

## Alloy Data: Zinc and ZA Die Casting Alloy Properties

Table A-3-14 Typical Material Properties: Zn and ZA Alloys

Typical values based on "as-cast" characteristics for separately die cast specimens, not specimens cut from production die castings.

Commercial: ASTM:	Zamak Die Casting Alloys				ZA Die Casting Alloys		
	No. 2	No. 3 AG-40A	No. 5 AC-41A	No.7 AG-40B	ZA-8	ZA-12	ZA-27
<b>Mechanical Properties</b>							
<b>Ultimate Tensile Strength</b>							
ksi	52	41	48	41	54	59	62
(MPa)	(359)	(283)	(328)	(283)	(372)	(400)	(426)
<b>Yield Strength<sup>Ⓐ</sup></b>							
ksi	41	32	39	32	41-43	45-48	52-55
(MPa)	(283)	(221)	(269)	(221)	(283-296)	(310-331)	(359-379)
<b>Compressive Yield Strength<sup>Ⓢ</sup></b>							
ksi	93	60 <sup>Ⓢ</sup>	87 <sup>Ⓢ</sup>	60 <sup>Ⓢ</sup>	37	39	52
(MPa)	(641)	(414)	(600)	(414)	(252)	(269)	(358)
<b>Elongation</b>							
% in 2 in. (51 mm)	7	10	7	13	6-10	4-7	2.0-3.5
<b>Hardness<sup>Ⓢ</sup></b>							
BHN	100	82	91	80	100-106	95-105	116-122
<b>Shear Strength</b>							
ksi	46	31	38	31	40	43	47
(MPa)	(317)	(214)	(262)	(214)	(275)	(296)	(325)
<b>Impact Strength</b>							
ft-lb	35	43 <sup>Ⓢ</sup>	48 <sup>Ⓢ</sup>	43 <sup>Ⓢ</sup>	24-35 <sup>Ⓢ</sup>	15-27 <sup>Ⓢ</sup>	7-12 <sup>Ⓢ</sup>
(J)	(47.5)	(58)	(65)	(58)	(32-48)	(20-37)	(9-16)
<b>Fatigue Strength<sup>Ⓢ</sup></b>							
ksi	8.5	6.9	8.2	6.9	15	—	21
(MPa)	(58.6)	(47.6)	(56.5)	(47.6)	(103)		(145)
<b>Young's Modulus</b>							
psi x 10 <sup>6</sup>	Ⓢ	Ⓢ	Ⓢ	Ⓢ	12.4	12	11.3
(GPa)					(85.5)	(83)	(77.9)
<b>Physical Properties</b>							
<b>Density</b>							
lb/in <sup>3</sup>	0.24	0.24	0.24	0.24	0.227	0.218	0.181
(g/cm <sup>3</sup> )	(6.6)	(6.6)	(6.7)	(6.6)	(6.3)	(6.03)	(5.00)
<b>Melting Range</b>							
°F	715-734	718-728	717-727	718-728	707-759	710-810	708-903
(°C)	(379-390)	(381-387)	(380-386)	(381-387)	(375-404)	(377-432)	(375-484)
<b>Specific Heat</b>							
BTU/lb°F	0.10	0.10	0.10	0.10	0.104	0.107	0.125
(J/kg°C)	(419)	(419)	(419)	(419)	(435)	(450)	(525)
<b>Coefficient of Thermal Expansion</b>							
μ in./in./°F	15.4	15.2	15.2	15.2	12.9	13.4	14.4
(μ m/m°C)	(27.8)	(27.4)	(27.4)	(27.4)	23.2	(24.1)	(26.0)
<b>Thermal Conductivity</b>							
BTU/ft hr °F	60.5	65.3	62.9	65.3	66.3	67.1	72.5
(W/m°C)	(104.7)	(113)	(109)	(113)	(115)	(116)	(122.5)
<b>Electrical Conductivity</b>							
% IACS	25.0	27.0	26.0	27.0	27.7	28.3	29.7
<b>Poisson's Ratio</b>							
(mm/m)	0.030	0.030	0.030	0.030	0.030	0.030	0.030

Ⓐ 0.2% offset, strain rate sensitive, values obtained at a strain rate of 0.125/min (12.5% per minute) Ⓢ 0.1% offset Ⓣ Compressive strength Ⓤ 500 kg load, 10mm ball Ⓥ ASTM E 23 unnotched 0.25 in. die cast bar Ⓦ Rotary Bend 5 x 10<sup>8</sup> cycles Ⓧ Varies with stress level: applicable only for short-duration loads. Use 10<sup>7</sup> as a first approximation. Source: International Lead Zinc Research Organization.

Die casting alloy selection requires evaluation not only of physical and mechanical properties, and chemical composition, but also of inherent alloy characteristics and their effect on die casting production as well as possible machining and final surface finishing.

This table includes selected die casting and other special characteristics which are usually considered in selecting a zinc alloy for a specific application.

The characteristics are rated from (1) to

(5), (1) being the most desirable and (5) being the least. In applying these ratings, it should be noted that all the alloys have sufficiently good characteristics to be accepted by users and producers of die castings. A rating of (5) in one or more categories would not rule out an alloy if other attributes are particularly favorable, but ratings of (5) may present manufacturing difficulties.

The benefits of consulting a custom die caster experienced in casting the zinc or ZA alloy being considered are clear.

**Table A-3-15 Die Casting and Other Characteristics: Zn and ZA Alloys**

(1 = most desirable, 5 = least desirable)

Commercial: ASTM:	Zamak Die Casting Alloys				ZA Die Casting Alloys		
	No. 2	No. 3 AG-40A	No. 5 AC-41A	No. 7 AG-40B	ZA-8	ZA-12	ZA-27
<b>Resistance to Hot Cracking<sup>Ⓐ</sup></b>	1	1	2	1	2	3	4
<b>Pressure Tightness</b>	3	1	2	1	3	3	4
<b>Casting Ease</b>	1	1	1	1	2	3	3
<b>Part Complexity</b>	1	1	1	1	2	3	3
<b>Dimensional Accuracy</b>	1	1	1	1	2	2	3
<b>Dimensional Stability</b>	4	2	2	1	2	3	4
<b>Corrosion Resistance</b>	2	3	3	2	2	2	1
<b>Resistance to Cold Defects<sup>Ⓐ</sup></b>	2	2	2	1	2	3	4
<b>Machining Ease &amp; Quality<sup>Ⓒ</sup></b>	1	1	1	1	2	3	4
<b>Polishing Ease &amp; Quality</b>	2	1	1	1	2	3	4
<b>Electroplating Ease &amp; Quality<sup>Ⓓ</sup></b>	1	1	1	1	1	2	3
<b>Anodizing (Protection)</b>	1	1	1	1	1	2	2
<b>Chemical Coating (Protection)</b>	1	1	1	1	2	3	3

Ⓐ The ability of alloy to resist formation of cold defects; for example, cold shuts, cold cracks, non-fill "woody" areas, swirls, etc. Ⓑ Ability of alloy to withstand stresses from contraction while cooling through the hot-short or brittle temperature range. Ⓒ Composite rating based on ease of cutting, chip characteristics, quality of finish and tool life. Ⓓ Ability of the die casting to take and hold an electroplate applied by present standard methods. Source: International Lead Zinc Research Organization.