EDRO #7™

color code: black

Shock Resistant S7 Tool Steel

EDRO #7™ is a chromium-molybdenum steel characterized by:

- High toughness
- Good wear resistance
- High impact resistance
- Good through hardening properties
- Good machinability
- Good dimensional stability during hardening

These benefits, coupled with the high wear resistance of EDRO #7™, offer the molder low-maintenance, long-life molds for the greatest overall molding economy.

EDRO #7™ is produced using the Electro-Slag-Refining (ESR) technique, resulting in an extremely fine and consistent micro-structure with superior cleanliness.

Applications

EDRO#7™ is suitable for plastic molding including injection, compression and transfer molds.

EDRO #7™ has a favorable combination of toughness and wear resistance for heavy duty blanking and forming tools. It is ideally suited for shear blades and cropping tools, both hot and cold. Other applications include rivet punches, chisels, cold heading dies and forging tools.

PROPERTIES

PHYSICAL DATA

Hardened and tempered to hardness HRC 57, Data at room and elevated temperatures.

Temperature	68˚F (20˚C)	390˚F (200˚C)	750˚F (400˚C)
Density lbs/in^3	0.282	0.280	0.278
kg/m^3	7800	7750	7700
Coefficient of thermal expansion			
/˚F from 68˚	—	6.7 x 10^{-6}	6.9 x 10^{-6}
/˚C from 20˚	—	12.2 x 10^{-6}	12.5 x 10^{-6}
Thermal conductivity			
Btu in/(ft^{2}h˚F)	202	207	215
W/m ˚C	28.9	30.0	31.0
Modulus of elasticity			
psi	29 x 10^{-6}	29 x 10^{-6}	26 x 10^{-6}
N/mm^2	197000	192000	177000
Specific heat			
Btu/lb˚F	0.11	—	—
J/kg ˚C	460	—	—

COMPRESSIVE STRENGTH

The figures are to be considered approximate.

Hardness HRC	Compressive strength			
	Rm		Rp0.2	
	psi 1000 x	N/mm^2	psi 1000 x	N/mm^2
58	385	1700	300	1300
55	355	1550	295	1250
50	295	1250	240	1100
45	250	1100	200	900

Heat Treatment - EDRO #7

Soft Annealing

Protect the steel and heat through to 1530˚F (830˚C). Then cool in the furnace at 20˚F (10˚C) per hour to 1000˚F (540˚C), then freely in air.

Stress-Relieving

After rough machining the tool should be heated through to 1200˚F (650˚C), holding time 2 hours. Cool slowly to 950˚F (500˚C), then freely in air.

Hardening

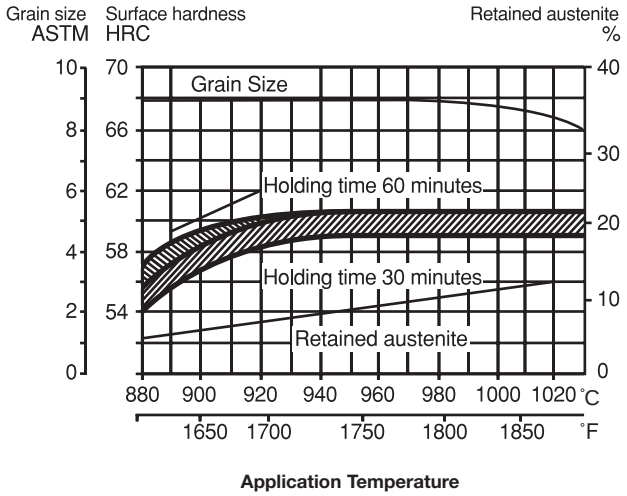
Pre-heating temperature: 1110˚F-1560˚F (600-850˚C).
Austenitizing temperature: 1690-1780˚F (920-970˚C) but usually 1725˚F (940˚C).

Quenching Media

- Forced air or gas
- Martempering bath 360-480˚F (180-250˚C), then cool in air.
- Circulating air or atmosphere
- Oil (large cross sections)

Temper the tool as soon as its temperature reaches 120-160˚F (50-70˚C).

Hardness, grain size and retained austenite as a function of the austenitizing temperature.



Temperature F˚	Temperature C˚	Soaking* time minutes	Hardness before tempering (HRC)
980	1800	40	52 ± 2
390	200	2	56 ± 2
570	300	2	57 ± 2

*Soaking time = time at hardening temperature after the tool is fully heated through.

Protection Against Decarburization

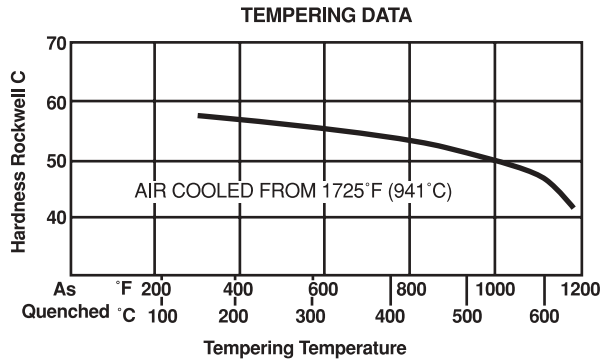
Protect the tool against decarburization and oxidation during the hardening process.

Typical analysis %	C	Si	Mn	Cr	Mo
	0.50	0.3	0.8	3.3	1.4
Standard spec.	AISI S 7				
Delivery condition	Soft annealed to approximately 200 HB				
Color code	Black				

Blanking and Shearing	Material thickness	Material hardness (HB) ≤ 180	Material hardness (HB) > 180
Tools for: Blanking, punching, cropping, shearing, trimming	up to 1/8" (3mm)	56-58	56-58
	1/8-1/4" (3-6 mm)	56-58	56-58
	1/4-13/32 (6-10 mm)	54-56	52-54
Shear blades - cold		56-58	
Shredding knives		56-58	
Shear blades - hot		56-58	
Circular shears		56-58	
Trimming tools for forgings		56-58	
Structural Applications		HRC	
Machine parts, rolls, grippers, mandrels, chisels, hammer, tools, slides, clutch parts, stripper plates		52-58	

Tempering

Choose the tempering temperature according the hardness required by reference to the tempering graph. Temper twice with intermediate cooling to room temperature. Lowest tempering temperature 360˚F (180˚C). Holding time at temperature minimum 2 hours.



This grade previously referred to as LESCO S-7 by Latrobe Steel Company.

Nitriding

Nitriding gives a hard surface which is very resistant to wear and erosion. A nitrided surface also increases the corrosion resistance. The surface hardness after nitriding at a temperature of 980˚F (525˚C) in ammonia gas will be approx. 1000 HV.

Nitriding Temperature ˚F	˚C	Nitriding time hours	Depth of case approx. in.	mm
945	525	20	0.010	0.25
945	525	30	0.012	0.30
945	525	60	0.014	0.35

Tufftriding

Tufftriding at 1068˚F (570˚C) will give a surface hardness of approx. 850 HV. After 2 hours treatment, the hard layer will be approx. 0.0004 in., (0.01 mm.)

Dimensional changes

During hardening
Sample plate, 4”x4”x1”, (100x100x25 mm)

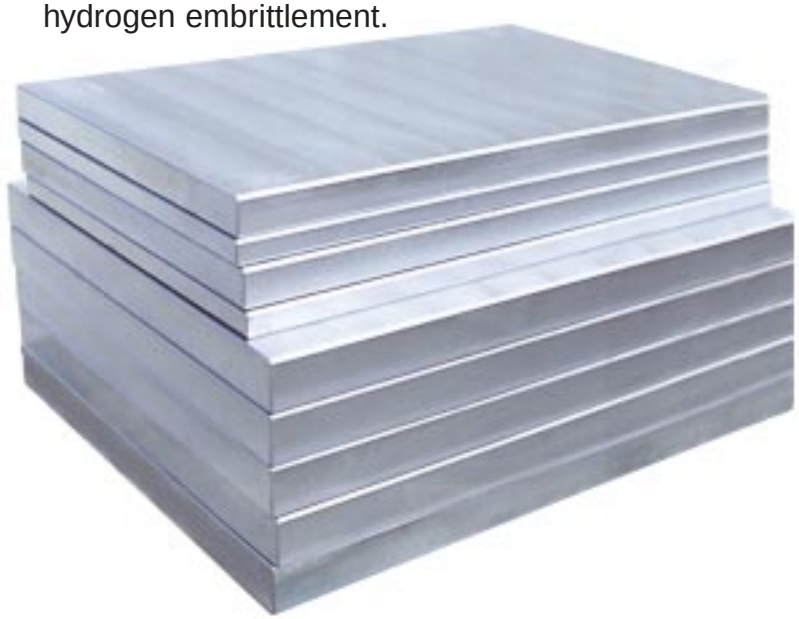
Hardening from 1020˚C (1870˚F)		Width %	Length %	Thickness %
Oil hardened	min.	±0.02	+0.02	+0.04
	max.	-0.05	-0.03	
Martempered	min.	+0.02	±0	-0.04
	max.	-0.03	+0.03	
Air hardened	min.	-0.02	±0	±0
	max.	+0.02	-0.03	
Vacuum hardened	min.	+0.01	±0	-0.04
	max.	-0.02	+0.01	

Machining

Turning	Turning with carbide tools		
	Rough turning	Medium turning	Finish turning
Depth of cut (t) in.	min. 0.4	0.08-0.4	max. 0.08
mm	min. 10	2-10	max 2
Feed (s) in/tooth	min. 0.04	0.12-0.04	max. 0.012
mm/tooth	min. 1	0.3-1	max. 0.3
ISO machining group	P30-P40	P20-P30	P10
Cutting speed (v) f.p.m.	165-285	230-360	325-525
m/min.	50-90	70-110	100-160

Hard-chromium-plating

After hard-chromium-plating, the tool should be tempered for approx. 4 hours at 350˚F (180˚C) in order to avoid hydrogen embrittlement.



Electrical-discharge Machining

(EDM, “spark machiniong”)

If spark-erosion is performed in the hardened and tempered condition, the tool should be stress relieved at 50-75˚F (27-42˚C) below the previous tempering temperature after the EDM process is complete.

Grinding

Correct grinding technique will avoid grinding cracks and improve tool life. Tools that have been tempered at low temperatures are especially sensitive during grinding.

Only properly dressed, soft, open-grained grinding wheels should be used. Restrict the peripheral speed and use plenty of coolant.

More detailed instructions can be obtained from the grinding wheel manufacturer.

Welding

Welding of tool steel should generally be avoided, due to the risk of cracking. Where repair welding is necessary it is essential to pre-heat the part prior to welding. Immediately after the welding operation:

1. Stress-relieve material that has been welded in the soft annealed state.
2. Temper material twice that has been welded in the hardened and tempered condition.

Polishing

EDRO #7™ has good polishability in the hardened and tempered condition. After grinding, polish with aluminum oxide or diamond paste.

1. Grind to 0.002 in. (0.05 mm) from finished size.
2. Polish with diamond paste grade 45, to obtain a dull, even surface.
3. Polish with diamond paste grade 15.
4. Polish with a diamond paste grade 3, or grade 1 for particularly high demands on surface finish.

Note: Each steel grade has an optimum polishing time which largely depends on hardness and polishing technique. Over-polishing can lead to a poor surface finish (e.g. and “orange peel” effect).

EDRO #7™

Edro will be pleased to provide additional information on our full line of quality mold steels, machining capabilities, and special mold bases.

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