REVISED: MARCH 1972
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# NONFERROUS ALLOYS

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

1. GENERAL
This heat treatable magnesium alloy, which is usually used in either the T5 (artificially aged) or the T6 (solution treated and aged) condition is produced in the form of extrusions and forgings. It has similar high strength properties to AZ80A, and its ductility and toughness are superior to those of any other magnesium extrusion and forging alloys. At temperatures above 300F, its strength falls below that of the thorium containing alloy, HM31A. ZK60A has poor arc-weldability, but reasonably good resistance-weldability. This alloy is used for highly stressed parts, primarily in aerospace and military applications at temperatures up to 300F. A variation of this alloy, designated (P)ZK60B, was formerly made by extruding atomized ZK60A alloy into structural shapes. It was used commercially to a very limited extent but is now obsolete and no longer produced.

1.01 Commercial Designation
ZK60A.

1.02 Alternate Designations
ZK60 and ZW6(British).

1.03 Specifications
Table 1.03

1.04 Composition
Table 1.04.

1.05 Heat Treatment
1.051 T5 condition: age as-forged (F condition) material at 290 to 310F 24 hours, air cool (6).
1.052 T6 condition: Solution treat at 925 to 935F 2 hours in furnace atmosphere containing 1.0 percent minimum $SO_2$ or 5.0 percent minimum $CO_2$, air cool, age at 290 to 310F 24 hours, air cool (6)(7).
1.053 O condition, full anneal: 550F 1 hour, air cool (6).
1.054 Stress relief after forming or welding: for material in F condition 500F 15 minutes, air cool; for material in T5 or T6 condition 300F 1 hour, air cool (6)(8).

1.06 Hardness
Table 1.06.

1.07 Forms and Conditions Available
Table 1.07.

1.08 Melting and Casting Practice
(See AZ31B, Code 3601, Section 1.08.)

1.09 Special Considerations
1.091 In the T5 and T6 conditions, ZK60A loses room temperature strength rapidly as a result of exposures to temperatures above 300F.

2. PHYSICAL AND CHEMICAL PROPERTIES

2.01 Thermal Properties
2.011 Melting range. 970 to 1175F (10).
2.012 Phase changes. In the F condition, this alloy contains magnesium-zinc and zirconium-zinc compounds within an alpha magnesium matrix. T5 (artificial aging) treatment of the F material causes finely divided precipitation of more of these compounds. Solution treatment (930F) causes most of the compounds to dissolve in the matrix, and artificial aging (about 300F) causes them to reprecipitate in finely divided form. Prolonged aging at higher temperatures causes coagulation and growth of the precipitates resulting in deterioration of strength.
2.0121 Time-temperature-transformation diagrams.
2.013 Thermal conductivity, Figure 2.013.
2.014 Thermal expansion. 15.0-15.1 x $10^{-6}$ per F from 68 to 392F (10).
2.015 Specific heat, Figure 2.015.
2.016 Thermal diffusivity. T5 condition, 2.59 sq ft per hr at 68F (10).

2.02 Other Physical Properties
2.021 Density. 0.0660 lb per cu in (10).
2.022 Electrical properties, Table 2.022.
2.023 Magnetic properties, non-magnetic.
2.024 Emittance.
2.0241 Effect of temperature on normal total emittance of magnesium alloys in general, Figure 2.0241.
2.025 Damping capacity. At a stress equal to 0.1 $F_{ty}$ the specific damping capacity of ZK60A in both the F and T5 conditions is 0.2, which is a low level compared with other magnesium alloys (13).

2.03 Chemical Properties
2.031 Corrosion resistance.
2.0311 ZK60A, like other magnesium alloys, is subject to stress corrosion and 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 (14).
2.0312 Effect of stress on time to stress corrosion failure of specimens exposed to atmosphere in Washington, D.C., Figure 2.0312.
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 HZ32A, Code 3408, Section 2.032).

2.04 Nuclear Properties

3. MECHANICAL PROPERTIES

3.01 Specified Mechanical Properties
Table 3.01.

3.02 Mechanical Properties at Room Temperature
3.021 Tension.
3.0211 Stress-strain diagrams.
3.02111 Stress-strain curves at room temperature for extrusions in different conditions, orientation, and sections sizes, Figure 3.02111.
3.0212 Tensile properties of extrusions and forgings in various conditions and sizes, Table 3.0212.
3.0213 Effect of exposures at elevated temperatures on tensile properties of extrusions at room temperature, Figure 3.0213.
3.0214 Tensile properties in various sections of aircraft wheel forging, Table 3.0214.
3.0215 Effect of rolling reduction and orientation on the tensile properties of roll forged rings produced directly from cast blanks, Figure 3.0215.
3.0216 Effect of rolling reduction and orientation on the tensile properties of roll forged rings produced from upset blanks, Table 3.0216.
3.022 Compression.
3.0221 Stress-strain diagrams.
3.02211 Compressive stress-strain curves at room temperature for extrusions in different conditions, orientations, and sections sizes, Figure 3.02211.
3.0222 Compressive yield strength of extrusions and forgings in various conditions and sizes, Table 3.0222.
3.0223 Effect of exposures at elevated temperatures on compressive yield strength at room temperature, Figure 3.0223.
3.0224 Effect of rolling reduction and orientation on the compressive yield strength of roll forged rings produced directly from cast blanks, Figure 3.0224.
3.0225 Effect of rolling reduction and orientation on the compressive yield strength of roll forged rings produced from upset blanks, Table 3.0225.
3.023 Impact (see Figure 3.0331).
3.024 Bending.
3.025 Torsion and shear.
3.0251 Shear strengths of extrusions and forgings in various conditions and sizes, Table 3.0251.
3.026 Bearing.
3.0261 Bearing properties of extrusions and forgings in various conditions and sizes, Table 3.0261.

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

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3.027 Stress concentration.
3.0271 Notch properties (see Figure 3.03711).
3.0272 Fracture toughness.
3.028 Combined properties.

3.03 Mechanical Properties at Various Temperatures
3.031 Tension.
3.0311 Stress-strain diagrams.
3.03111 Stress-strain curves at room and elevated temperatures for forgings, forged at 600 F from extruded material, Figure 3.03111.
3.03112 Stress-strain curves at room and elevated temperatures for forgings, forged at 800 F from cast material, Figure 3.03112.
3.03113 Stress-strain curves at room and low temperatures for extrusions, Figure 3.03113.
3.0312 Effect of temperature on tensile properties of extrusions, Figure 3.0312.
3.0313 Effect of temperature on tensile properties of forgings, Figure 3.0313.
3.0314 Effect of temperature on tensile properties of extrusions after various exposure times at test temperature, Figure 3.0314.
3.0315 Effect of temperature and strain rate on tensile properties of extrusions in F condition, Figure 3.0315.
3.0316 Effect of temperature and strain rate on tensile properties of extrusions in T5 condition, Figure 3.0316.
3.032 Compression.
3.0321 Stress-strain diagrams.
3.0322 Effect of temperature on compressive yield strength of extrusions, Figure 3.0322.
3.033 Impact.
3.0331 Effect of low temperatures on impact strength of both smooth and notched Charpy bars, Figure 3.0331.
3.034 Bending.
3.035 Torsion and shear.
3.036 Bearing.
3.037 Stress concentration.
3.0371 Notch properties.
3.03711 Effect of low temperatures on notched tensile strength, Figure 3.03711.
3.0372 Fracture toughness.
3.038 Combined properties.

3.04 Creep and Creep Rupture Properties
3.041 Isochronous stress-strain curves for forgings in T5 condition, Figure 3.041.
3.042 Isochronous stress-strain curves for forgings in T6 condition, Figure 3.042.
3.043 Total creep strain curves for extrusions, Figure 3.043.
3.044 100 hour creep strength of forgings, Table 3.044.

3.05 Fatigue Properties
3.051 Fatigue properties of extrusions, Figure 3.051.
3.052 Fatigue properties of forgings, Figure 3.052.

3.06 Elastic Properties
3.061 Poisson's ratio. 0.35 (9).
3.062 Modulus of elasticity.
3.0621 Effect of temperature on static modulus of elasticity, Figure 3.0621.
3.0622 Compressive tangent modulus curves for extrusions of various section sizes in T5 condition, Figure 3.0622.
3.0623 Compressive tangent modulus curves for extrusions of various section sizes in F condition, Figure 3.0623.
3.0624 Compressive secant modulus curves for extrusions of various section sizes in T5 condition, Figure 3.0624.
3.0625 Compressive secant modulus curves for extrusions of various section sizes in F condition, Figure 3.0625.
3.063 Modulus of rigidity. $2.4 \times 10^3$ ksi (9).

4. FABRICATION

4.01 Formability
4.011 ZK60A, which can be formed by the usual methods and equipment used in the forming of other metals, has good formability at elevated temperatures but relatively poor formability at room temperature.
4.012 Formability limits for extrusions, Table 4.012.
4.013 Although it is not normally necessary after hot forming, stress relief in accordance with section 1.054 will minimize chances of stress corrosion after severe forming at temperatures appreciably below the maximum recommended forming temperatures.
4.014 ZK60A has excellent forgeability in the range 750 to 500 F. Overheating must be avoided to prevent grain growth, which can cause cracking during forging. When reheating during forging is required, it is desirable to reduce the starting temperature by about 50 F for each reheat cycle. A minimum section reduction of 20 percent after the final reheat is recommended to insure a fine grain structure. (23).

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 (24).

4.03 Welding
4.031 Because of a tendency to hot cracking, ZK60A has poor weldability by the gas-shielded arc processes applied to many other magnesium alloys. Although arc welding is not recommended because the results are inconsistent, AZ92A filler metal should be used if welding is necessary. Stress relief in accordance with section 1.054 will minimize the danger of stress corrosion cracking in welded joints. Gas welding is not recommended (17).
4.032 ZK60A can be satisfactorily resistance welded, spot welding being used to the greatest extent. Spot welds have good static strength (shear and tension), but poor fatigue strength (9)(17).

4.04 Surface Treatment
For a discussion of various surface treatments that can be applied for corrosion protection see HZ32A, Code 3408, Sections 4.041, 4.042, and 4.043.

TABLE 1.03

| Alloy | ZK60A |
|---|---|
| Source | (1) |
| Forms | Specifications |
| Extruded rods, bars, and shapes | AMS 4352D<br>ASTM B107-69<br>Federal QQ-M-31b(1)<br>SAE 524 |
| Forgings | AMS 4362B<br>ASTM B91-68<br>Federal QQ-M-40b(1)<br>SAE 524 |
| Extruded tubes | AMS 4352D<br>ASTM B107-69<br>Federal WW-T-825a<br>SAE 524 |

TABLE 1.04

| Alloy | ZK60A | |
|---|---|---|
| Source | (2)(3)(4)(5) | |
| | Percent | |
| Element | Minimum | Maximum |
| Zinc | 4.8 | 6.2 |
| Zirconium | 0.45 | - |
| Impurities (total) | - | 0.30 |
| Magnesium | Balance | |

| Mg |
|---|
| 5.5 Zn |
| 0.5 Zr |

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TABLE 1.06

| Alloy | ZK60A | |
|---|---|---|
| Source | (9) | |
| Form | Condition | Brinell Hardness |
| Extrusions | F | 75 |
| | T5 | 82 |
| Forgings | T5 | 65 |
| | T6 | 75 |

TABLE 2.022

| Alloy | ZK60A | | |
|---|---|---|---|
| Condition | T5 | | |
| Source | (10) | | |
| | Electrical Conductivity | | Electrical |
| Temperature F | Percent IACS | Megmhos per in$^3$ | Resistivity microhm-in |
| 68 | 30.4 | 0.447 | 2.24 |
| 100 | 28.8 | 0.424 | 2.36 |
| 200 | 24.6 | 0.362 | 2.76 |
| 300 | 21.5 | 0.316 | 3.16 |
| 400 | 19.2 | 0.282 | 3.55 |
| 500 | 17.4 | 0.256 | 3.90 |

TABLE 1.07

| Alloy | ZK60A |
|---|---|
| Source | (9) |
| Forms | Condition |
| Extrusions: rods, bars, solid shapes, tubes, semi-hollow and hollow shapes | F and T5 |
| Forgings: die forgings, hand forgings, and roll forged rings | T5 and T6 |

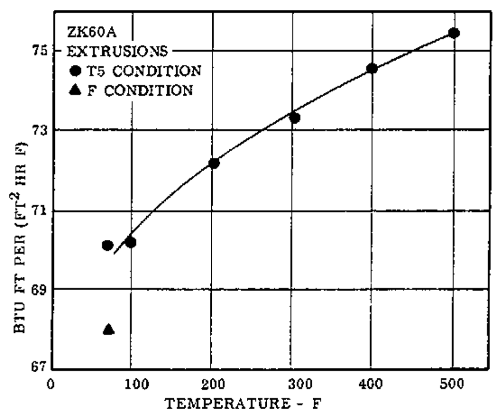


FIG. 2.013 THERMAL CONDUCTIVITY. (10)(11)

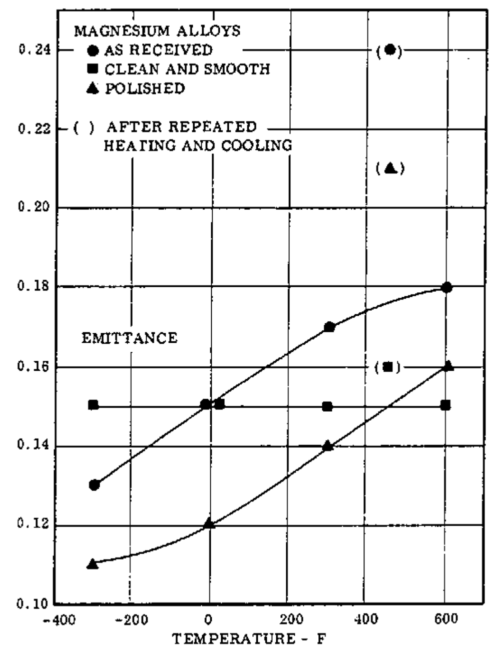


FIG. 2.0241 EFFECT OF TEMPERATURE ON NORMAL TOTAL EMITTANCE OF MAGNESIUM ALLOYS IN GENERAL (11)(12)

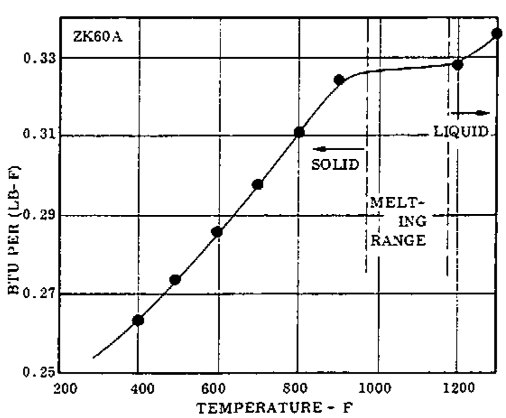


FIG. 2.015 SPECIFIC HEAT. (10)

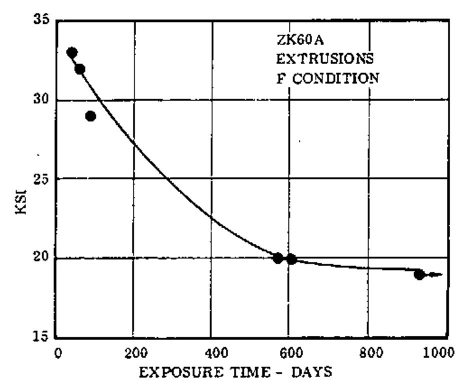


FIG. 2.0312 EFFECT OF STRESS ON TIME TO STRESS CORROSION FAILURE OF SPECIMENS EXPOSED TO ATMOSPHERE IN WASHINGTON D.C. (15)

| Mg |
|---|
| 5.5 Zn |
| 0.5 Zr |

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TABLE 3.01

| Alloy | ZK60A | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Form | Extrusions | | | | | | | |
| Condition | T5 | | | | | | | |
| Shapes | Source | Cross sectional area - in$^2$ | Outside diameter in | Section thickness in | $F_{tu}$ ksi min | $F_{ty}$ ksi min | e (2 in) min | $F_{cy}$ ksi min |
| Bars, rods, and solid shapes | (2) | up to 2 | - | - | 45.0 | 36.0 | 4 | 30.0 |
| | | 2 to 3 | - | - | 45.0 | 36.0 | 4 | 28.0 |
| | | 3 to 5 | - | - | 45.0 | 36.0 | 4 | 25.0 |
| | | 5 to 10 | - | - | 45.0 | 34.0 | 6 | 23.0 |
| | | 10 to 25 | - | - | 45.0 | 34.0 | 6 | 22.0 |
| | | 25 to 40 | - | - | 43.0 | 31.0 | 6 | 20.0 |
| Tubing | (2) | - | up to 3 | 0.028-0.250 | 46.0 | 38.0 | 4 | 26.0 |
| | | - | 3 to 8.5 | 0.094-1.188 | 44.0 | 33.0 | 4 | 21.0 |
| Hollow shapes | (2) | all | - | all | 46.0 | 38.0 | 4 | 26.0 |
| Bars, rods, and shapes | (5) | up to 5 | - | - | 45.0 | 36.0 | 4 | - |
| Tubing | (5) | - | up to 3 | 0.028-0.250 | 46.0 | 38.0 | 4 | - |
| | | - | 3 to 8.5 | 0.094-1.188 | 44.0 | 33.0 | 4 | - |
| Hollow shapes | (5) | all | - | all | 46.0 | 38.0 | 4 | - |
| Form | Extrusions | | | | | | | |
| Condition | F | | | | | | | |
| Bars, rods, and shapes | (5) | up to 5 | - | - | 43.0 | 31.0 | 5 | - |
| | | 5 to 40 | - | - | 43.0 | 31.0 | 4 | - |
| Tubing | (5) | - | up to 3 | 0.028-0.750 | 40.0 | 28.0 | 5 | - |
| Hollow shapes | (5) | all | - | all | 40.0 | 28.0 | 5 | - |
| Form | Forgings | | | | | | | |
| Condition | T5 | | | | | | | |
| Die Forgings | (3)(4) | - | - | up to 3 | 42.0 | 26.0 | 7 | - |
| Hand Forgings | (3) | - | - | up to 6 | 38.0 | 20.0 | 7 | - |

Note: Test specimens oriented in the direction of maximum flow.

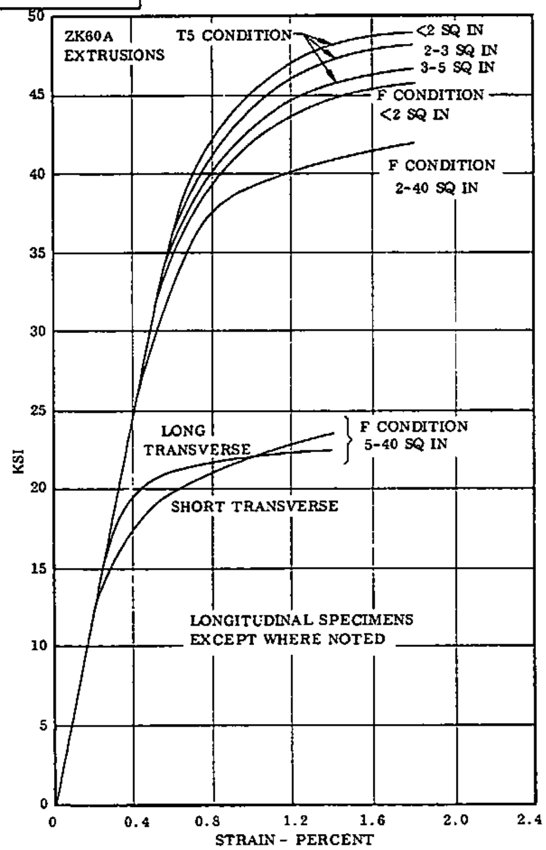



FIG. 3.02111 STRESS-STRAIN CURVES AT ROOM TEMPERATURE FOR EXTRUSIONS IN DIFFERENT CONDITIONS, ORIENTATIONS, AND SECTION SIZES. (9)

| Mg |
|---|
| 5.5 Zn |
| 0.5 Zr |

ZK60A

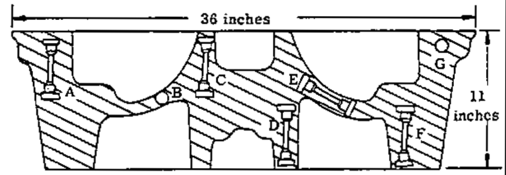
TABLE 3.0212

| Alloy | ZK60A | | | | |
|---|---|---|---|---|---|
| Source | (9) | | | | |
| Condition | Form | Cross Sectional Area - sq in | $F_{tu}$ ksi | $F_{ty}$ ksi | e(2 in) |
| T5 | Extruded rods, bars, and shapes | under 2.000 | 53 | 44 | 11 |
| | | 2.000-2.999 | 52 | 43 | 12 |
| | | 3.000-4.999 | 51 | 42 | 14 |
| F | Extruded rods, bars, and shapes | under 2.000 | 49 | 38 | 14 |
| | | 2.000-2.999 | 49 | 37 | 14 |
| | | 3.000-4.999 | 49 | 36 | 14 |
| | | 5.000-39.999 | 48 | 37 | 9 |
| T5 | Extruded tubes | Dimensions-in | | | |
| | | 3.0 max OD and 0.028-0.250 wall | 50 | 40 | 11 |
| | | 3.0-8.5 OD and 0.094-1.188 wall | 49 | 39 | 12 |
| T5 | Extruded hollow shapes | limits not established | 50 | 40 | 11 |
| F | | | 46 | 34 | 12 |
| T5 | Forgings | limits not given | 44 | 30 | 16 |
| T6 | | | 47 | 39 | 11 |

Note: All properties apply to longitudinal orientation.

TABLE 3.0214

| Alloy | ZK60A | | | |
|---|---|---|---|---|
| Form | Aircraft Wheel Forging | | | |
| Source | (25) | | | |
| Condition | Test Location | $F_{tu}$ - ksi | $F_{ty}$ - ksi | e(2 in) |
| T5 | A. Rim Vertical | 36.0 | 19.5 | 10.5 |
| | B. Web Tangential | 43.5 | 32.5 | 18.5 |
| | C. Center Vertical | 39.5 | 24.0 | 15.0 |
| | D. Center Vertical | 39.5 | 23.0 | 16.5 |
| | E. Web Radial | 41.5 | 25.0 | 16.5 |
| | F. Rim Vertical | 42.0 | 24.0 | 12.0 |
| | G. Rim Tangential | 45.0 | 36.5 | 22.0 |
| T6 | A. Rim Vertical | 43.0 | 34.0 | 10.5 |
| | B. Web Tangential | 45.5 | 38.0 | 11.0 |
| | C. Center Vertical | 43.0 | 34.0 | 10.5 |
| | D. Center Vertical | 43.0 | 34.0 | 10.5 |
| | E. Web Radial | 42.5 | 35.0 | 15.5 |
| | F. Rim Vertical | 43.0 | 34.0 | 10.5 |
| | G. Rim Tangential | 45.5 | 38.0 | 11.0 |



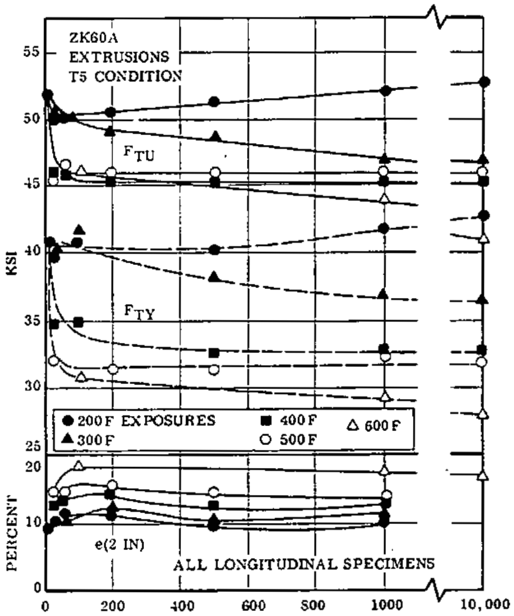




FIG. 3.0213 EFFECT OF EXPOSURES AT ELEVATED TEMPERATURES ON TENSILE PROPERTIES OF EXTRUSIONS AT ROOM TEMPERATURE. (9)(16)

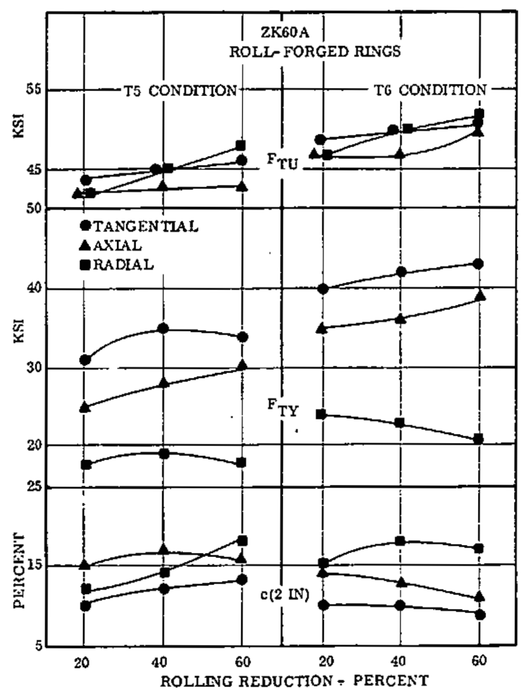



FIG. 3.0215 EFFECT OF ROLLING REDUCTION AND ORIENTATION ON THE TENSILE PROPERTIES OF ROLL-FORGED RINGS PRODUCED DIRECTLY FROM CAST BLANKS. (18)

Mg
5.5 Zn
0.5 Zr

ZK60A

TABLE 3.0216

| Alloy | ZK60A | | | | |
|---|---|---|---|---|---|
| Form | Roll Forged Rings | | | | |
| Source | (18) | | | | |
| Condition | Orientation | Rolling Reduction Percent | $F_{tu}$ ksi | $F_{ty}$ ksi | e (2 in) |
| T5 | Tangential | 40 | 49 | 39 | 13 |
| | | 60 | 51 | 42 | 12 |
| | Axial | 40 | 45 | 26 | 14 |
| | | 60 | 45 | 28 | 14 |
| | Radial | 40 | 44 | 21 | 20 |
| | | 60 | 45 | 23 | 15 |
| T6 | Tangential | 40 | 54 | 47 | 10 |
| | | 60 | 51 | 43 | 9 |
| | Axial | 40 | 47 | 32 | 11 |
| | | 60 | 46 | 33 | 9 |
| | Radial | 40 | 49 | 25 | 22 |
| | | 60 | 50 | 21 | 14 |

TABLE 3.0222

| Alloy | ZK60A | | |
|---|---|---|---|
| Source | (9) | | |
| Condition | Form | Cross Sectional Area - sq in | $F_{cy}$ - ksi |
| T5 | Extruded rods, bars, and shapes | under 2.000 | 36 |
| | | 2.000-2.999 | 31 |
| | | 3.000-4.999 | 30 |
| F | Extruded rods, bars, and shapes | under 2.000 | 33 |
| | | 2.000-2.999 | 28 |
| | | 3.000-4.999 | 27 |
| | | 5.000-39.999 | 23 |
| | | Dimensions - in | |
| T5 | Extruded tubes | 3.0 max OD and 0.094-1.188 wall | 30 |
| | | 3.0-8.5 OD and 0.094-1.188 wall | 26 |
| T5 | Extruded hollow shapes | limits not established | 29 |
| F | | | 25 |
| T5 | Forgings | limits not given | 28 |
| F | | | 25 |
| Note: All properties apply to longitudinal orientation. | | | |

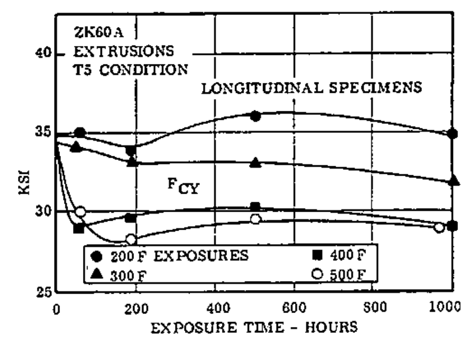



FIG. 3.0223 EFFECT OF EXPOSURES AT ELEVATED TEMPERATURES ON COMPRESSIVE YIELD STRENGTH AT ROOM TEMPERATURE. (9)

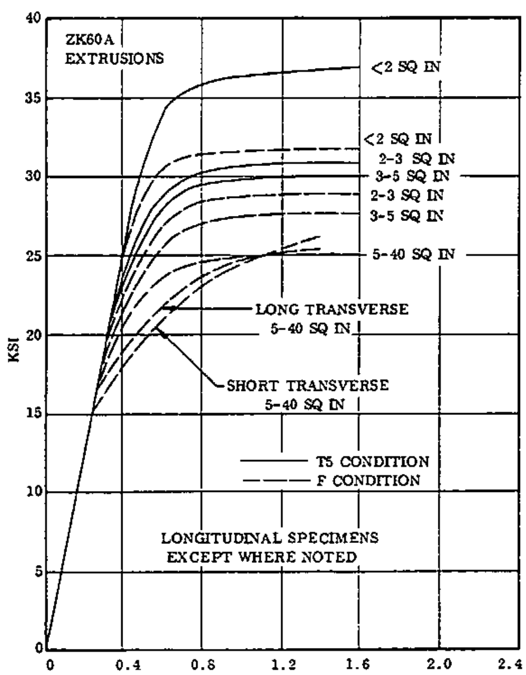



FIG. 3.02211 COMPRESSIVE STRESS-STRAIN CURVES AT ROOM TEMPERATURE FOR EXTRUSIONS IN DIFFERENT CONDITIONS, ORIENTATIONS, AND SECTION SIZES. (9)

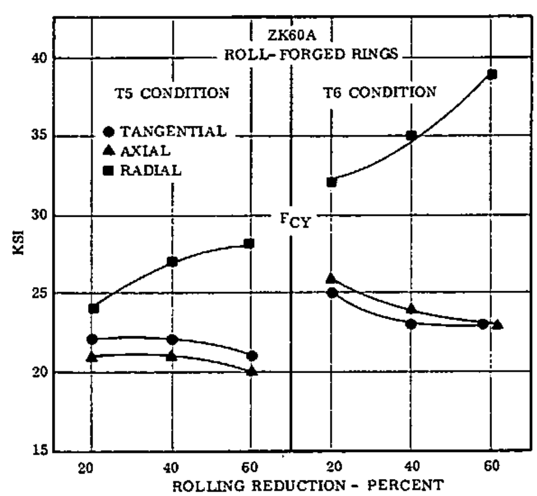



FIG. 3.0224 EFFECT OF ROLLING REDUCTION AND ORIENTATION ON THE COMPRESSIVE YIELD STRENGTH OF ROLL-FORGED RINGS PRODUCED DIRECTLY FROM CAST BLANKS. (18)

| Mg |
|---|
| 5.5 Zn |
| 0.5 Zr |

ZK60A

TABLE 3.0225

| Alloy | ZK60A | | |
|---|---|---|---|
| Form | Roll Forged Rings | | |
| Source | (18) | | |
| Condition | Orientation | Rolling Reduction Percent | $F_{cy}$ - ksi |
| T5 | Tangential | 40 | 25 |
| | | 60 | 27 |
| | Axial | 40 | 22 |
| | | 60 | 25 |
| | Radial | 40 | 26 |
| | | 60 | 30 |
| T6 | Tangential | 40 | 27 |
| | | 60 | 24 |
| | Axial | 40 | 27 |
| | | 60 | 22 |
| | Radial | 40 | 35 |
| | | 60 | 37 |

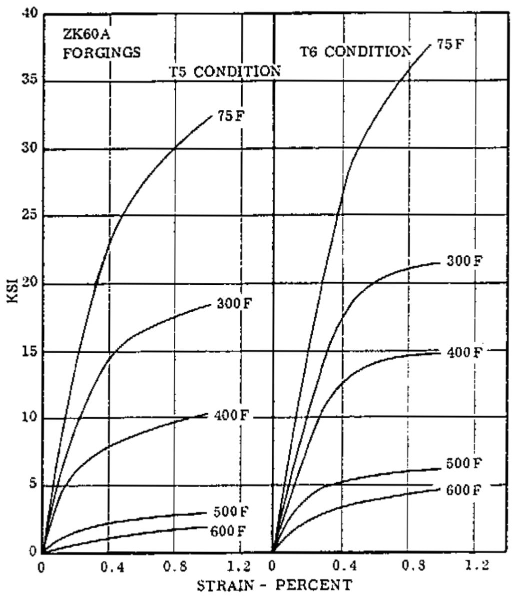



FIG. 3.03111 STRESS-STRAIN CURVES AT ROOM AND ELEVATED TEMPERATURES FOR FORGING, FORGED AT 600F FROM EXTRUDED MATERIAL. (17)

TABLE 3.0251

| Alloy | ZK60A | | |
|---|---|---|---|
| Source | (9) | | |
| Condition | Form | Cross Sectional Area - sq in | $F_{su}$ - ksi |
| T5 | Extruded rods, bars, and shapes | under 2.000 | 26 |
| | | 2.000 - 2.999 | 26 |
| | | 3.000 - 4.999 | 25 |
| F | Extruded rods, bars, and shapes | under 2.000 | 24 |
| | | 2.000 - 2.999 | 24 |
| | | 3.000 - 4.999 | 24 |
| | | 5.000 -39.999 | 24 |
| T5 | Forgings | limits not given | 24 |
| F | | | 25 |
| Note: All properties apply to longitudinal orientation. | | | |

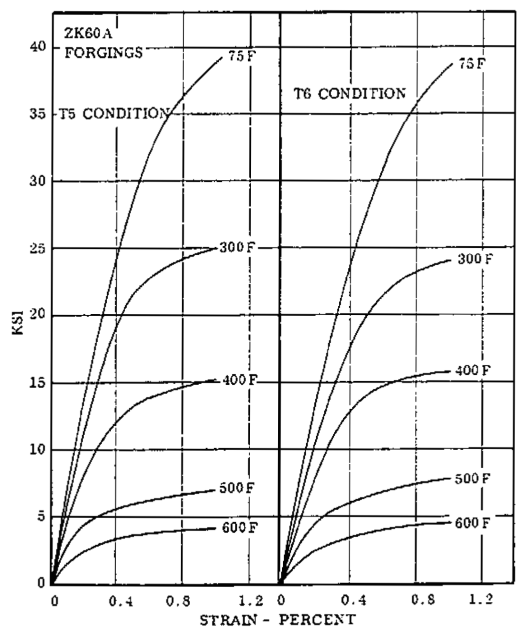



FIG. 3.03112 STRESS-STRAIN CURVES AT ROOM AND ELEVATED TEMPERATURES FOR FORGINGS, FORGED AT 500F FROM CAST MATERIAL. (17)

TABLE 3.0261

| Alloy | ZK60A | | | |
|---|---|---|---|---|
| Source | (9) | | | |
| Condition | Form | Cross sectional area - sq in | $F_{bru}$* ksi | $F_{bry}$* ksi |
| T5 | Extruded rods, bars, and shapes | under 2.000 | 79 | 59 |
| | | 2.000-2.999 | 78 | 53 |
| | | 3.000-4.999 | 77 | 52 |
| F | Extruded rods, bars, and shapes | under 2.000 | 76 | 56 |
| | | 2.000-2.999 | 76 | 50 |
| | | 3.000-4.999 | 76 | 49 |
| | | 5.000-39.999 | 75 | 44 |
| T5 | Forgings | limits not given | 58 | 42 |
| F | | | 65 | 46 |
| * edge-distance-to-hole-diameter-ratio of 2. | | | | |
| Note: All properties apply to longitudinal orientation. | | | | |

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

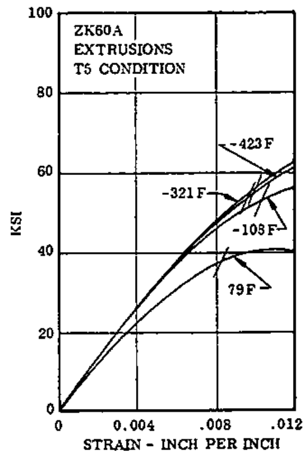



FIG. 3.03113 STRESS-STRAIN CURVES AT ROOM AND LOW TEMPERATURES FOR EXTRUSIONS. (19)

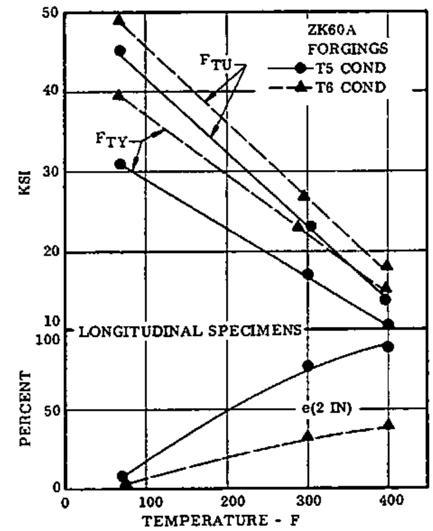



FIG. 3.0313 EFFECT OF TEMPERATURE ON TENSILE PROPERTIES OF FORGINGS. (9)

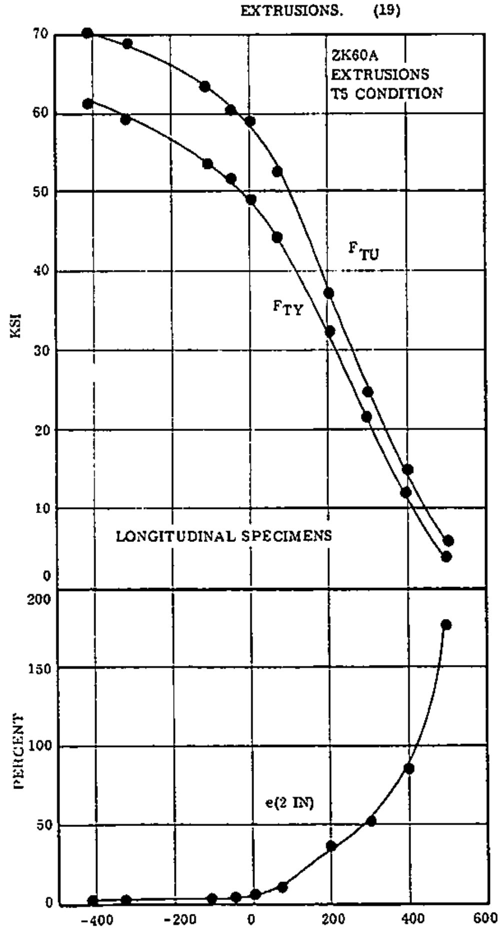



FIG. 3.0312 EFFECT OF TEMPERATURE ON TENSILE PROPERTIES OF EXTRUSIONS. (9)(12)

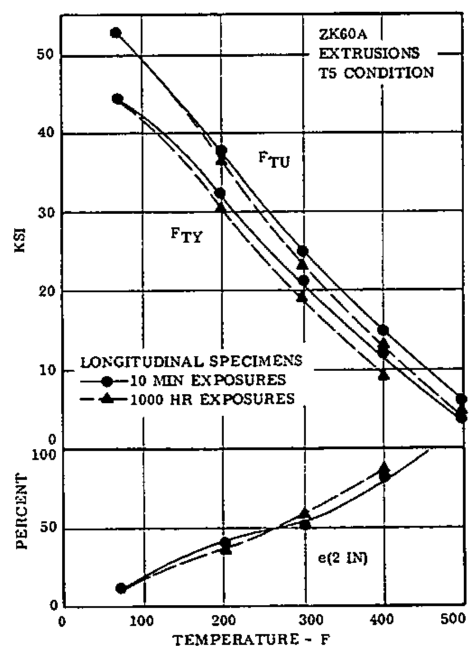



FIG. 3.0314 EFFECT OF TEMPERATURE ON TENSILE PROPERTIES OF EXTRUSIONS AFTER VARIOUS EXPOSURE TIMES AT TEST TEMPERATURE. (9)(20)

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

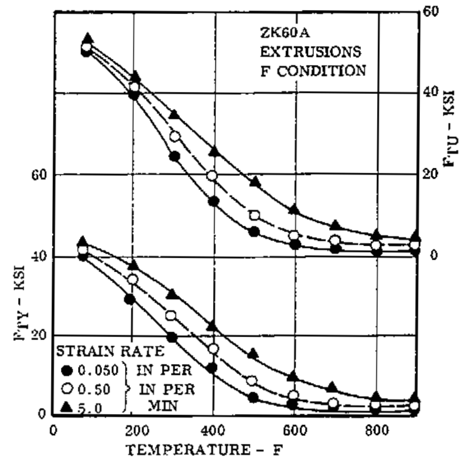



FIG. 3.0315 EFFECT OF TEMPERATURE AND STRAIN RATE ON TENSILE PROPERTIES OF EXTRUSIONS IN F CONDITION. (9)

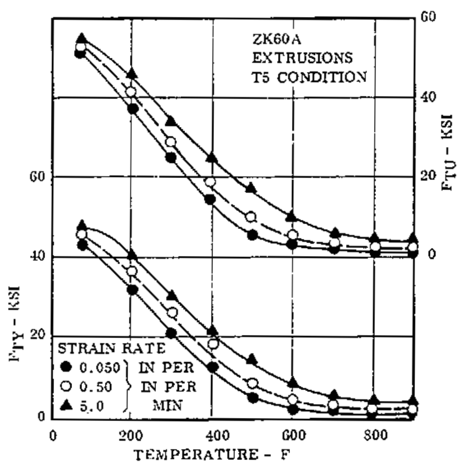



FIG. 3.0316 EFFECT OF TEMPERATURE AND STRAIN RATE ON TENSILE PROPERTIES OF EXTRUSIONS IN T5 CONDITION. (9)

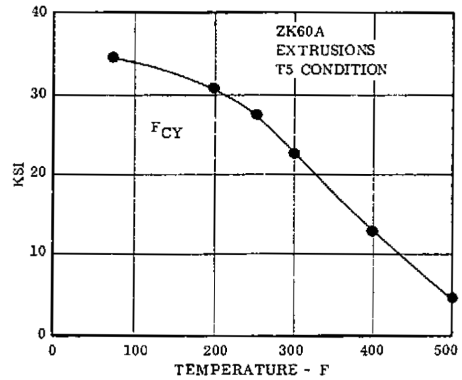



FIG. 3.0322 EFFECT OF TEMPERATURE ON COMPRESSIVE YIELD STRENGTH OF EXTRUSIONS.(9)

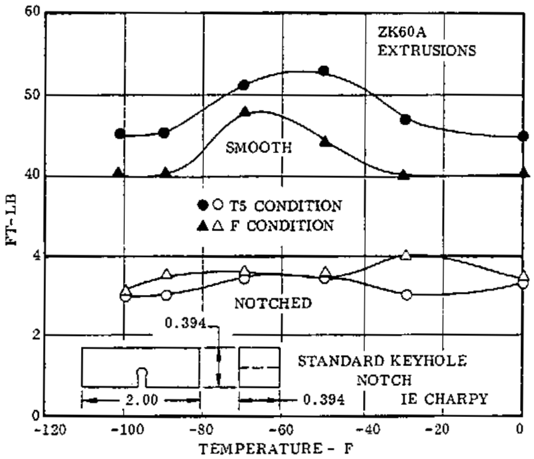



FIG. 3.0331 EFFECTS OF LOW TEMPERATURES ON IMPACT STRENGTH OF BOTH SMOOTH AND NOTCHED CHARPY BARS. (12)

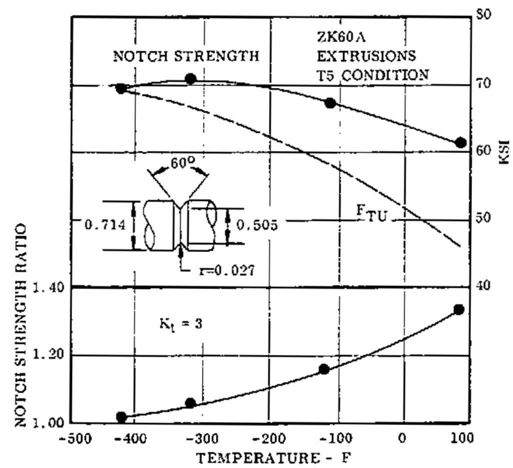



FIG. 3.03711 EFFECT OF LOW TEMPERATURES ON NOTCHED TENSILE STRENGTH. (19)

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

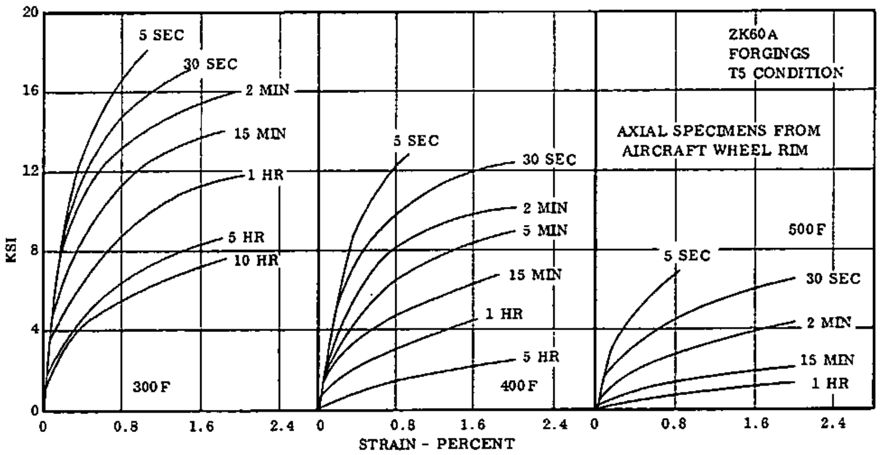



FIG. 3.041 ISOCHRONOUS STRESS-STRAIN CURVES FOR FORGINGS IN T5 CONDITION. (9)

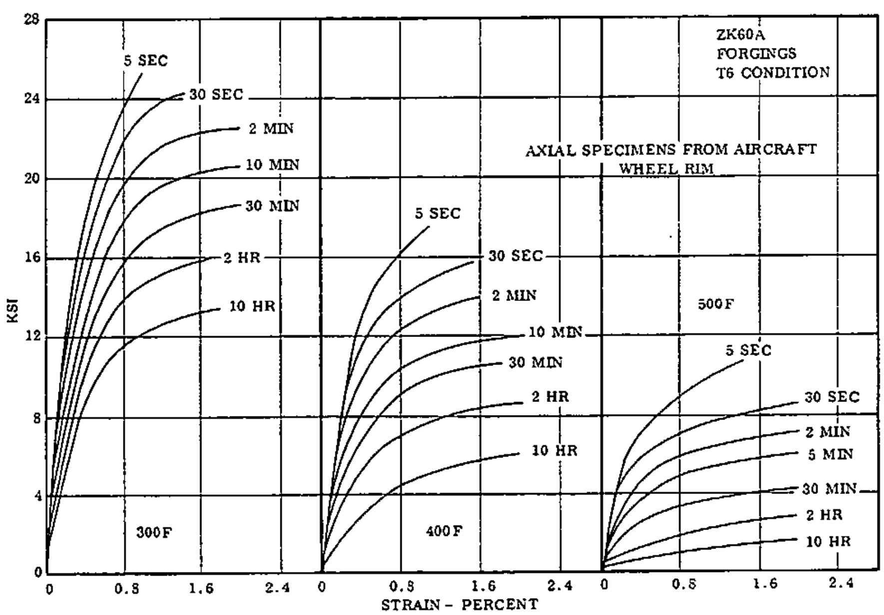



FIG. 3.042 ISOCHRONOUS STRESS-STRAIN CURVES FOR FORGINGS IN T6 CONDITION. (9)

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

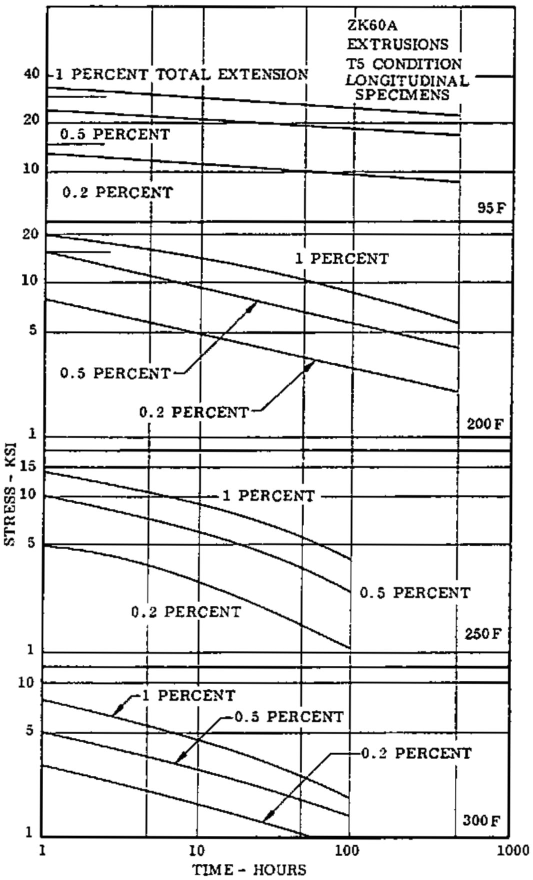



FIG. 3.043 TOTAL CREEP STRAIN CURVES FOR EXTRUSIONS. (9)(20)

TABLE 3.044

| Alloy | ZK60A | | | |
|---|---|---|---|---|
| Source | (9) | | | |
| | | 100 hour creep strength - ksi | | |
| Condition | Temp | 0.1 percent creep extension | 0.2 percent total extension | 0.5 percent total extension |
| T5 | 300 | 0.9 | 1.3 | 2.3 |
| | 400 | 0.2 | 0.3 | 0.5 |
| T6 | 300 | 3.3 | 3.8 | 6.2 |
| | 400 | 1.2 | 1.5 | 2.3 |

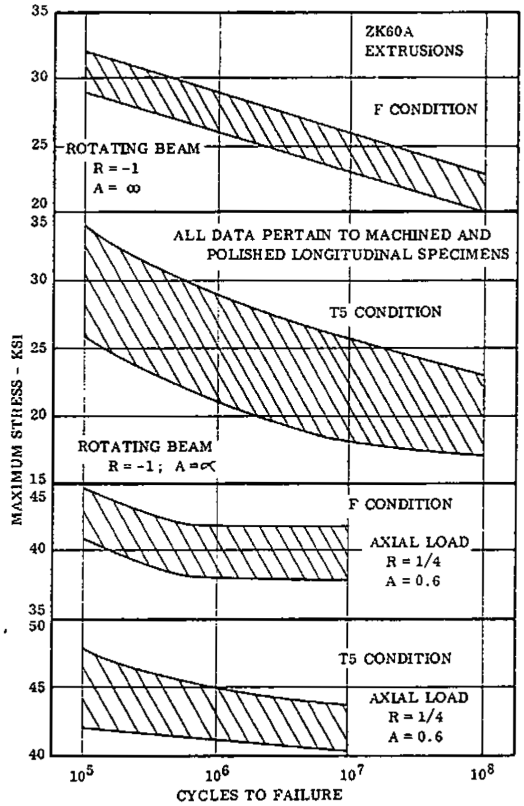



FIG. 3.051 FATIGUE PROPERTIES OF EXTRUSIONS. (9)

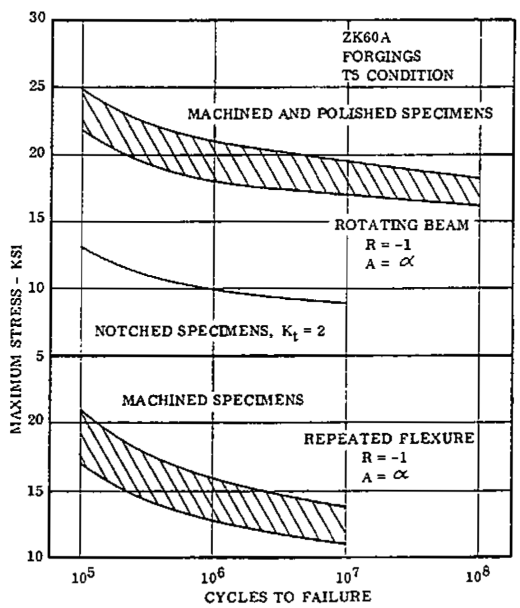



FIG. 3.052 FATIGUE PROPERTIES OF FORGINGS. (9)(21)

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

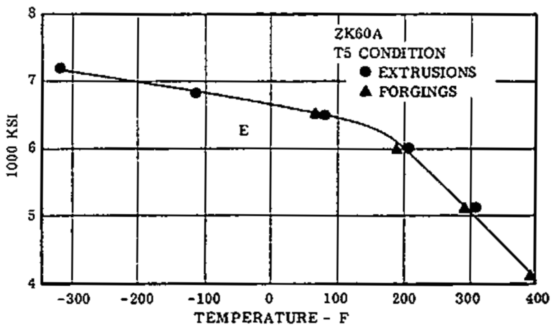



FIG. 3.0621 EFFECT OF TEMPERATURE ON STATIC MODULUS OF ELASTICITY. (9)(19)

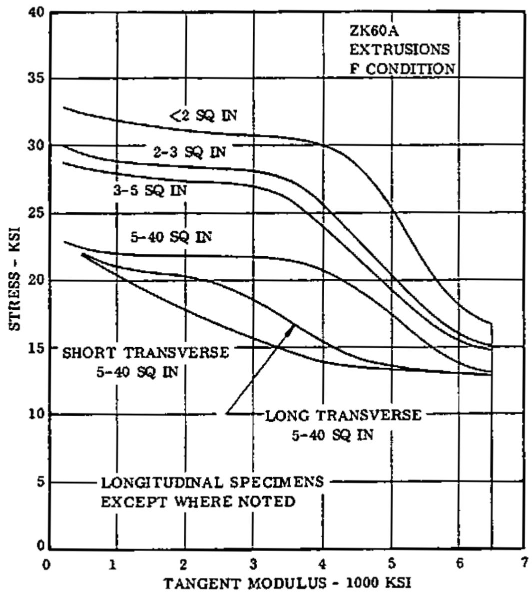



FIG. 3.0623 COMPRESSIVE TANGENT MODULUS CURVES FOR EXTRUSIONS OF VARIOUS SECTION SIZES IN F CONDITION. (9)

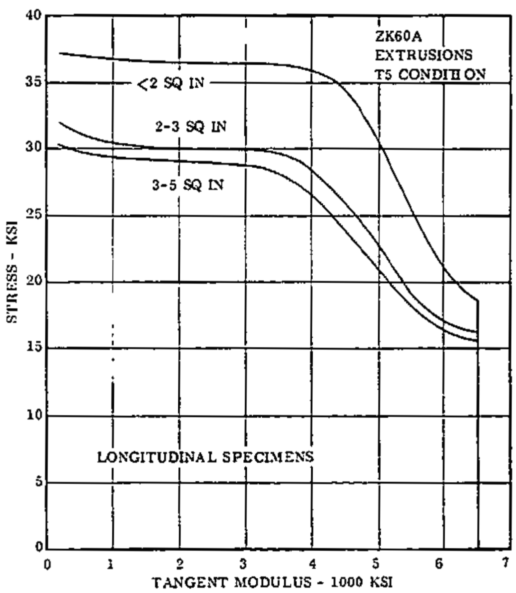



FIG. 3.0622 COMPRESSIVE TANGENT MODULUS CURVES FOR EXTRUSIONS OF VARIOUS SECTION SIZES IN T5 CONDITION. (9)

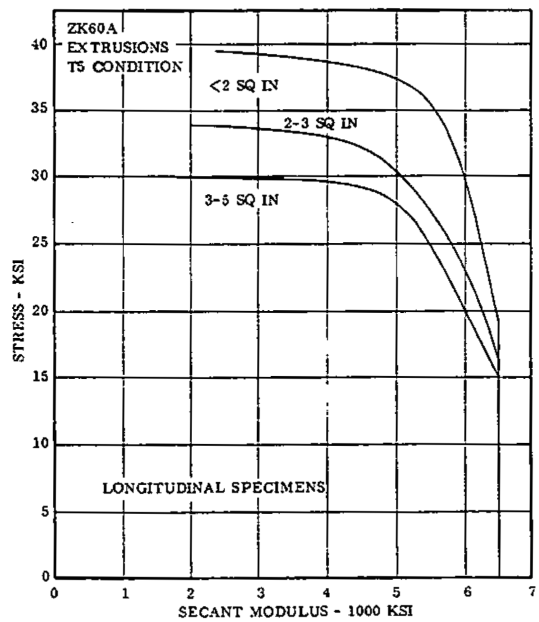



FIG. 3.0624 COMPRESSIVE SECANT MODULUS CURVES FOR EXTRUSIONS OF VARIOUS SECTION SIZES IN T5 CONDITION. (9)

| | |
|---|---|
| | Mg |
| 5.5 | Zn |
| 0.5 | Zr |

ZK60A

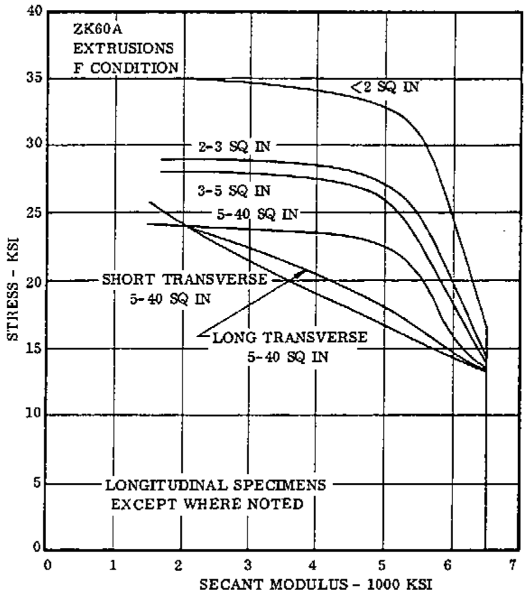



FIG. 3.0625 COMPRESSIVE SECANT MODULUS CURVES FOR EXTRUSIONS OF VARIOUS SECTION SIZES IN F CONDITION. (9)

TABLE 4.012

| Alloy | ZK60A | | | |
|---|---|---|---|---|
| Source | (22) | | | |
| | | Min bend | Hot forming limits | |
| Form | Condition | rad at 75 F | Time and Temp | Min bend rad |
| Solid | F | 12t | 1/2 hr at 550 F | 2t |
| extrusions | T5 | 12t | 1/2 hr at 400 F | 6.6t |
| Tubing | F | 5D | - | - |
| Note: t = thickness; D = tube OD | | | | |

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3. AMS 4362B, Forgings (May 1, 1968).
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| |
|---|
| Mg |
| 5.5 Zn |
| 0.5 Zr |

ZK60A

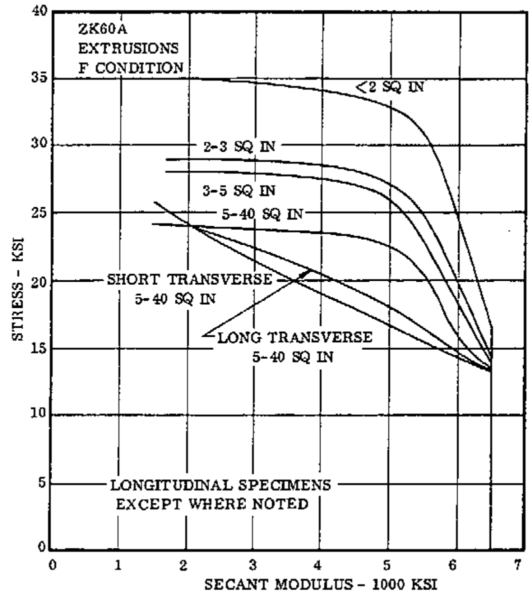


FIG. 3.0625 COMPRESSIVE SECANT MODULUS CURVES FOR EXTRUSIONS OF VARIOUS SECTION SIZES IN F CONDITION. (9)

TABLE 4.012

| Alloy | ZK60A | | | |
|---|---|---|---|---|
| Source | (22) | | | |
| | | Min bend | Hot forming limits | |
| Form | Condition | rad at 75 F | Time and Temp | Min bend rad |
| Solid extrusions | F | 12t | 1/2 hr at 550 F | 2t |
| | T5 | 12t | 1/2 hr at 400 F | 6.6t |
| Tubing | F | 5D | - | - |
| Note: t = thickness; D = tube OD | | | | |

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18. "Magnesium Rolled Rings," Dow Chemical Company, Metal Products Department, Code 0.4 JFP/HB (December 29, 1964).
19. McGee, R. L., Campbell, J. E., Carlson, R. L., and Manning, G. K., "The Mechanical Properties of Certain Aircraft Structural Metals at Very Low Temperatures," Battelle Memorial Institute, WADC TR58-386 (November 1958).
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