



BICO STEEL

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 at least by 5 when replacing P20 by 41x40 grade
- 41x40 is not suitable for polishing requirements

Chemical Analysis - % Weight

C	S	P max	Si	Mn	Cr	Mo
.4	.060	.012	.3	1.5	1.9	.2

Typical values

Mechanical Properties

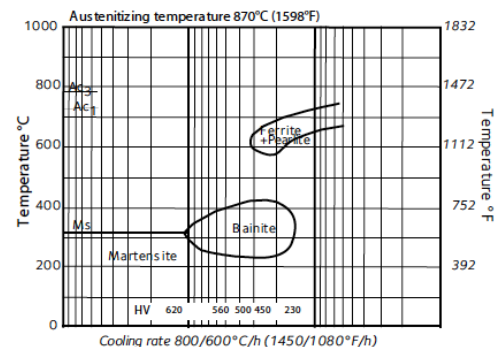
	Hardness		YS 0.2		UTS		EI	Reduction of area	Elastic modulus	
	HB	MPa	KSI	MPa	KSI	%			Z%	GPa
Longitudinal direction	320	920	133	1075	156	9	40	205	29745	
Transverse direction	320	900	131	1060	154	8	35	205	29745	

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

Physical Properties

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

CCT Diagram



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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

AC1 °C (°F)	AC3 °C (°F)	M _s °C (°F)	V1 °C/h (°F/h)	V2 °C/h (°F/h)
733 (1351)	780 (1436)	320 (608)	1000 (1800)	300 (540)

Heating conditions :

150°C/h up to 875°C, holding time 10 minutes

270°F/h up to 1607°F, holding time 10 minutes

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

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

Polishing

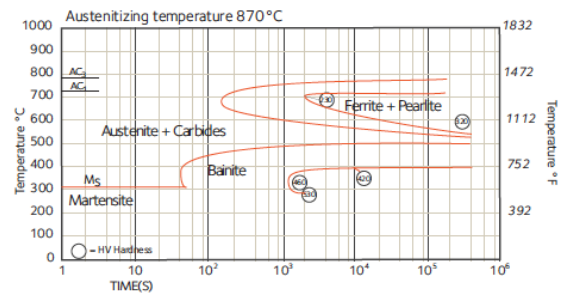
41x40 can be roughly polished in the quenched and tempered condition. After grinding, polishing will be made with aluminium oxide or diamond paste.

A typical polishing sequence could be:

Grinding » Emery polishing paper or stones
120 » 240 » 320

NOTE: Finishes over 320 are not recommended for 41x40

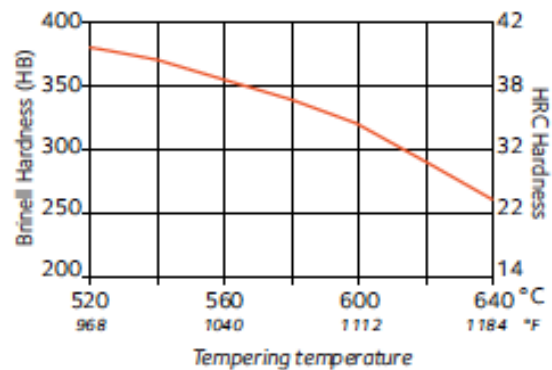
TTT Diagram



Tempering Curve

Test conditions :

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



NOTE: Complicated shapes require accurate control of steel temperature uniformity and sufficient holding times to limit stresses and prevent cracking.

Welding

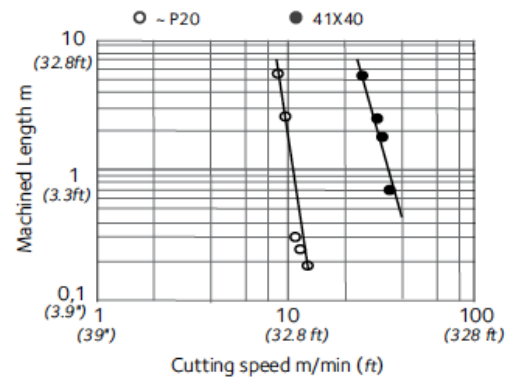
Welding of 41x40 requires exceptional care due to the high sulfur level. High pre postheating temperature should be used (350°C - 660°F) to avoid cold cracking.

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:

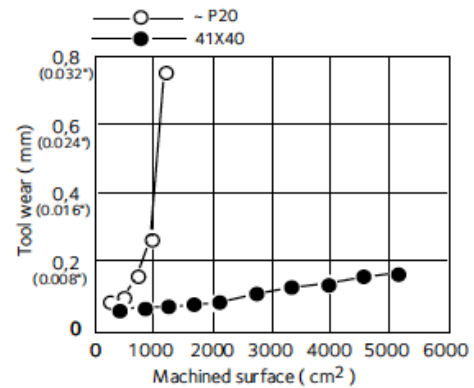
- 500% increase in milling tool life (at constant cutting speed)
- 300% increase in drilling speed
- 30% increase in milling speed



NOTE: Taylor curve in drilling

Dimensional Programme

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")



NOTE: Tool wear in fine milling with TiCN coated carbide tools

Applications

Typical applications for 41x40 grade are:

- Plastic injection molds for thermoplastics
- Extrusion dies for thermoplastics
- Compression molds

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

NOTE: 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 program 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.