Data Sheet

SOREL FORGE

PREHARDENED HOT WORK DIE STEEL

SF-DIE

■ GENERAL :

Delivery Condition:

Hardened and tempered

SF-DIE is a tough alloy steel of a balanced chromium, nickel and molybdenum composition with excellent high temperature physical properties.

SF-DIE is a quality tool steel of the hot work class specially designed for larger die sections.

SF-DIE is melted by electric arc furnace, ladle refined and vacuum degassed to ensure superior quality.

SF-DIE is made by the "densified method" a specialized forging technique whereby tool steel can withstand the shock loading characteristic of metal forming process. This process is designed to achieve more uniform isotropic physical properties, higher strength and freedom of internal discontinuities.

Typical Analysis (%)

C	Mn	Si	Cr	Ni	Mo	V
.55	85	.25	1.25	1.25	.45	.07

SF-DIE is usually forged with the grain flow parallel to the length dimension, but a block can be cross forged on die designer requests i.e. grain flow in width direction.

SF-DIE is characterized by :

- Excellent through hardening characteristics resulting in uniform surface/center hardness distribution, even in very large sections.
- A high level of toughness and ductility, particularly above 200°F (95°C), in transverse as well as longitudinal directions.

SF-DIE is 100% ultrasonic tested to very stringent acceptance levels.

TYPICAL APPLICATIONS :

- Hammer dies
- Press dies
- Sow blocks
- Hammer rams and guides
- Inserts
- Gripper dies
- Trim dies
- Wedge blocks

SPECIAL APPLICATIONS

SF-DIE performs well in other applications :

- Support toolings in aluminum extrusion.
- Die casting dies for tin, lead and zinc alloys.
- Tools for hot shearing.
- Special molds for plastics and other material forming.

TYPICAL HARDNESS RANGE

Because of this large adaptability, SF-DIE is available in three (3) temper ranges.

- **Recommended applications :**

Temper 1

For thin, light section forgings with corresponding shallow die impression.

Temper 2

For general production purposes. Ideal for forgings of medium weight and size and of various shapes.

Temper 3

For heavy forgings of complex shapes.

Temper	Hardness (BHN)	(Rc)
Class 1	388-429	42-46
Class 2	341-375	37-40
Class 3	302-331	32-36
Annealed	229 approx.	20 approx.

HEAT TREATMENT

SF-DIE is delivered in hardened and tempered conditions and requires no additional heat treatment. However, if a different hardness than that provided is required, the following instructions are recommended :

- **Soft Annealing**

1. Protect the steel, charge into a furnace at a temperature of 600°F (315°C) or lower, heat at a maximum rate of 200°F/hr (110°C/hr) to 1450°F (790°C).

2. Soak at 1440/1460°F (780-790°C) - 1/2 hour per inch (25.4 mm) of least dimensions or a maximum of six (6) hours.

3. Cool at about 20°F/hour (10°C/hour) to 800°F (430°C), followed by cooling freely in air. The annealing cycle should yield a hardness of approximately 229 BHN (20 Rc).

- **Hardening**

1. Protect the steel, charge into a furnace at a temperature of 600°F (315°C) or lower, heat at a maximum rate of 200°F/hr (110°C/hr) to 1550°F (845°C).
2. Soak at 1550/1600°F (840/870°C) - 1 hour per inch (25.4 mm) of least dimensions.
3. After soaking at 1550/1600°F (840/870°C), drop the temperature of the part to 1450°F (790°C) before oil quench. This drop in temperature will reduce quenching hazards such as breakage and warpage.
4. Withdraw from oil bath when the surface temperature of the part reaches approximately 500°F to 600°F (260-315°C) and immediately place in tempering furnace at 400°F (205°C).

- **Tempering**

1. Allow temperature of die to equalize at 400°F (205°C).
2. Heat the part uniformly to tempering temperature.
3. Soak at tempering temperature for one (1) hour per inch (25.4 mm) of least dimension.

Since part size, furnace and quenching media affect the final hardness, the below tempering temperatures are only a guide for specific hardnesses.

Tempering-Temperature (°F)	Hardness (BHN)	(Rc)
1040-1050	388	42
1080-1100	352	38
1130-1150	321	34
Normalized	269	28

cooling rate=60°F/hour (35°C/hr)

MATERIAL CHARACTERISTICS

- **Hardness**

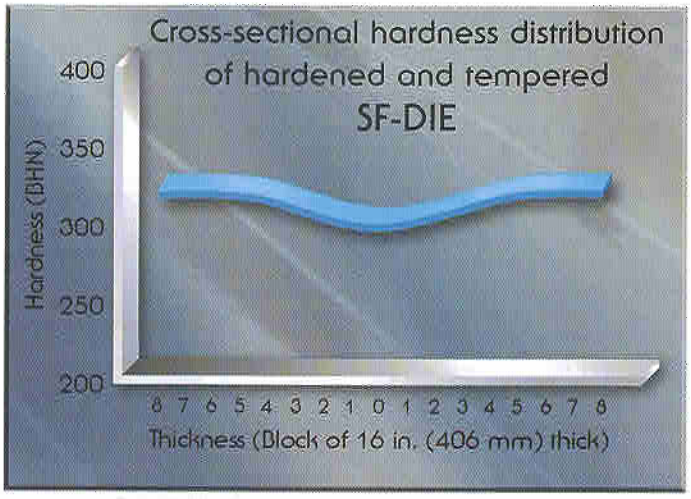
Hardness is one fundamental characteristic by which a material is selected.

A uniform hardness throughout the material is regarded as good.

The benefits of through hardness are :

Stable and continued machining can be performed with (C.N.C.) automatic machines.

A uniform machined surface free of plucking and other such defects can be obtained.



• Mechanical Properties

Mechanical properties are important indexes for die design.

Consistent strength and toughness throughout the material are regarded as good.

The benefit is :

Predictable strength : when designing deep-sinking dies, consistent strength assures that die center will offer sufficient strength.

Mechanical Properties * (Minimum Values)

Temper No.	Orientation	Room Temp. Tensile Values 0.2% YS (KSI)	UTS (KSI)	% Elong. 2.0"	% RA	Charpy V-Notch CVN ft-lb
1	Longi.	158	186	10	26	10
2	Longi.	144	169	12	32	13
	Transv.	140	165	12	33	10
3	Longi.	135	162	14	45	15
Norm.	Longi.	66	131	13	19	5

Results from test specimens taken at mid-thickness of a 16 X 44 X 142 inches (406 X 1118 X 3607 mm) block.

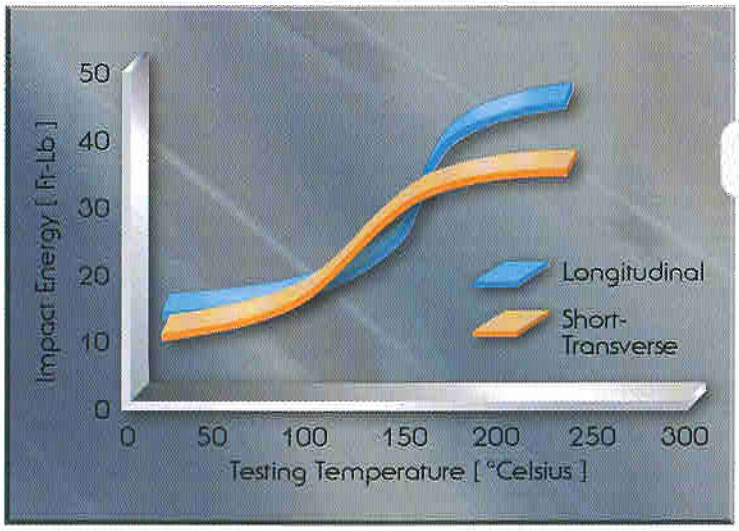
■ TOUGHNESS

High level of toughness and ductility.

The FATT (transition temperature) is between 255 and 300°F (125-150°C).

The benefit :

It does prevent cracking failure.



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