

Table 4.1 Die Casting Alloys Material Properties Comparison

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

	Aluminum Alloys										
Designation	360.0	A360.0	380.0	A380.0	383.0	384.0	B390.0	413.0	A413.0	C443.0	518.0
Mechanical Properties											
Ultimate Tensile Strength											
ksi	44	46	46	47	45	48	46	43	42	33	45
(MPa)	(300)	(320)	(320)	(320)	(310)	(330)	(320)	(300)	(290)	(230)	(310)
Tensile Yield Strength [Ⓐ]											
ksi	25	24	23	23	22	24	36	21	19	14	28
(MPa)	(170)	(170)	(160)	(160)	(150)	(170)	(250)	(140)	(130)	(100)	(190)
Compressive Yield Strength [Ⓑ]											
ksi	-	-	-	-	-	-	-	-	-	-	-
(MPa)											
Elongation											
% in 2 in. (51 mm)	2.5	3.5	3.5	3.5	3.5	2.5	<1	2.5	3.5	9.0	5.0
Hardness											
BHN	75 [Ⓒ]	75 [Ⓒ]	80 [Ⓒ]	80 [Ⓒ]	75 [Ⓒ]	85 [Ⓒ]	120 [Ⓒ]	80 [Ⓒ]	80 [Ⓒ]	65 [Ⓒ]	80 [Ⓒ]
Shear Strength											
ksi	28	26	28	27	-	29	-	25	25	19	29
(MPa)	(190)	(180)	(190)	(190)		(200)		(170)	(170)	(130)	(200)
Impact Strength											
ft-lb	-	-	3	-	3 [Ⓕ]	-	-	-	-	-	7
(J)			(4)		(4)						(9)
Fatigue Strength											
ksi	20 [Ⓓ]	18 [Ⓓ]	20 [Ⓓ]	20 [Ⓓ]	21 [Ⓓ]	20 [Ⓓ]	20 [Ⓓ]	19 [Ⓓ]	19 [Ⓓ]	17 [Ⓓ]	20 [Ⓓ]
(MPa)	(140)	(120)	(140)	(140)	(145)	(140)	(140)	(130)	(130)	(120)	(120)
Young's Modulus											
psi x 10 ⁶	10.3	10.3	10.3	10.3	10.3	-	11.8	10.3	-	10.3	-
(GPa)	(71)	(71)	(71)	(71)	(71)		(81.3)	(71)		(71)	
Physical Properties											
Density											
lb/in ³	0.095	0.095	0.099	0.098	0.099	0.102	0.098	0.096	0.096	0.097	0.093
(g/cm ³)	(2.63)	(2.63)	(2.74)	(2.71)	(2.74)	(2.82)	(2.73)	(2.66)	(2.66)	(2.69)	(2.57)
Melting Range											
°F	1035-1105	1035-1105	1000-1100	1000-1100	960-1080	960-1080	950-1200	1065-1080	1065-1080	1065-1170	995-1150
(°C)	(557-596)	(557-596)	(540-595)	(540-595)	(516-582)	(516-582)	(510-650)	(574-582)	(574-632)	(574-632)	(535-621)
Specific Heat											
BTU/lb°F	0.230	0.230	0.230	0.230	0.230	-	-	0.230	0.230	0.230	-
(J/kg°C)	(963)	(963)	(963)	(963)	(963)			(963)	(963)	(963)	
Coefficient of Thermal Expansion											
μ in./in. °F x 10 ⁻⁶	11.6	11.6	12.2	12.1	11.7	11.6	10.0	11.3	11.9	12.2	13.4
(μ m/m°C)	(21.0)	(21.0)	(22.0)	(21.8)	(21.1)	(21.0)	(18.0)	(20.4)	(21.6)	(22.0)	(24.1)
Thermal Conductivity											
BTU/ft hr°F	65.3	65.3	55.6	55.6	55.6	55.6	77.4	70.1	70.1	82.2	55.6
(W/m°C)	(113)	(113)	(96.2)	(96.2)	(96.2)	(96.2)	(134)	(121)	(121)	(142)	(96.2)
Electrical Conductivity											
% IACS	30	29	27	23	23	22	27	31	31	37	24
Poisson's Ratio											
	0.33	0.33	0.33	0.33	0.33	-	-	-	-	0.33	-

n/a = data not available [Ⓐ] 0.2% offset [Ⓑ] 0.1% offset [Ⓒ] 500 kg load, 10mm ball [Ⓓ] Rotary Bent 5 x 10⁸ in./in./m/m [Ⓔ] Notched Charpy. [Ⓕ] Average hardness based on scattered data. [Ⓖ] ASTM E 23 unnotched .25 in. die cast bar [Ⓗ] Rotating Beam fatigue test according to DIN 50113. Stress corresponding to a lifetime of 5 x 10⁷ cycles. Conservative values; higher values have been reported. Soundness of samples has a great effect on fatigue properties resulting in disagreement among data sources. Although every effort has been made to assure the accuracy of data presented here, the North American Die Casting Association cannot be responsible for the results obtained by use of this data.

Chapter 4: Selecting Alloys: Specifications for Al, Mg, Zn and ZA Alloys

Magnesium Alloys			Zamak Die Casting Alloys				ZA Die Casting Alloys			Designation
AZ91D	AM60B	AS41B	No. 2	No. 3	No. 5	No. 7	ZA-8	ZA-12	ZA-27	
Mechanical Properties										
Ultimate Tensile Strength										
34 (230)	32 (220)	31 (215)	52 (359)	41 (283)	48 (328)	41 (283)	54 (372)	59 (400)	62 (426)	ksi (MPa)
Tensile Yield Strength [Ⓐ]										
23 (160)	19 (130)	20 (140)	41 (283)	32 (221)	39 (269)	32 (221)	41-43 (283-296)	45-48 (310-331)	52-55 (359-379)	ksi (MPa)
Compressive Yield Strength [Ⓑ]										
24 (165)	19 (130)	20 (140)	93 (641)	60 [Ⓜ] (414)	87 [Ⓜ] (600)	60 [Ⓜ] (414)	37 (252)	39 (269)	52 (358)	ksi (MPa)
Elongation										
3	6-8	6	7	10	7	13	6-10	4-7	2.0-3.5	% in 2 in. (51 mm)
Hardness										
75 [Ⓒ]	62 [Ⓒ]	75 [Ⓒ]	100 [Ⓒ]	82 [Ⓒ]	91 [Ⓒ]	80 [Ⓒ]	100-103 [Ⓒ]	95-105 [Ⓒ]	116-122 [Ⓒ]	BHN
Shear Strength										
20 (140)	n/a	n/a	46 (317)	31 (214)	38 (262)	31 (214)	40 (275)	43 (296)	47 (325)	ksi (MPa)
Impact Strength										
1.6 [Ⓓ] (2.2)	4.5 [Ⓓ] (6.1)	3.0 [Ⓓ] (4.1)	35 [Ⓓ] (47.5)	43 [Ⓓ] (58)	48 [Ⓓ] (65)	43 [Ⓓ] (58)	24-35 [Ⓓ] (32-48)	15-27 [Ⓓ] (20-37)	7-12 [Ⓓ] (9-16)	ft-lb (J)
Fatigue Strength										
10 [Ⓔ] (70)	10 [Ⓔ] (70)	n/a	8.5 [Ⓓ] (58.6)	6.9 [Ⓓ] (47.6)	8.2 [Ⓓ] (56.5)	6.9 [Ⓓ] (47.6)	15 [Ⓓ] (103)	-	21 [Ⓓ] (145)	ksi (MPa)
Young's Modulus										
6.5 (45)	6.5 (45)	6.5 (45)	[Ⓝ]	[Ⓝ]	[Ⓝ]	[Ⓝ]	12.4 (85.5)	12 (83)	11.3 (77.9)	psi x 10 ⁶ (GPa)
Physical Properties										
Density										
0.066 (1.81)	0.065 (1.79)	0.064 (1.77)	0.24 (6.6)	0.24 (6.6)	0.24 (6.7)	0.24 (6.6)	0.227 (6.3)	0.218 (6.03)	0.181 (5.00)	lb/in ³ (g/cm ³)
Melting Range										
875-1105 (470-595)	1005-1140 (540-615)	1050-1150 (565-620)	715-734 (379-390)	718-728 (381-387)	717-727 (380-386)	718-728 (381-387)	707-759 (375-404)	710-810 (375-404)	708-903 (375-484)	°F (°C)
Specific Heat										
0.25 (1050)	0.25 (1050)	0.24 (1050)	0.10 (419)	0.10 (419)	0.10 (419)	0.10 (419)	0.104 (435)	0.107 (450)	0.125 (525)	BTU/lb°F (J/kg°C)
Coefficient of Thermal Expansion										
13.8 (25.0)	14.2 (25.6)	14.5 (26.1)	15.4 (27.8)	15.2 (27.4)	15.2 (27.4)	15.2 (27.4)	12.9 23.2	13.4 (24.1)	14.4 (26.0)	μ in./in. °F x 10 ⁻⁶ (μ m/m°C)
Thermal Conductivity										
41.8 [Ⓙ] (72)	36 (62)	40 (68)	60.5 (104.7)	65.3 (113)	62.9 (109)	65.3 (113)	66.3 (115)	67.1 (116)	72.5 (122.5)	BTU/ft hr°F (W/m°C)
Electrical Conductivity										
10	11		25.0	27.0	26.0	27.0	27.7	28.3	29.7	% IACS
Poisson's Ratio										
0.35	0.35	0.35	0.30	0.30	0.30	0.30	0.30	0.30	0.30	

[Ⓐ] At 212-572 °F (100-300°C) [Ⓑ] Estimated [Ⓒ] Casting conditions may significantly affect mold shrinkage. [Ⓜ] Compressive strength [Ⓝ] Varies with stress level; applicable only for short-duration loads. Use 10⁷ as a first approximation. Al Sources: ASTM Standard B85-92a; ASM; SAE; Wabash Alloys. Mg Source: International Magnesium Association. Zn/ZA Source: International Lead Zinc Research Organization.