

## AISI 41X40

### 41X40: A prehardened mold steel (311-345 HB / 33-37 HRC) with improved machinability

**41X40** is a chromium-manganese-molybdenum grade designed for plastic mold industry.

This grade is normally delivered in a prehardened condition at a hardness level of 33/37HRC.

The grade has a fully homogeneous martensite-bainite microstructure. **41X40** grade has specific sulfur addition (0.060% typical) in order to increase strongly its machinability.

Compared to AISI P20 grade, 30% increase in milling speed and 300% increase in drilling speed can be expected. At constant cutting speed, tool life is multiplied a least by 5 when replacing P20 by **41X40** grade.

**41X40** is not suitable for polishing requirements.

This grade is typically used for:

- > plastic injection molds for thermoplastics
- > extrusion dies for thermoplastics
- > compression molds

## PROPERTIES

### CHEMICAL ANALYSIS -% WEIGHT

Typical values

C	S	P max	Si	Mn	Cr	Mo
0.4	0.060	0.012	0.3	1.5	1.9	0.2

### MECHANICAL PROPERTIES

Typical values for plates air quenched and tempered (thickness 45 mm - 1.8").

	Hardness	YS 0.2		UTS		Elongation	Reduction of area	Elastic modulus	
	HB	MPa	KSI	MPa	KSI	%	Z%	GPa	KSI
Longitudinal direction	320	920	133	1075	156	9	40	205	29745
Transverse direction	320	900	131	1060	154	8	35	205	29745

### PHYSICAL PROPERTIES

Thermal conductivity $W m^{-1} K^{-1}$	Thermal expansion coefficient $10^{-6} C^{-1} / 10^{-6} K^{-1}$			
20°C 68°F	20-100°C 68-212°F	20-200°C 68-392°F	20-300°C 68-572°F	20-400°C 68-752°F
34	11.5	11.57	12.47	12.81

PROPERTIES

**METALLURGICAL PROPERTIES**

41X40 has an excellent hardenability resulting in good uniformity of hardness and microstructure.

**Internal soundness:**

All plates are ultrasonically tested according to NFA 04305 Class C.

**Grain size:**

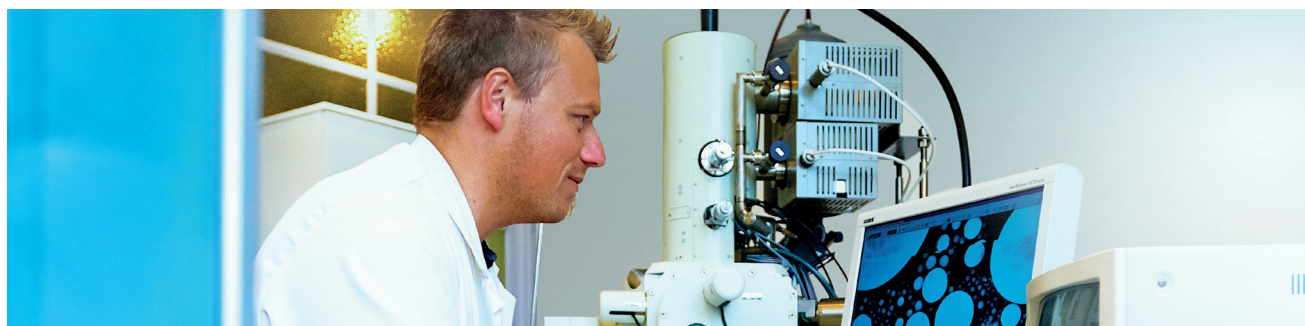
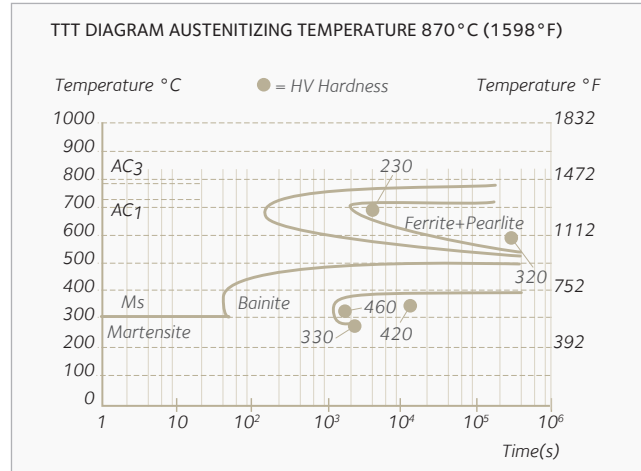
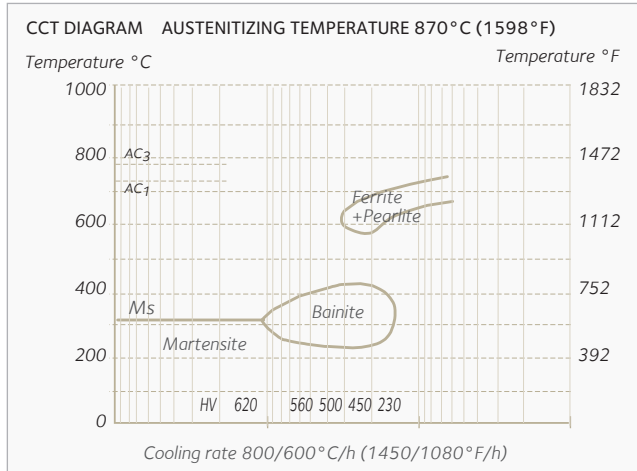
Uniform 7/8 grain size according to ASTM E112.

**Metallurgical transformation points**

AC <sub>1</sub>	AC <sub>3</sub>	M <sub>s</sub>	V <sub>1</sub>	V <sub>2</sub>
733°C 1351°F	780°C 1436°F	320°C 608°F	1000°C/h 1800°F/h	300°C/h 540°F/h

Heating conditions:

150°C/h up to 875°C, holding time 10 minutes,  
270°F/h up to 1607°F, holding time 10 minutes.



DELIVERY CONDITIONS

**DIMENSIONAL PROGRAM**

Thickness	Width
20 - 120 mm (.79" - 4.7")	1500 - 2500 mm (59 - 98.4")
120 - 600 mm (4.7" - 23.6")	1500 - 2100 mm (49" - 82.7")

## HEAT TREATMENT

For specific applications where mechanical properties higher than 34 HRC are required, hardening can be performed in the following way:

- > heating (about 850 °C - 1562 °F) with a sufficient holding time (1 hour/inch)
- > water, oil or air quenching depending on thickness (see C.C.T diagram)
- > the tempering temperature controls the mechanical characteristics (see tempering curve)

The following instructions must be followed to obtain an efficient tempering:

- > Uniform heating at the selected tempering temperature (see tempering curve)
- > Holding time of one hour per inch of total thickness
- > Double tempering with complete cooling to room temperature for each treatment

## MACHINING

41X40 grade performs very well in drilling and in milling using high speed steel or carbide tools. The machinability of 41X40 is increased (compared to AISI P20) by a controlled sulfur addition which gives:

- > 500% increase in milling tool life (at constant cutting speed)
- > 300% increase in drilling speed
- > 30% increase in milling speed

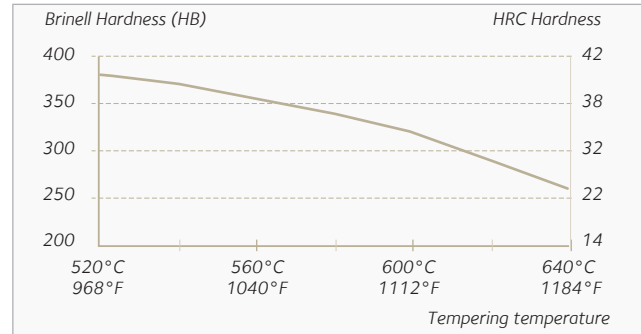
Cutting conditions (cutting speed, feed rate...) depend on the tool, but those of P20 could be applied taking into account:

- > 30% increase in milling speed with carbide inserts
- > 300% increase in drilling speed with high speed steel tools

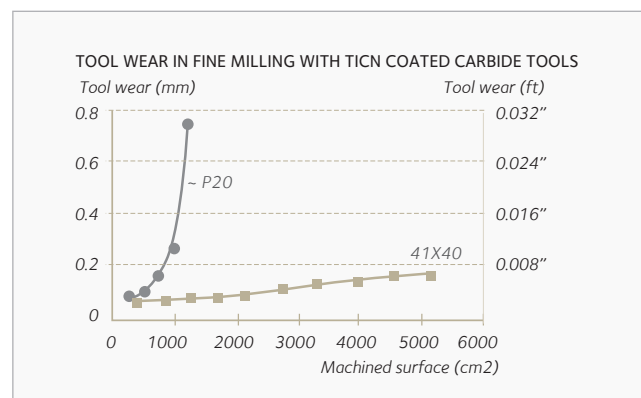
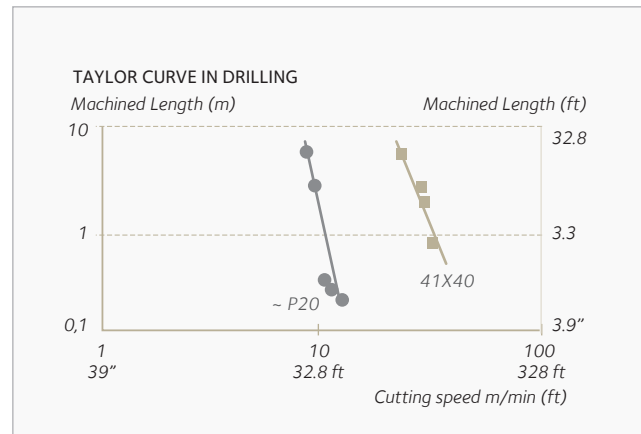
## Tempering curve

Test conditions:

- > austenitization 870 °C (1598 °F)
- > tempering/holding time 1h
- > air cooling



Note that complicated shapes require accurate control of steel temperature uniformity and sufficient holding times to limit stresses and prevent cracking.

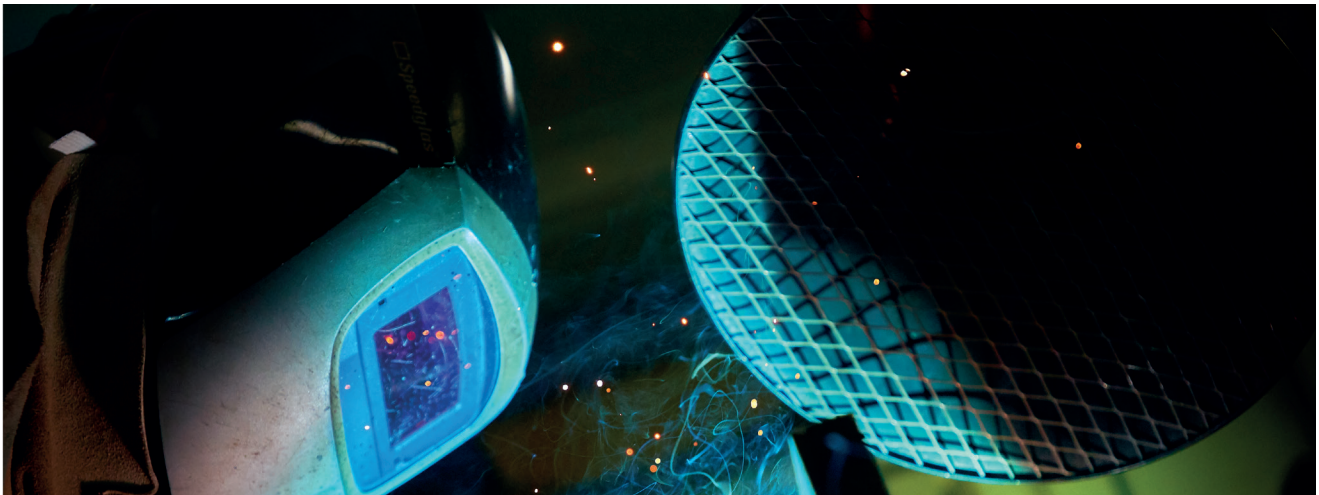


## POLISHING

41X40 can be roughly polished in the quenched and tempered condition. After grinding, polishing will be made with aluminium oxide or diamond paste.

## WELDING

Welding of 41X40 requires exceptional care due to the high sulfur level. High pre/post-heating temperature should be used (350°C – 660°F) to avoid cold cracking.



## YOUR CONTACTS

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*Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.*