

NONFERROUS ALLOYS

1. GENERAL  
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). 26.5 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							
	Form	Sand Cast						
		T-5						
		AMS 4438B (18)			ASTM B80-68			
Specification	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	min
		ksi	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

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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)

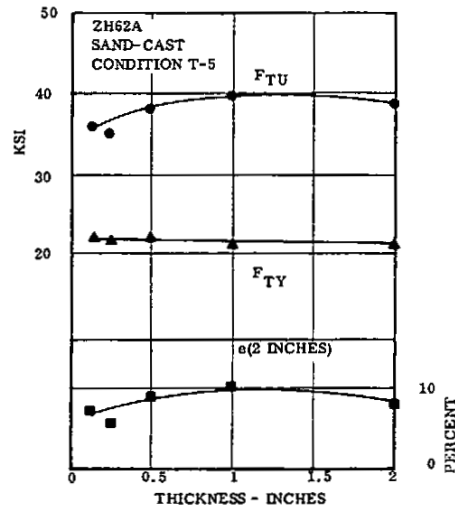


FIG. 3.0212 EFFECT OF SECTION THICKNESS ON TENSILE PROPERTIES (10).

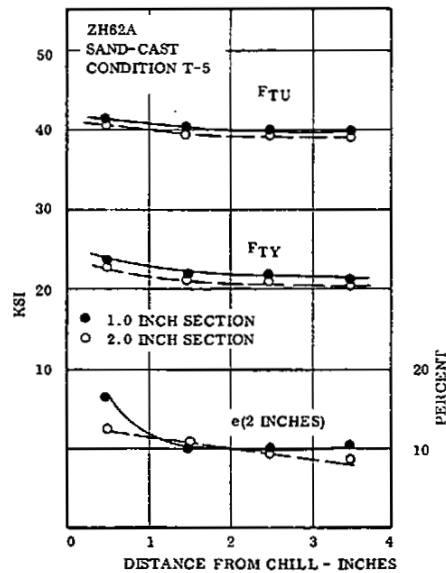


FIG. 3.0213 EFFECT OF END CHILL ON TENSILE PROPERTIES OF CAST PLATES OF TWO THICKNESSES (10).

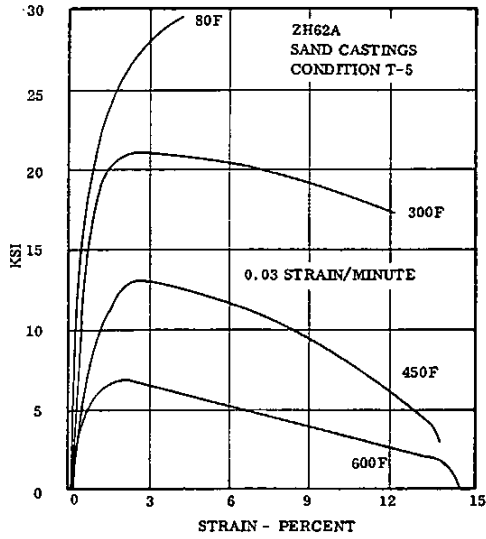


FIG. 3.0311 COMPLETE TENSILE STRESS-STRAIN CURVES AT VARIOUS TEMPERATURES (9).

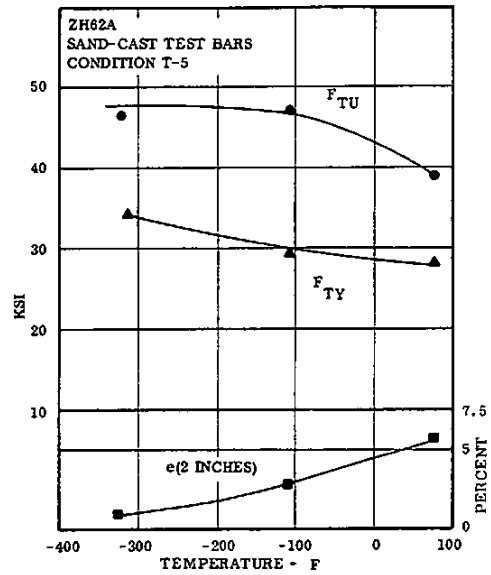


FIG. 3.0313 EFFECT OF SUBZERO TEMPERATURES ON TENSILE PROPERTIES (11).

Mg  
1.5 Th  
5.7 Zn  
0.7 Zr

ZH62A

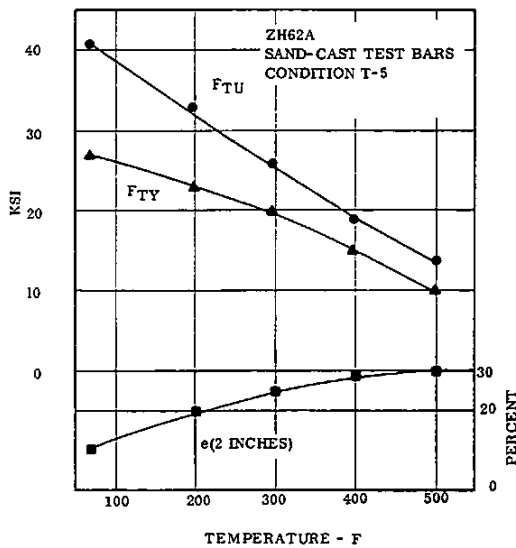


FIG. 3.0312 EFFECT OF ELEVATED TEMPERATURES ON TENSILE PROPERTIES (12).

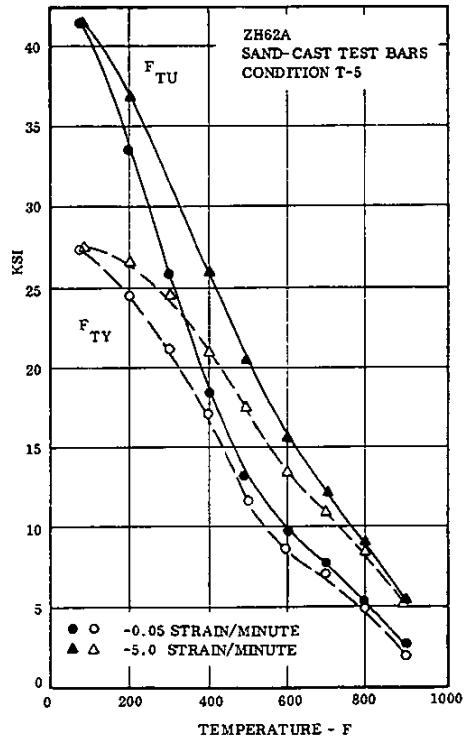


FIG. 3.0314 EFFECT OF STRAIN RATE ON TENSILE PROPERTIES AT DIFFERENT TEMPERATURES (13).

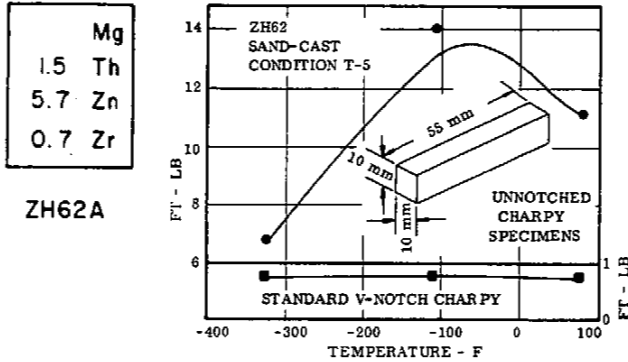


FIG. 3.0331 EFFECT OF SUBZERO TEMPERATURES ON CHARPY IMPACT STRENGTH. (11)

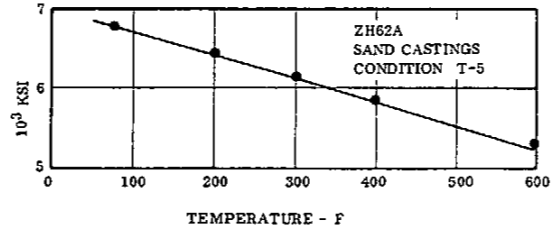


FIG. 3.0621 EFFECT OF TEMPERATURE ON TENSION MODULUS (14).

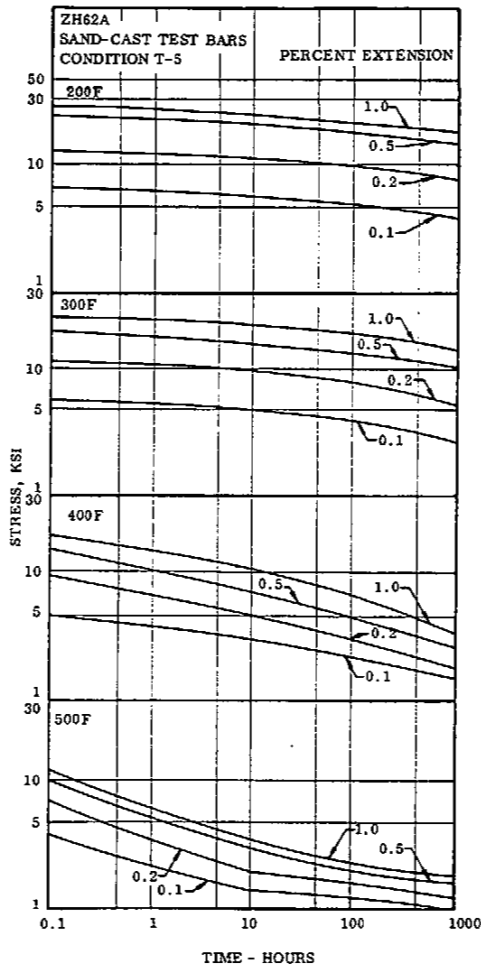


FIG. 3.041 EFFECT OF TEMPERATURE AND STRESS ON TIME TO VARIOUS AMOUNTS OF CREEP EXTENSION (12).

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