Data Sheet

SOREL FORGE

HOT WORK TOOL STEEL
SF-H 13

■ GENERAL:

AISI H-13

Delivery Condition:

Annealed to approx. 229 BHN (20 Rc)

SF-H 13 is the universal die casting steel for aluminum and magnesium die casting dies and die inserts. It is also suitable for metal extrusion dies and associated tooling.

SF-H 13 is a hot work steel suitable for tools requiring a higher degree of toughness at moderate elevated temperatures.

SF-H 13 is particularly suitable for all hot work operations on which drastic coolants are used. It is very resistant to heat checking when water cooled in operation.

SF-H 13 is melted by electric arc furnace, ladle refined and vacuum degassed to ensure superior quality.

Typical Analysis (%)

C	Mn	Si	Cr	Mo	V
.40	.35	1.05	5.25	1.35	1.05

Standard Specification: AISI H 13

SF-H 13 is made by the "densified method" specially designed to forge tool steel with more uniform physical properties in all directions, higher strength and greater freedom from internal discontinuities. Those characteristics combined with a minimum reduction ratio of 5 to 1 enhance the density of the steel and provide great homogeneity.

SF-H 13 steel characterized by excellent hot wear resistance and toughness.

SF-H 13 is available in standard incremental sizes in premachined condition.

SF-H 13 is 100% ultrasonic tested to very stringent acceptance levels.

SF-H 13 conforms to a maximum cleanliness rating of 2 in all categories as measured per ASTM E-45 method A. This level of microcleanliness provides excellent polishability and improved fatigue life as well.

TYPICAL APPLICATIONS :

- Pressure casting dies
- Extrusion tool for the processing of light metal
- Hot forging die inserts
- Molds for plastic injection, compression and transfer molds of intermediate hardness for which dimensional stability in heat treating is required
- Backers
- Dummy blocks
- Hot shear blades
- Ejector pins
- Bolsters
- Plungers, sleeves and slides

HEAT TREATMENT

Stress Relieving

• Annealed Material

Heat to 1100-1350°F (595-735°C), hold 1/2 hour per inch (25.4 mm) of maximum thickness (two hours minimum), cool in furnace until black then air cool.

• Hardened Material

Heat to a temperature 100°F (55°C) below the last tempering temperature, hold 1/2 hour per inch (25.4mm) of maximum thickness (two hours minimum), and air cool.

Hardening

Preheat to 1400-1500°F (760-815°C) and equalize.

Raise the temperature to 1800-1850°F (980-1010°C) depending on properties desired.

1800°F (980°C) - Best toughness for resistance to gross cracking

1850°F (1010°C) - Higher heat checking resistance, with some loss in impact strength

Air cool to below 150°F (65°C). Interrupt oil quenching may be required to develop optimum properties.

The selection of quenching method should be based on section size, properties required and control of distortion.

Straightening

Any necessary straightening is best done from the quench at any temperature down to about 250°F (120°C). The usual straightening temperatures are from 750 to 250°F (400 to 120°C).

Tempering

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

A. Heat uniformly and thoroughly at the selected tempering temperatures and hold at temperature for one hour per inch (per 25.4 mm) of total thickness (2 hours minimum)

B. Double tempering is required to produce optimum properties

C. Double tempering is accomplished by cooling to room temperature after the first tempering and then repeating the operation

Table 1: Attainable Hardness

Hardness results of a 4 inches (101.6 mm) cube heated to 1850°F (1010°C), air cooled and tempered at indicated temperatures for the times shown.

Tempering Time	Tempering Temperature (°F)	Tempering Temperature (°C)	Hardness (Rc)	Hardness (BHN)
	As hardened	As hardened	48 - 50	455 - 481
4 + 4 hours	1000	540	50 - 52	481 - 512
4 + 4 hours	1050	565	49 - 51	469 - 496
4 + 4 hours	1100	595	46 - 48	432 - 455
4 + 4 hours	1125	605	40 - 42	371 - 390
4 + 4 hours	1150	620	35 - 37	327 - 344

Note : Massive and complicated dies require accurate controls of steel temperatures and holding times.

Table 2 : Dimensional Changes

Results of a 1 X 2 X 6 inches (25.4 X 50.8 X 152.4 mm) test specimen.

Tempering Temperature (°F)	Tempering Temperature (°C)	Average Dimensional change (Percent)
As hardened		-0.005
900	480	-0.000
1000	540	+0.060
1100	595	+0.060
1200	650	+0.045

NITRIDING

Where a high wear resistant surface is needed to retard washing and soldering, gas nitriding is used. This treatment is done after all grinding and polishing have been completed.

Dies and die inserts should be given a gas nitriding treatment for 10 to 12 hours at 950°F (510°C). This treatment should result in a case of approx. .004 to .005 in. (.102 mm to .127 mm).

Cores, ejector pins, plungers, sleeves and slides may be treated for 40 to 50 hours at 950°F (510°C), which will result in a case of approximately .012 to .015 in. (.305 mm to .381 mm).

PHYSICAL PROPERTIES

Elastic Modulus (psi x 10^6)		30.0
Density (lb./in.^{3})	(7.76 Mg/M^3)	.280
Specific Heat		
68°F (BTU/lb)/(0° F)		0.110
20°C J/(kg.-K)		460.0
Thermal Conductivity (BTU ft.)/(hr.sq.ft. °F)		
68°F		14.2
390°F		14.5
750°F		15.1
1110°F		15.4
Thermal Conductivity (W/(M-K)		
20°C		24.6
200°C		25.1
400°C		26.1
600°C		26.6
Coefficient of Thermal Expansion (in./in./°F x 10^{-6})		
100- 800°F		6.88
100-1000°F		7.00
Coefficient of Thermal Expansion (mm/mm/°K)		
38-427°C		12.38
38-538°C		12.60

WELDING

The repair welding of tool steel always entails a risk of cracking, however if proper care is taken and heating instructions are followed, good results can be obtained.

Atomic hydrogen, oxy-acetylene, gas tungsten-arc and shielding metal-arc are processes commonly acceptable on tool steel.

Procedure:

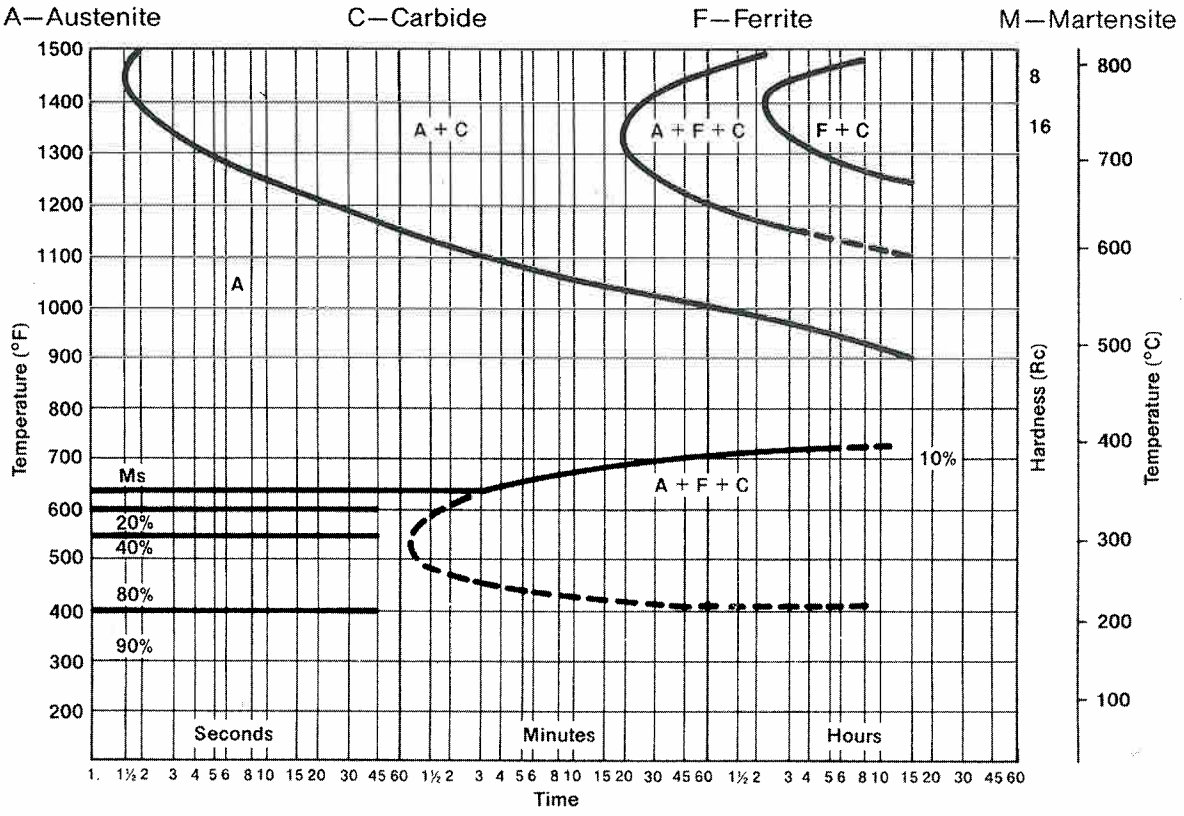
1. Preheat to 800-1000°F (430-535°C) (do not exceed the original tempering temperature)
2. Maintain above 700°F (370°C) during welding
3. Postheat of annealed dies:
   Reanneal or temper to 1400°F (760°C) for 6 hours

   Postheat of hardened dies:
   Cool in air to approx. 175°F (80°C)
   Temper at 50°F (28°C) below original tempering temperature or at 1000°F (535°C) minimum, one hour per inch (25.4 mm) of weld depth plus one additional hour.

   **We recommend to double temper.*

TTT Curve

Grade - SF-H 13



"The TTT curve shows the times required for the austenite of the steel to start and to complete transformation at each temperature, as well as the Rockwell C hardness values of the resulting transformation products. It summarizes the reactions, which may take place when the steel cools from above its Ae, critical temperature. It is useful in predicting the approximate structures and hardnesses to be obtained when the steel is cooled at different rates. It indicates necessary quenching speeds for hardening; and correct hot quenching procedures for austempering and martempering. The TTT curve also indicates holding times, temperatures, and suitable cooling rates for annealing. When using these curves for transformation annealing, (austenitizing temperature is the annealing temperature rather than the hardening temperature), the upper transformation curves are shifted slightly downward and to the left".

Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and conditions of heat treatment may cause deviations from the values. For additional data or metallurgical engineering assistance consult Brampton Service Center or directly at the mill, Sorel Forge inc.

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