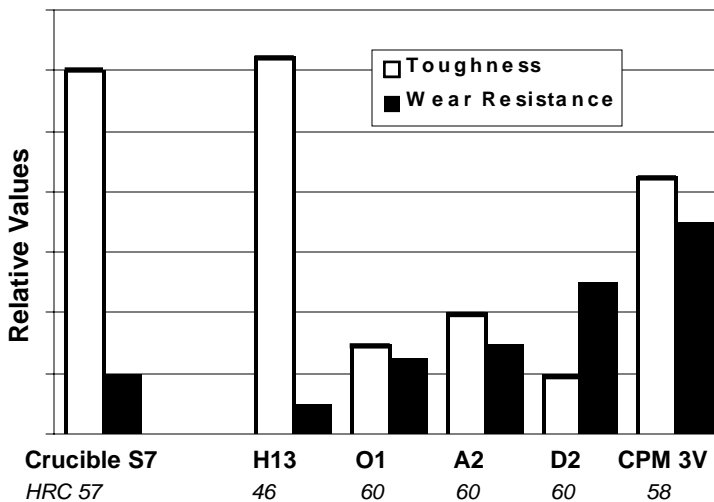


CRUCIBLE

Crucible S7 is a shock resisting tool steel with excellent toughness and high strength, along with low to medium wear resistance. It has been widely used for many years to make chisels and punches which undergo shock loading, and has found increasing use for small plastic molds. S7 is easy to machine in the annealed condition and can be readily heat treated. It is deep hardening and in many cases (except for large sections) it can be air quenched, exhibiting minimal distortion on hardening. Due to its relatively high attainable hardness (HRC 58/60) it offers high compressive strength (resistance to deformation) while retaining good toughness. Crucible S7 is a versatile tool steel for both cold and warm shock applications.

Tool Steel Comparagraph



Typical Applications

Punches
Blanking Dies
Forming Dies
Cold/Warm Heading Dies
Chisels
Shears

Plastic Molds
Hobbed Dies
Plastic Molds
Tablet Compression Dies
Zinc Die Casting Dies

Note: These are some typical applications. Your specific application should not be undertaken without independent study and evaluation for suitability.

Crucible...
The Tool Steel Pros®

DATA SHEET

Crucible S7 (AISI S7)

Issue #6

Carbon	0.55%
Manganese	0.70%
Silicon	0.35%
Chromium	3.25%
Molybdenum	1.40%
Vanadium	0.25%

Physical Properties

Elastic Modulus	30 X 10 ⁶ psi	(207 GPa)
Density	0.283 lbs./in ³	(7.83 g/cm ³)
Thermal Conductivity		
at 200° F (95° C)	BTU/hr-ft-°F 16.5	W/m-°K 28.5 cal/cm-s-°C 0.068
Coefficient of Thermal Expansion		
70-400° F (20-205° C)	in/in/°F 7.0 X 10 ⁻⁶	mm/mm/°C (12.6 X 10 ⁻⁶)
70-750° F (20-400° C)	7.3 X 10 ⁻⁶	(13.1 X 10 ⁻⁶)
70-1000° F (20-540° C)	7.6 X 10 ⁻⁶	(13.7 X 10 ⁻⁶)

Mechanical Properties

	Heat Treatment ⁽¹⁾ Austenitizing Temperature	HRC	Impact Toughness ⁽²⁾ ft.-lb. (J)	Wear Resistance ⁽³⁾ Adhesive
S7	1750°F (955°C)	57	125 (169)	1
H13	1850°F (1010°C)	45	175* (237*)	---
O1	1475°F (800°C)	60	30 (41)	---
A2	1750°F (955°C)	60	40 (53)	2-3
D2	1850°F (1010°C)	60	21 (28)	3-4
CPM 3V	1950°F (1065°C)	60	70 (95)	7

(1) Heat Treatment: Austenitized as indicated and tempered to hardness.

(2) Charpy C-Notch Impact Test

(3) Crossed cylinder adhesive wear test (higher number = better wear resistance)

*H13 Impact Toughness estimated from Charpy V-Notch data

Machinability

The machinability of Crucible S7 as annealed is about 75% of W1 tool steel.

Surface Treatments

Crucible S7 can be given standard surface treatments such as nitriding, chromium plating or nickel plating if desired. However, S7 is not usually nitrided because heat treatment prior to nitriding should include tempering at a temperature above the nitriding process temperature, and this typically results in lower than normal hardness.

The Crucible logo, Crucible, CPM, 3V, and The Tool Steel Pros are trademarks of Crucible Materials Corporation, Syracuse, NY.

Thermal Treatments

Critical Temperature: 1470°F (800°C)

Annealing: Heat to 1550°F (845°C), hold 2 hours, slow cool 50°F (30°C) per hour to 1000°F (540°C) then air cool. OR heat to 1550°F (845°C), hold 2 hrs., cool to 1400°F (760°C) hold 4 hrs. then air cool.

Annealed Hardness: About BHN187/220

Stress Relieving

Annealed Parts: Heat to 1200-1250°F (650-675°C), hold 2 hours, then cool in still air.

Hardened Parts: Heat to 25-50°F (15-30°C) below the original tempering temperature, hold 2 hours, then cool in still air.

Hardening

Preheat: Heat to 1350-1400°F (730-760°C), equalize.

Austenitize: 1725-1750°F (940-955°C), Hold time at temperature 30-45 minutes.

Quench: Air, positive pressure quench (2 bar minimum) or interrupted oil to below 150°F (65°C) Sections >3" may require interrupted oil quench. Oil quench to 1000-1100°F (540-595°C), then air cool to handwarm.

Temper: 400-1000°F (205-540°C).

Temper 2 hours minimum or at least 1 hour per inch (25mm) of thickness. Double Tempering is recommended. Cool to room temperature in between tempers.

Size Change: +0.001in/in (0.10%) when air cooled from 1725-1750°F (940-955°C) and tempered at 400°F (205°C).

Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values. For additional data or metallurgical engineering assistance, consult your local Crucible Service Center.

Service Center Locations

Location	Phone	Toll Free	FAX
Auburn, MA	508-832-5353	800-365-1101	508-832-2217
Charlotte, NC	704-372-3073	800-365-1160	704-342-0985
Chicago, IL	630-378-0093	800-365-1151	630-378-1965
Cincinnati, OH	513-771-1310	800-365-1163	513-771-0119
Cleveland, OH	330-562-3131	800-365-1132	330-562-7818
Columbus, OH	614-262-4959	800-365-1131	614-262-7850
Dallas, TX	817-649-2800	800-365-1168	817-633-8142
Detroit, MI	248-528-0332	800-365-1133	248-528-1977
Grand Rapids, MI	616-554-9699	800-365-1137	616-554-9328
Huntsville, AL	256-772-0201	800-365-1161	256-772-3361
Indianapolis, IN	317-638-4501	800-365-1146	317-634-7375
Los Angeles, CA	714-632-1131	800-365-1179	714-632-1181

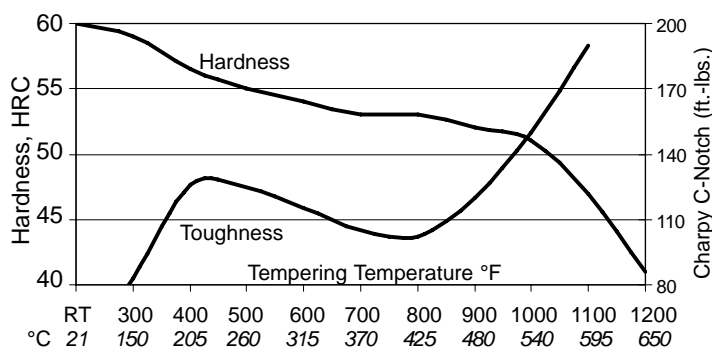
Heat Treat Response

Hardness and Impact Toughness Data

Austenitized 1725°F (940°C) Air Cool

Tempering Temperature	HRC	Charpy C-Notch Ft. lbs.	Charpy C-Notch Joules
As Air Quenched	59-61	46	62
400°F (205°C)	55-58	126	171
500°F (260°C)	54-56	125	169
600°F (315°C)	53-55	115	156
700°F (370°C)	52-54	105	142
800°F (420°C)	52-54	102	138
900°F (480°C)	51-53	120	163
1000°F (540°C)	50-52	150	203
1100°F (595°C)	46-48	190	257
1200°F (650°C)	40-42	—	—
1300°F (705°C)	33-35	—	—

Results may vary with hardening method and section size. Vacuum or atmosphere cooling may result in up to 1-2 HRC points lower.



Welding

Use S7 filler material. Alternatively, hot work tool steel filler or 4140 or 4150 filler may be used for small repairs or welds away from the working surface of the tool.

Annealed Material: Preheat 400-600°F (205-315°C), maintain the temperature of the workpiece above 400°F (205°C) during welding. After welding, reanneal or temper at 1400°F (760°C) for 6 hours.

Hardened Material: Preheat 25-50°F (15-30°C) below original tempering temperature or 350°F (175°C) minimum. Maintain the workpiece above 350°F (175°C) during welding. Cool to 150°F (65°C) after welding. Temper 25-50°F (15-30°C) below original tempering temperature.



A Division of Crucible Materials Corporation

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