

DATA SHEET



**S O R E L
F O R G E**

SF-2000® PREMIUM PREHARDENED MOULD STEEL

TYPICAL APPLICATIONS

- Injection moulds of any size
- Compression moulds
- Dies for plastic extrusion
- Blow-moulding moulds
- Die-casting prototype insert dies for tin, lead and zinc alloys
- High strength holder/die shoe
- Structural components

GENERAL:

Delivery Condition:

Hardened and tempered
Hardness Range

	BHN	HRC	N/mm²
Regular	285-320	30-34	963-1082
High Hard	320-355	34-38	1082-1202

SF-2000® is a premium prehardened mould steel grade specially designed for through hardenability, ease of machining and simple post-production mould maintenance. It has good impact strength and good temper resistance. The well-balanced chemistry assures homogeneous hardness and minimal section hardness loss due to mass.

SF-2000® is forged on a 5000 ton press equipped with wide dies assuring maximum core deformation during forging process.

Typical Chemical Analysis - % weight

C	Mn	Si	Mo	Cr	Ni	Other
0.35	0.85	0.40	0.45	1.85	Added	Micro alloying

SF-2000® is forged using a special densifying process which assures optimum consolidation of centers.

SF-2000® is melted with a low sulphur content to enhance polishability.

SF-2000® is quenched in water. Best properties in steel are produced with the highest achievable quench severity.

SF-2000® is characterized by :

- Best machinability
- High polishability
- Excellent weldability
- Uniform hardness
- Good wear resistance
- Improved conductivity
- Superior texturing

SF-2000® is 100 % ultrasonic tested to very stringent acceptance levels. It is defect free.

SF-2000® high hardenability ensures hardness level to be maintained at the working surfaces, even on large moulds with deep impressions.

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MATERIAL CHARACTERISTICS

The benefits of through hardness are :

- Stable and continued machining can be performed with (C.N.C.) automatic machines.
- A defect free machined surface can be obtained.

Structure

After hardening and tempering, the structure of SF-2000® consists of tempered martensite and fine bainite.

The benefits of the through hardness combined with a uniform and stable micro-structure are :

- For mould design, consistent properties are assured.
- The machining distortion is minimized in the finished mould.
- A uniform luster can be obtained.

PROPERTIES SF-2000®

Cleanliness :

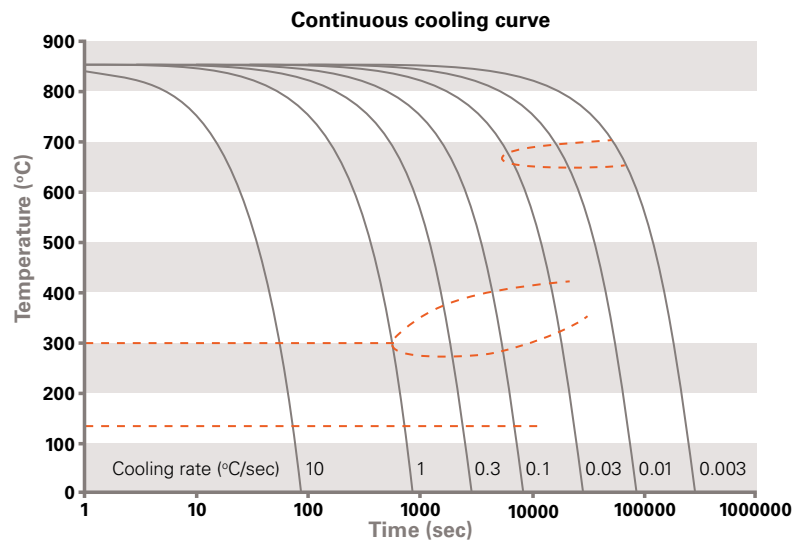
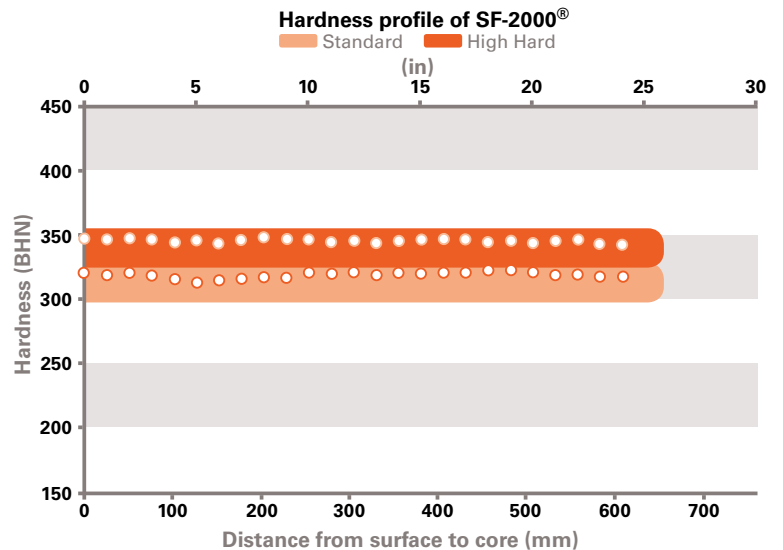
Method	A	B	C	D
ASTM E45	≤ 1.5	≤ 1.5	≤ 0.5	≤ 1.5
DIN 50602	K4 ≤ 20			

Physical Properties :

Thermal conductivity	Thermal expansion coefficient ($10^{-6} K^{-1}$)			Thermal capacity	Density
(W.m ⁻¹ .K ⁻¹)	25-100 °C	25-300 °C	25-400°C	(J.Kg ⁻¹ .K ⁻¹)	Kg/m ³
38	12.3	13.7	14.7	462	7.85

Mechanical Properties : Typical values for a 4" (101.6 mm) thick plate.

Hardness range	Hardness BHN (HRC)	Y.S. 0.2 MPa (KSI)	UTS MPa (KSI)	EI (%)	Impact@RT J (Ft-lb)	
					Long.	Trans.
285-320 BHN	311 (33)	827 (120)	979 (142)	> 15	111 (82)	108 (80)
320-355 BHN	331 (36)	924 (134)	1062 (154)	> 15	88 (65)	81 (60)



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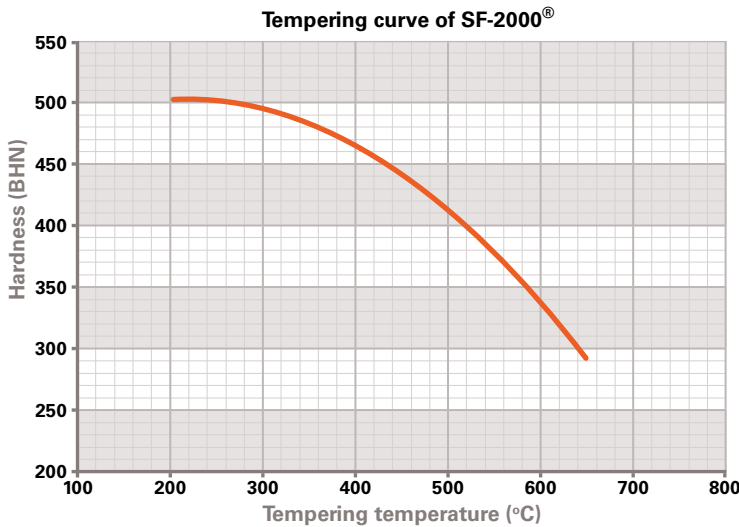
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HEAT TREATMENT

Attainable Hardness of SF-2000®

Quenched from 1650 °F (900 °C)
and Tempered 4 hours
(Size of section – 4" X 4" (101.6 mm X 101.6 mm))



Stress Relieving

Mould can be finish machined to their final dimensions. Heat finished die at a rate of one hour per inch (25.4 mm) of maximum thickness to 850 to 900 °F (454-482 °C) Hold at temperature for one hour per inch (25.4 mm) and air cool.

Tempering

Tempering treatments vary for different sizes and applications. The following instructions will provide through tempering:

Heat uniformly at the selected tempering temperatures and hold at temperature for one hour per inch (25.4 mm) of total thickness.

CARBURIZING

It is necessary to exercise caution during heating to the carburizing temperature. Heat slowly to 1200 °F (649 °C) as in stress relieving, soak for 1/2 hour per inch (25.4 mm), and resume heating to the carburizing temperature of 1600 °F (871 °C) for a sufficient time to produce the depth of case required.

Cool in the pack or chamber to 1450 - 1500 °F (788-816 °C) and quench to approximately 125 °F (52 °C) or until warm to the touch. Temper immediately to the desired hardness, hold at temperature one hour per inch (25.4 mm) or total thickness with a minimum holding time to two hours. (See table 1).

Note : Larger sections than those tested will show lower hardness values; smaller sections will show higher hardness values.

Table 1 : Attainable Hardness of Carburized SF-2000®

Gas Carburized - 1600 °F (871 °C)
Furnace Cooled to 1475 °F (802 °C)
Quenched and Tempered 4 + 4 hours
(Section size - 4" (101.6 mm) diameter bar)

Tempering Temperature		Case Hardness	Core Hardness
°C	°F	(HRC)	(HRC)
316	600	57-58	47-48
343	650	57-58	46-47
371	700	55-56	45-46
399	750	54-55	44-45
427	800	53-55	43-44
482	900	52-53	39-40

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FLAME HARDENING

SF-2000® lends itself to flame hardening of selective surfaces creating a surface hardness of up to 60-63 HRC varying in depth from skin hardness up to 3 mm (0.125").

EDM (ELECTRIC DISCHARGE MACHINING)

This method of machining is widely used on prehardened **SF-2000®**. However, precaution should be taken since this method of machining leaves a rehardened surface layer (white layer) on the steel. It is advisable to remove this layer.

HARD-CHROMIUM PLATING

After hard-chromium plating, the tool should be tempered for a minimum of four (4) hours at 350 °F (180 °C) in order to avoid hydrogen embrittlement. In case of replating, the tool should be tempered after it has been acid stripped.

TEXTURING

SF-2000® offers good response to texturing because of the great homogeneity of its structure.

SF-2000® is elaborated with minimum use of segregational elements.

Note: Provided technical data and information in this data sheet are typical values. Normal variations in chemistry, size and conditions of heat treatment may cause deviations from these values. We suggest that information be verified at time of enquiry or order. For additional data or metallurgical assistance, please contact us.

POLISHING

The following is an example of good hardpolishing procedure :

Preparation for diamond polishing

- Step 1 • Polish with 220 – grit silicon stone
- Step 2 • Polish with 320 – grit silicon stone
- Step 3 • Polish with 520 – grit silicon stone
- Step 4 • Polish with 800 – grit silicon stone
- Step 5 • Polish with diamond paste grade 15
- Step 6 • Polish with diamond paste grade 6
- Step 7 • Polish with diamond paste grade 3

When the demands for finish are particularly high, use grade 1. Be aware that the best result is obtained after a certain optimum polishing time. Over polishing is detrimental to the surface leading to so called orange-peel appearance and pitting.

SIZE SF-2000®

(As forged / approx.)

Max weight	25 000 kg	55 000 lbs
Max section	1.55 m ²	2400 sq in
Max width	2 130 mm	84"
Max thickness	1 245 mm	49"



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