

AUBERT&DUVAL



SDCTM

Super Die Casting

A new die material for longer service life

**CONTINUOUS
METALLURGICAL
INNOVATION**

SPECIAL STEELS

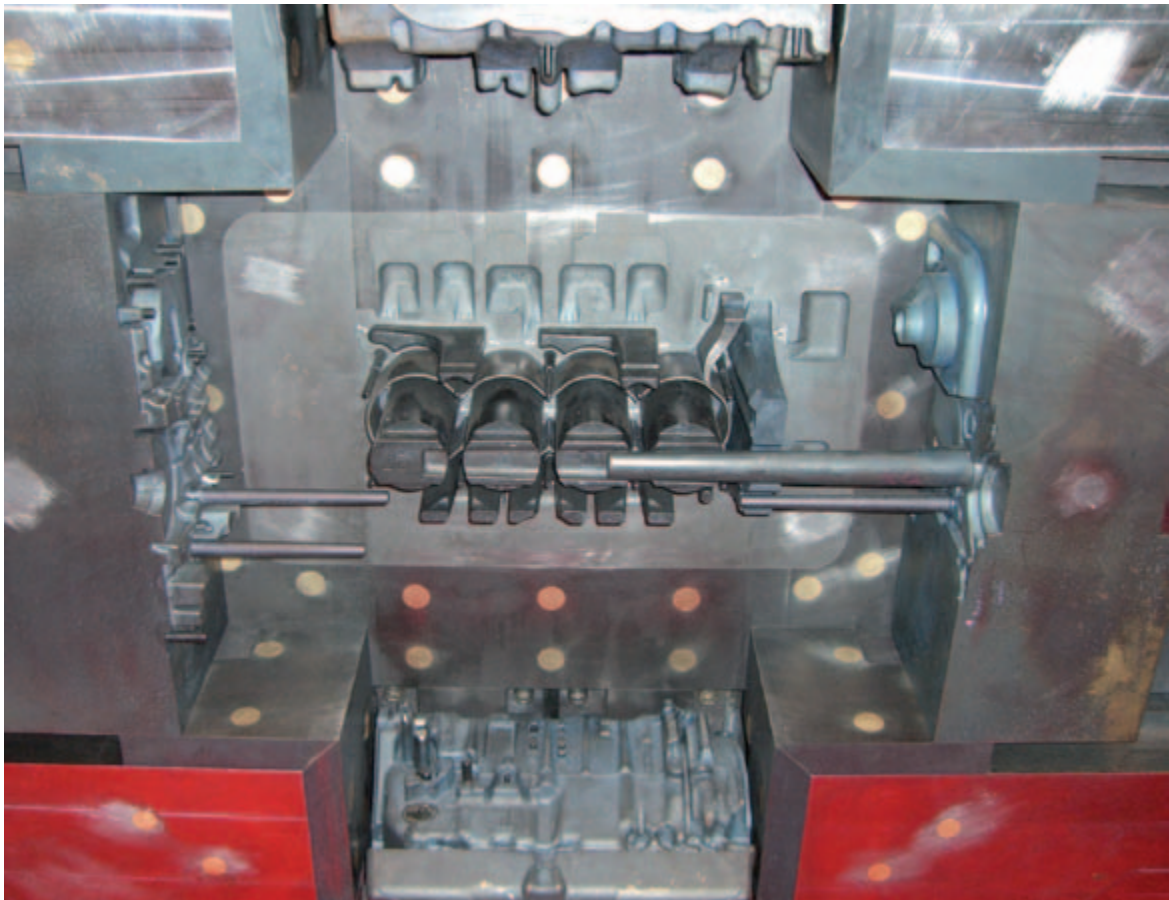
DEVELOPMENT

RESEARCH

SERVICE

Enhancing your performance

Mold for cylinder blocks made by OCMB *



With courtesy of PSA

* Central Tool shop Mechanic and Raw parts of PSA group



SDC™ Super Die Casting

NEW DIE MATERIAL FOR LONGER SERVICE LIFE

The lifetime of light alloy die cast parts highly depends on the thermal fatigue behavior of the material. Aubert&Duval has created a grade for improved thermal fatigue resistance while maintaining high properties of resistance to abrasion at temperature: the **SDC™**

With a high Molybdenum and Nickel content, **SDC™** yields an improved compromise between crack initiation and propagation. Improved alloying balance and optimized melting and converting processes delay crack initiation through an improved superficial softening resistance. Concurrently, **SDC™** shows higher toughness and Charpy V notch impact resistance, therefore slowing down crack propagation. Its wide spectrum of applications completes the Aubert&Duval grade range for die casting.

CHEMICAL COMPOSITION %

C	Si	Mn	Cr	Mo	Ni	V
0.35	0.35	0.50	5.00	1.80	1.50	0.60

X35CrMoNiV5-2-2

ADVANTAGES

- Excellent resistance to crack initiation
- Very good toughness
- Excellent thermal conductivity
- High resistance to thermal shock
- Good hot oxidation resistance
- Very good softening resistance
- Excellent wear resistance
- Excellent quenching behavior

PHYSICAL PROPERTIES

Density: (g/cm³)

7.8

Coefficient of linear thermal expansion:

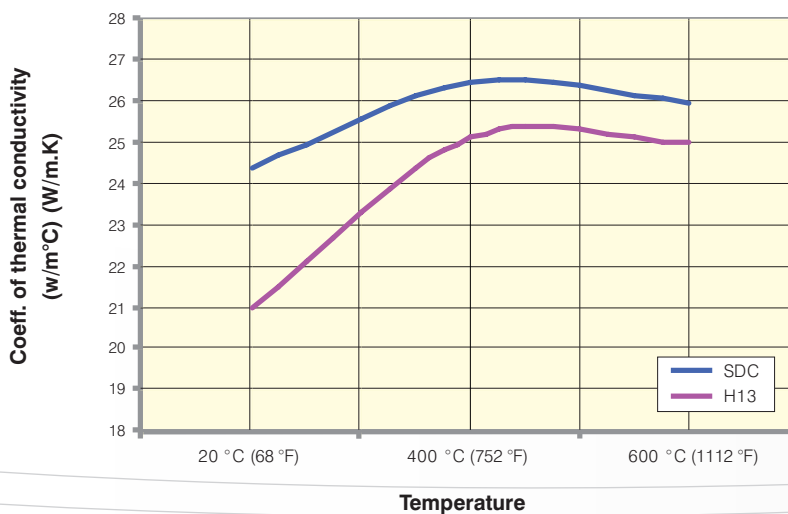
	in/in. °F.10 ⁻⁴	m/m. °C x 10 ⁻⁶
Between 20 – 200 °C (68 – 400 °F)	6.6	11.9
Between 20 – 400 °C (68 – 752 °F)	7.1	12.8
Between 20 – 600 °C (68 – 1112 °F)	7.4	13.3

Critical Points:

Ac1: 740 °C (1364 °F)

Ac3: 885 °C (1635 °F)

Thermal conductivity:



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DELIVERY CONDITION

SDC™ is delivered in annealed condition with a hardness of 235 HB max. Because of its innovative metallurgy, the annealed structures differ from the typical 5% Cr grades used for toolsteels. The usage heat treatment (austenitizing / quenching + tempering cycles) yield a fine structure which conforms to the strictest specifications (NADCA 207-2003...). This heat treated structure provides the optimum set hardness / ductility / temperature resistance.

HEAT TREATMENT

SDC™ heat treatment procedures are important. We can participate in the development of the range of heat treatment in collaboration with heat treaters.

Hardening

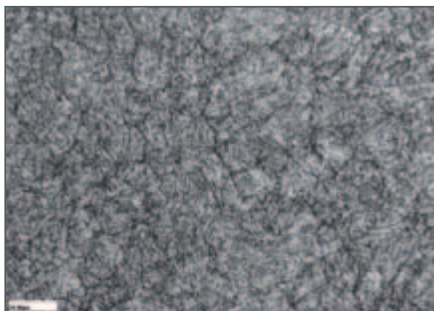
- Preheat the die slowly in a vacuum furnace to 750 °C (1382 °F). Continue heating to the austenitizing temperature of 1025-1030 °C (1875-1885 °F). Holding time after core temperature equalization: 20 to 40 min. Then quench with inert gas under pressure to 60 °C (140 °F). The quenching rate has to be as high as possible, to prevent distortion and cracking incidents linked to the shape and the massiveness of the die.

Tempering

Tempering has to be carried out immediately after quenching if possible.

- First temper at 550 °C (1025 °F). Hold 1 hour per 25 mm (1 inch) of thickness with a minimum of 3 hours
- Second temper between 550 °C (1025 °F) and 650 °C (1200 °F), according to the hardness desired. Hold 1 hour per 25 mm (1 inch) of thickness with a minimum of 3 hours.

Quenched and tempered structure



x 500



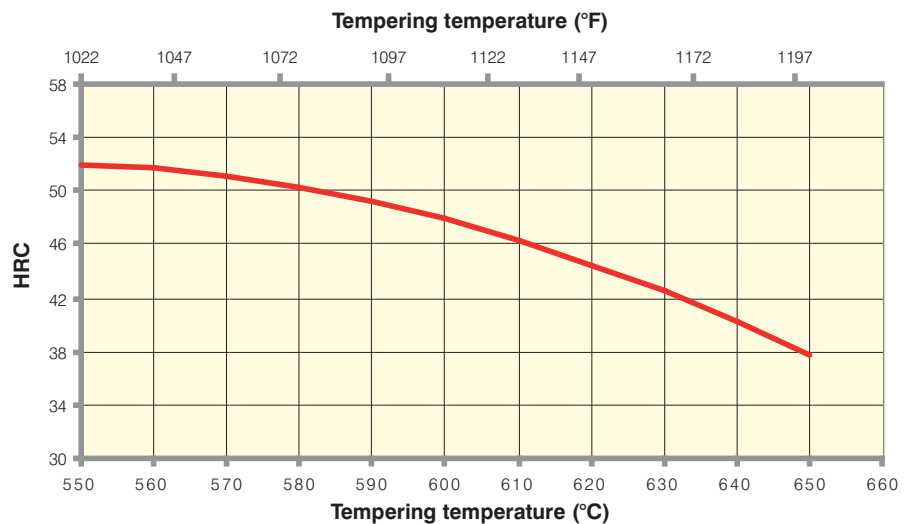
Tempering curves

Reminder:

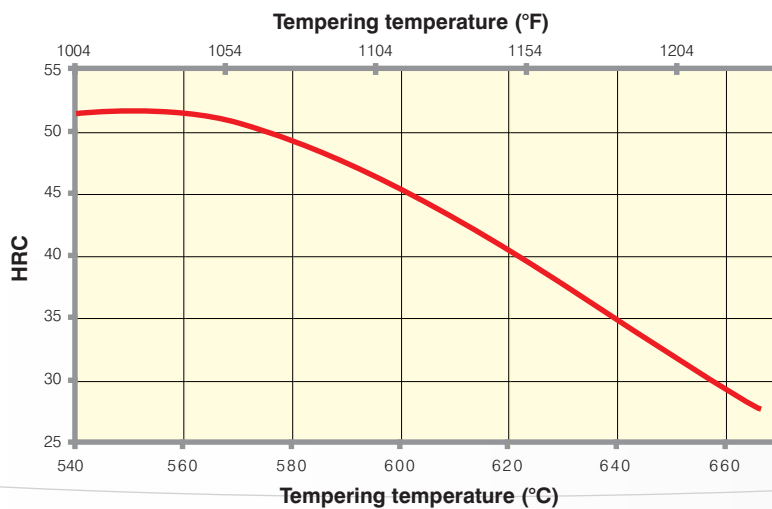
The heat treatment of the 5% Cr steels is complex. Holding time at temperature have a major effect on the hardness and have to be adjusted according to the desired properties for each part.

Note therefore that a bias can be measured between the die and the master curve obtained on a thin sample.

Tempering curve on a 10 mm square sample



Tempering curve on an equivalent sample of 400 mm





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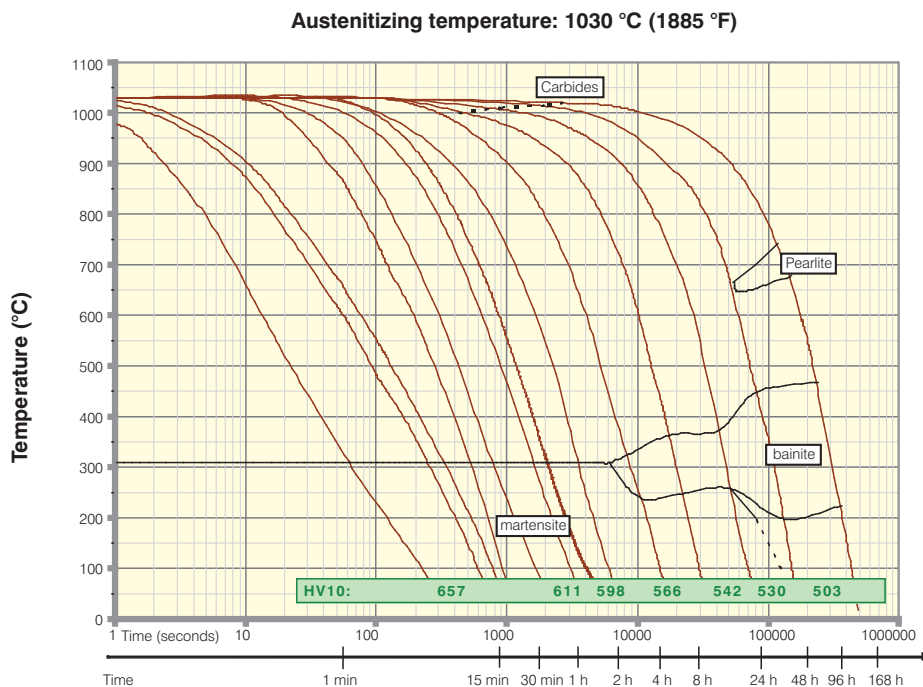
Annealing:

- This treatment is carried out at about 800-850 °C (1472-1562 °F) with a slow controlled cooling at a rate of 20 °C/h (35 °F/h) down to 600 °C (1112 °F), further cooling in air.

Stress relieving:

- Mill produced condition:
Heat die slowly to 650 °C-700 °C (1200-1300 °F). Holding about 6 hours. Allow the die to cool slowly down to room temperature.
- Heat treated condition:
Heat the die slowly to 50 °C (90 °F) below the last temper. Hold this temperature for 1 hour after temperature equalization.

CCT Curves





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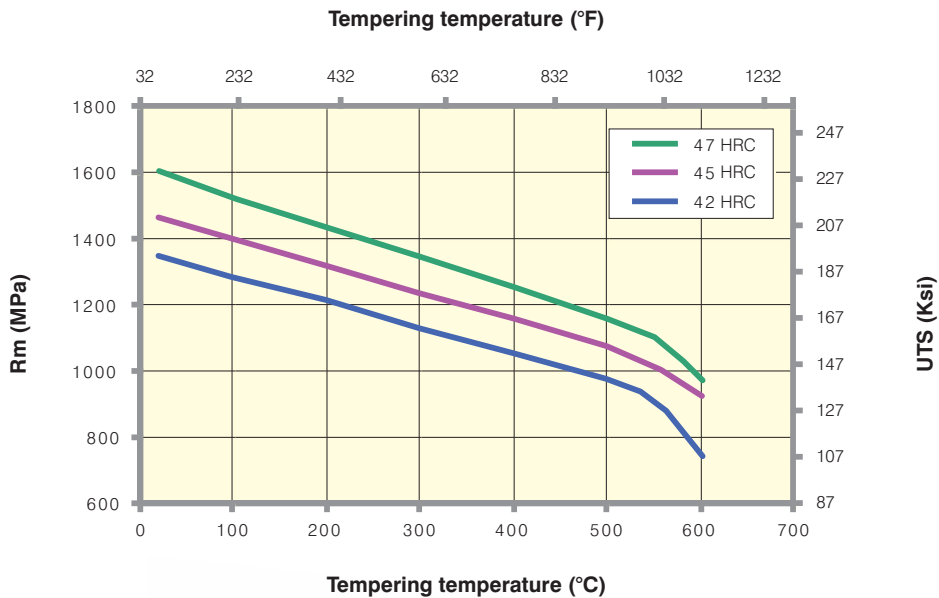
SURFACE TREATMENT

Nitriding is an acceptable surface treatment particularly suitable for **SDC™**. Gas, salt and ion processes are all acceptable. Nitriding produces a hard, abrasion resistant surface. This procedure is particularly effective for gates and risers where liquid metal could erode the die. In die casting the recommended depth is 0.10 mm (0.004 in.) maximum. Surface hardness is a minimum of 1000 HV.

MECHANICAL PROPERTIES

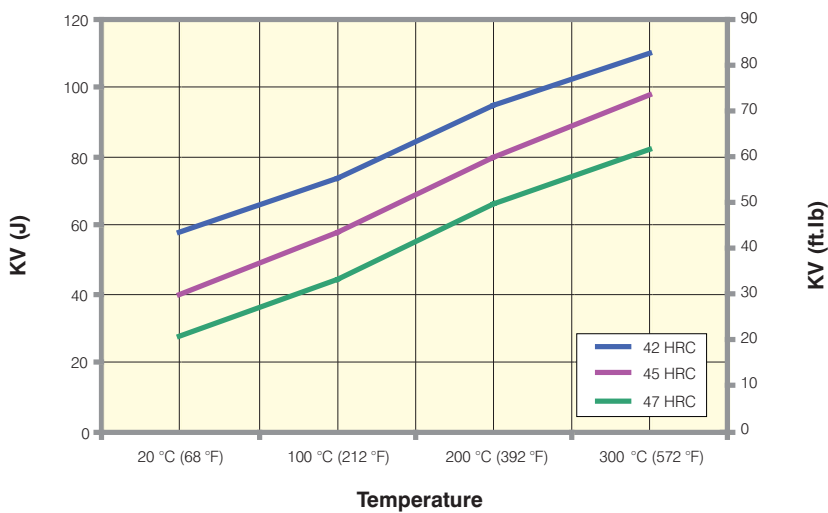
UTS as a function of the testing temperature.

Blocks austenitized at 1030 °C (1885 °F)/gas pressure quenched and double tempered.
 Dimensions: Ø 265 mm (10 ½ inch)

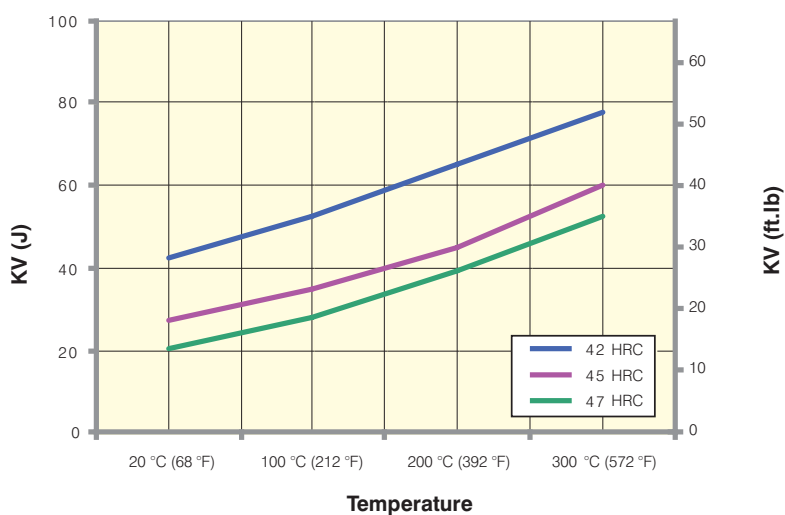


Impact properties (Charpy-V) versus hardness and testing temperature

Samples austenitized at 1030 °C (1885 °F) /oil quenched and double tempered.



Block austenitized at 1030 °C (1885 °F) /gas pressure quenched and double tempered.
Dimensions: 520 x 300 x 400 mm (20 ½ x 11 ¾ x 15 ¾ inch.).



All tests carried out on specimens removed from the core, in the short transversal direction.





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WELDING & REPAIRS

Quality welds and repairs of our **SDC™** require that the following precautions be observed. Avoid sharp radii by ensuring a smooth machine finish over the working die surface. Clean thoroughly and avoid moisture. It is best to maintain the entire die at a temperature above 250 °C (480 °F) uniform during the overall welding and/or repair processes.

Parent metal in the annealed condition:

Preheat the die to 250-300 °C (480-570 °F). Apply the prescribed weld rod of SR3S™, H11 or H13 electrode in straight stringer beads. Use the lowest amperage possible and do not weave. Be sure to maintain the temperature of the die while welding. Then allow the die to cool slowly to 60 °C (140 °F), maintaining a uniform cooling rate. Next to stress relieve, heat the die to 750 °C (1375 °F), hold at this temperature 1 hour per 25 mm (1 in.) of material thickness. Finally, cool the die slowly and uniformly down to room temperature.

Parent metal in the treated condition:

Grind away all heat checks or small cracks completely. Preheat the die to 250 °C (480 °F) and weld with Maraging or SR3S™ electrodes. In this last case preheat the die to 50 °C (90 °F) below the last temper.



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MACHINING

		Tool material	Cutting speed m/min. (ft/min.)	Feed mm/tooth (in/tooth)	Depth of cut mm (in.)
Milling	Roughing	P30/P40	50-100 (165-330)	Min. 0.2 (0.008)	Min. 2 (0.08)
	Finishing	P10/P20	80-140 (260-460)	Max. 0.2 (0.008)	Max. 2 (0.08)
		Tool material	Cutting speed m/min. (ft/min.)	Feed mm/rev (in/rev)	Depth of cut mm (in.)
Turning	Roughing	P30/P40	60-100 (200-330)	Min.1 (0.04)	Min.10 (0.4)
	Finishing	P10	130-200 (430-660)	Max. 0.3 (0.012)	Max. 2 (0.08)
Drilling	< Ø25 mm (1 in)	K15-K20	70 (230)	0.15 (0.006)	
	25 <Ø<50 mm (2 in)	P25	100 (330)	0.10 (0.004)	

For optimum machining parameters, please consult your machine tool manufacturer.

ELECTRICAL DISCHARGE MACHINING

When **SDC™** is subjected to EDM a harmful surface layer can be generated. This surface layer should be removed to a depth of 0.075 mm (0.003 inch) by honing, stoning, lapping and /or polishing. Failure to remove this layer could result in the presence of microcracks on die surface leading to premature heat checking and shorter die life. Subsequent to this mechanical removal, the die should be stress relieved at a temperature not to exceed 540 °C (1000 °F).



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Design and realization:

affinity   - Aubert & Duval® 02/2012

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