving of radar and radio signals (8).

3. MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties  
Table 3.01.

TABLE 3.01

Alloy	Zn62A						
	Sand Cast						
	T-5						
	Specification		AMS 4438B (18)		ASTM B80-68		
Specimen	Temp	F <sub>tu</sub>	F <sub>ty</sub>	e(2 in)	F <sub>tu</sub>	F <sub>ty</sub>	e(2 in)
	F	min	min	min	min	min	min
		ksi	ksi	ksi	ksi	ksi	ksi
Cut from casting							
(single)	75	28.0	17.5	1.0	26.5	15.5	-
(average of 4 or more)	75	31.5	19.5	2.0	31.5	17.5	1.25
Separately cast	75	35.0	22.0	5.0	35.0	22.0	5.0

3.02 Mechanical Properties at Room Temperature

3.021 Tension. Typical. F<sub>tu</sub> = 40.0 ksi, F<sub>ty</sub> = 25.0 ksi, and e(2 inches) = 6 percent.  
3.0211 Stress-strain diagrams (see Figure 3.0311).  
3.0212 Effect of section thickness on tensile properties. Figure 3.0212.  
3.0213 Effect of end chill on tensile properties of cast plates of two thicknesses. Figure 3.0213.

Mg
1.5 Th
5.7 Zn
0.7 Zr

Zn62A

	Mg
1.5	Th
5.7	Zn
0.7	Zr

ZH62A

3.022 Compression Typical  $F_{CY} = 25.0$  ksi (11).  
 3.0221 Stress-strain diagrams.  
 3.023 Impact. Notched Izod - 2.5 ft-lbs (5).  
 3.024 Bending.  
 3.025 Torsion and shear.  
 3.0251 Typical shear,  $F_{su} = 24.0$  ksi (11).  
 3.026 Bearing. Typical for separately sand-cast test specimens with  $e/D=2.5$  (3)(11).  $F_{bru} = 72.0$  ksi,  $F_{bry} = 49.0$  ksi.  
 3.027 Stress concentration.  
 3.0271 Notch properties.  
 3.0273 Fracture toughness.  
 3.028 Combined properties.

3.03 Mechanical Properties at Various Temperatures

3.031 Tension.  
 3.0311 Stress strain diagrams.  
 3.03111 Complete tensile stress strain curves at various temperatures, Figure 3.0314.  
 3.0312 Effect of elevated temperatures on tensile properties, Figure 3.0312.  
 3.0313 Effect of subzero temperatures on tensile properties, Figure 3.0313.  
 3.0314 Effect of strain rate on tensile properties at different temperatures, Figure 3.0314.  
 3.032 Compression.  
 3.0321 Stress-strain diagrams.  
 3.033 Impact.  
 3.0331 Effect of subzero temperatures on Charpy impact strength, Figure 3.0331.  
 3.034 Bending.  
 3.035 Torsion and shear.  
 3.036 Bearing.  
 3.037 Stress concentration.  
 3.0371 Notch properties.  
 3.0372 Fracture toughness.  
 3.038 Combined properties.

3.04 Creep and Creep Rupture Properties

3.041 Effect of temperature and stress on time to various amounts of creep extension, Figure 3.041.

3.05 Fatigue Properties

3.051 Wohler fatigue strength at 300F, sand-cast, smooth machined specimens:  $10^7$  cycles, 8.5 ksi;  $5 \times 10^7$  cycles, 7.6 ksi (6).

3.06 Elastic Properties

3.061 Poisson's ratio, 0.3 (5).  
 3.062 Modulus of elasticity.  
 3.0621 Effect of temperature on tension modulus, Figure 3.0621.  
 3.063 Modulus of rigidity,  $2.5 \times 10^3$  ksi (5).

4. FABRICATION

4.01 Formability

4.02 Machining and Grinding

4.021 This alloy, like other magnesium alloys, has exceptionally good machinability, which enables it to be machined at high speeds and feeds. For further details, see HZ32A, Code 3408, Section 4.021.  
 4.022 The alloy can be chemically milled with sulfuric, nitric, or hydrochloric acid of 5 percent strength or greater (6).

4.03 Welding

4.031 The alloy can be arc welded with helium or argon shielding and ZH62A or EZ33A electrodes. One of the artificial aging treatments (Section 1.05 or 1.051) should be applied after welding (1)(3)(5).  
 4.032 ZH62A should not be gas welded because of probable losses of zirconium (6).

4.04 Surface Treatment

(See HZ32A, Code 3408, Sections 4.041 and 4.042)

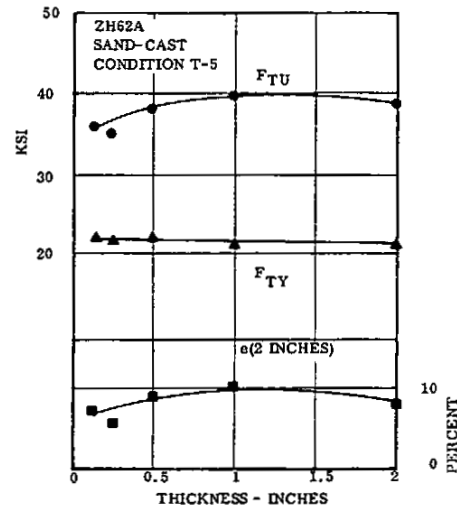


FIG. 3.0212 EFFECT OF SECTION THICKNESS ON TENSILE PROPERTIES (10).

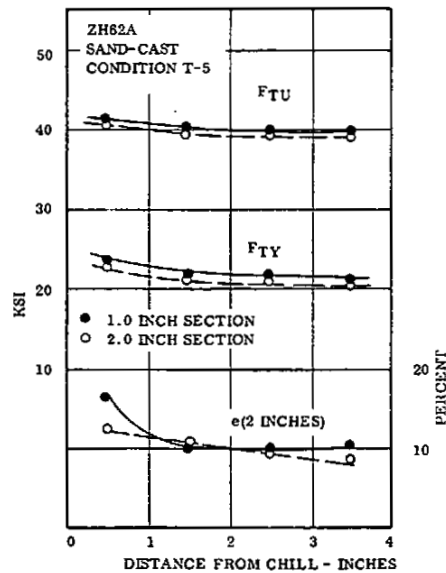


FIG. 3.0213 EFFECT OF END CHILL ON TENSILE PROPERTIES OF CAST PLATES OF TWO THICKNESSES (10).

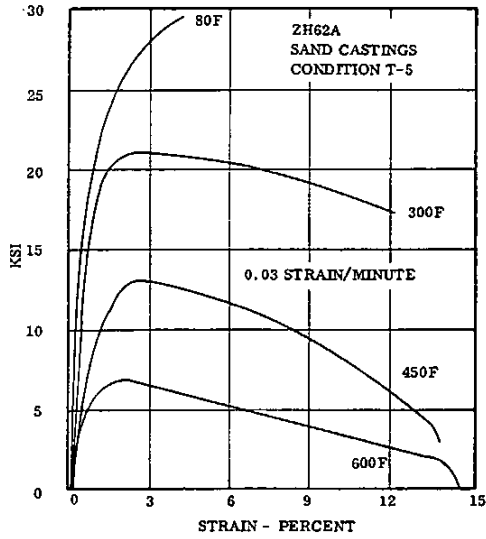


FIG. 3.0311 COMPLETE TENSILE STRESS-STRAIN CURVES AT VARIOUS TEMPERATURES (9).

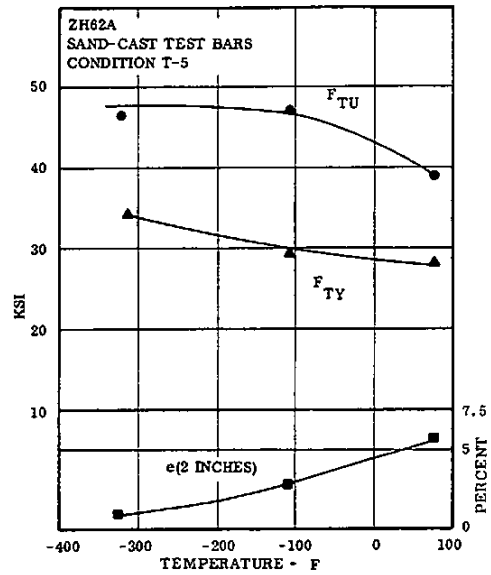


FIG. 3.0313 EFFECT OF SUBZERO TEMPERATURES ON TENSILE PROPERTIES (11).

Mg  
1.5 Th  
5.7 Zn  
0.7 Zr

ZH62A

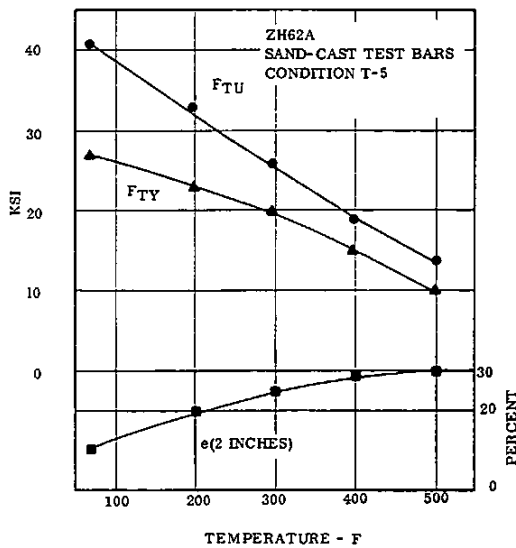


FIG. 3.0312 EFFECT OF ELEVATED TEMPERATURES ON TENSILE PROPERTIES (12).

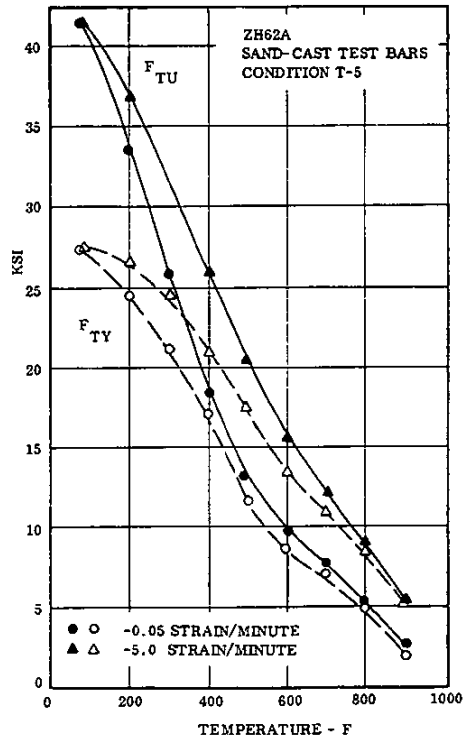


FIG. 3.0314 EFFECT OF STRAIN RATE ON TENSILE PROPERTIES AT DIFFERENT TEMPERATURES (13).