

Die Casting Die Cooling Line Design

The cooling line is the heat conveyor of a die casting die, and its diameter decides how hot the surface runs. The tables below give the surface temperature, the cracking and the hardness measured at four cooling line diameters in premium grade H13, and the hardness profile that follows them.

Reference only. This is a reference summary of a published study and it is not a specification of ours. The values are reproduced from the source, which tested one grade, one specimen shape and one set of casting conditions. What a particular die reaches depends on the die design, the alloy, the cycle and the cooling circuit. Final design is confirmed on the job.

Why the cooling line sets where the die fails

A larger cooling line lowers the surface temperature

Item	1.8 in	1.7 in	1.6 in	1.5 in
Maximum temperature, F	909	939	1002	1087
Minimum temperature, F	197	237	326	399
Total crack area, x 10 ⁶ μm ² , after 15,000 cycles	35	62.05	79.44	108.56
Average maximum crack length, x 100 μm, after 15,000 cycles	8.25	10	12.25	12.5
Hardness at the average maximum crack length, HRC	35.1	34.6	34.1	31.6

Effect of the cooling line diameter on the temperature at the corner of a premium grade H13 specimen, and on the cracking measured after 15,000 cycles in molten aluminium at 1350 F. A longer cooling line gives a lower peak temperature and less cracking, and the minimum temperature falls at the same time.

Hardness across the surface follows the same line

Distance from the corner, in	1.8 in	1.7 in	1.6 in	1.5 in
0.01	30.6	29.4	29.3	24.3
0.02	33.7	31.3	30.6	25.1
0.04	35.6	34.2	33.9	27.7
0.06	38.6	37.3	36.3	29.2
0.08	40.1	38.2	36.9	29.2
0.1	40.5	39.4	38.3	30
0.2	43.5	42.9	42	34.1

Hardness measured from the corner inward on the four specimens, in HRC, after 15,000 cycles. The soft band runs deeper and softer as the cooling line gets smaller.

The design rule the test supports

What this means on the job

Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, DC53, A2, O1, H13, H11, H10, H21, S7, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.

Source, Effect of Design Factors on Thermal Fatigue Cracking of Die Casting Dies, D. Schwam, J. F. Wallace and S. Birceanu, Case Western Reserve University, final technical report to the U.S. Department of Energy, Award No. DE-FC07-00ID138486, October 2004.

CONTACT

EMAIL
sales@aobosteel.com

WHATSAPP
+86 180 6294 5370

WEB
aobosteel.com



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