



BICO STEEL

4140 Pre Hard

2312
(311-345 HB / 33-37 HRC)
with improved machinability

- 4140PH is a chromium-manganese-molybdenum grade
- This grade is delivered in a prehardened condition at a hardness level of 33/37HRC
- The grade has a fully homogeneous martensite-bainite microstructure
- 4140PH grade has specific sulfur addition (0.060% typical) in order to increase strongly its machinability

Chemical Analysis - % Weight

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

Typical values

Mechanical Properties

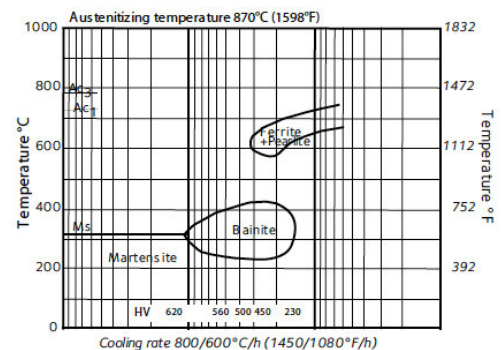
	Hardness		YS 0.2		UTS		EI	Reduction of area	Elastic modulus	
	HB	MPa	KSI	MPa	KSI	%			Z%	GPa
Longitudinal direction	320	920	133	1075	156	9	40	205	29745	
Transverse direction	320	900	131	1060	154	8	35	205	29745	

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



Metallurgical Properties

- 4140PH 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

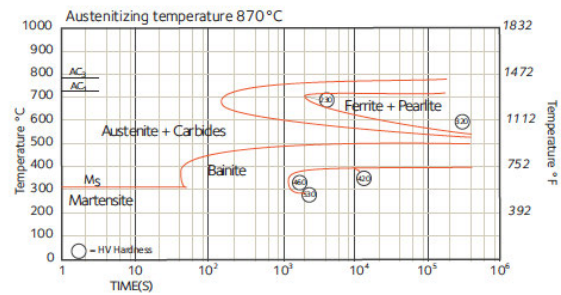
The following instructions must be followed to obtain an efficient tempering:

- 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

Welding

Welding of 4140PH requires exceptional care due to the high sulfur level. High pre postheating temperature should be used (350°C - 660°F) to avoid cold cracking.

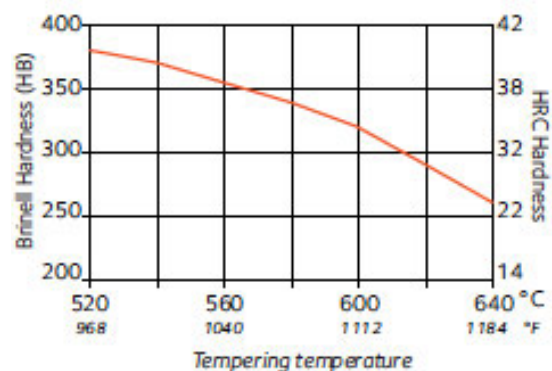
TTT Diagram



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.

Machining

4140PH grade performs very well in drilling and in milling using high speed steel or carbide tools.

The machinability of 4140PH is increased 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

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: 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.