

# DATA SHEET

## DS92X™ GUN

### BARREL STEEL



## Product Information

Damasteel's hardenable gun barrel steel is a RSP (Rapid Solidification Powder) based steel with AISI 4140/4340 as the constituent alloys. The steel is developed and tested specifically for hunting firearm applications. This steel has gone through a torsion twisting operation to turn the grain structure towards the transverse direction. The results are improved ductility and fatigue properties compared to non-torsional variations of the steel. Damasteel's hardenable barrel Damascus patterned steel should be your first choice when it comes to rifle material.

## Distinctive Feature

- High ductility and fatigue properties
- High purity and cleanliness
- Ease of machining

## Mechanical and physical properties

Grade	C	Si	Mn	Cr	Mo	Ni	S	P
4140	0,40	0,20	0,85	1	0,20		0,040	0,035
4340	0,40	0,20	0,70	1	0,20	2	0,040	0,035

Table 1. Nominal chemical compositions in wt-% of the constituent alloys

Yield strength, Rp 0,2	440	MPa	Young's modulus	210	GPa
Tensile strength, Rm	690	MPa	Poisson's ratio	0,3	-
Elongation, A5	22	%	Thermal conductivity	43	W/m·K
Hardness	210	HV	Heat capacity	473	J/kg·K
Density	7,85	kg/dm <sup>3</sup>	Linear thermal expansion coefficient, $\alpha$	12	$\mu\text{m}/\text{m}\cdot\text{K}$

Table 2. Mechanical and physical properties of Damasteel DS92X™ in annealed condition at 20°C.

## Hot working

Hot working temperature 800-1180 °C (1700-2200 F).

## Cold Working

## Welding

Damasteel's barrel steel can be welded using all conventional techniques. However, the mechanical properties of this steel will be affected if it is welded in the heat-treated condition, and post weld heat treatment should be performed.

## Machining

The recommendation is to have the material relaxation annealed before any cold working operations or machining. The machinability is excellent in annealed condition. Suggestions on parameters for machining in table 3.

### Machining data

Hardness		300 HB		400 HB	
Type		Speed m/min (ft/min)	Feed mm/rev (in/rev)	Speed m/min (ft/min)	Feed mm/rev (in/rev)
Drilling, HSS-drill 6 mm		14 (45)	0,10 (0,004)	8 (25)	0,08 (0,003)
Drilling, HSS-drill 18 mm		14 (45)	0,20 (0,008)	8 (25)	0,15 (0,006)
Gun drilling, carbide Ø 6 mm		120 (385)	0,03 (0,001)	40 (125)	0,004 (0,0002)
Ejection, STS-drilling Ø 19 mm		70 (229)	0,16 (0,006)	40 (131)	0,12 (0,005)
Reaming		Mm/tooth (in/tooth)		Mm/tooth (in/tooth)	
HSS		8 (26)	0,13 (0,005)	5 (16)	0,13 (0,005)
Carbide		18 (60)	0,20 (0,008)	40 (131)	0,20 (0,008)
Turning	Depth of cut	m/min (ft/min)	mm/rev (in/rev)	m/min (ft/min)	mm/rev (in/rev)
Coated carbide	1 mm (0,04 in)	150 (500)	0,30 (0,01)	120 (400)	0,30 (0,01)
	4 mm (0,16 in)	120 (400)	0,60 (0,025)	85 (279)	0,60 (0,025)
	8 mm (0,32 in)	90 (300)	0,50 (0,020)	65 (213)	0,50 (0,020)
Face milling	Depth of cut	m/min (ft/min)	mm/tooth (in/tooth)	m/min (ft/min)	mm/tooth (in/tooth)
Coated carbide	1 mm (0,04 in)	220 (725)	0,18 (0,007)	150 (485)	0,15 (0,006)
	4 mm (0,16 in)	150 (485)	0,15 (0,006)	105 (345)	0,10 (0,004)
	8 mm (0,32 in)	115 (375)	0,10 (0,004)	81 (265)	0,08 (0,003)
Grinding	Wheel identity	Wheel speed m/s (ft/min)	Work speed m/min (ft/min)	Infeed mm (in)	
Surface grinding		A46HV	30 (6000)	20 (70)	0,05 (0,002)
Surface finishing		A46HV	30 (6000)	20 (70)	0,013 (0,0005)
Cylindrical grinding		A60IV	30 (6000)	20 (70)	0,05 (0,002)
Cylindrical finishing		A60IV	30 (6000)	20 (70)	0,013 (0,0005)
Internal grinding		A60JV	30 (6000)	30 (105)	0,013 (0,0005)
Internal finishing		A60JV	30 (6000)	30 (105)	0,005 (0,0002)

Table 3. Machining data for DS92X™

## Heat treatment

Annealing at 650 °C (1200 F) for 4 hours. Achieved hardness around 28 HRC.

Normalizing at 870 °C (1600 F), air cooling.

All material supplied from Damasteel is delivered in annealed condition.

## Hardening

Austenitizing: 845 °C (1555 F) for 30 min, quench in oil.

Quenching: Oil.

Tempering: Recommended range is between 170 – 700°C (340 – 1300 F) for 3 hours. Higher tempering temperature gives better fatigue and ductility properties but lower hardness. See diagram 1. Table 4 shows some examples of hardness and tensile strength for different tempering temperatures.

	Brinell Hardness	Approx. tensile	Hardening	Tempering	Area contraction
I	300	1000 (66 tsi)	845 °C / 1555 F	625 °C / 1157 F	54
II	400	1350 (87 tsi)	845 °C / 1555 F	450 °C / 842 F	50
III	500	1800 (112 tsi)	845 °C / 1555 F	250 °C / 482 F	46

Table 4. Hardening and tempering suggestions for a Ø 25 mm bar with corresponding hardness.

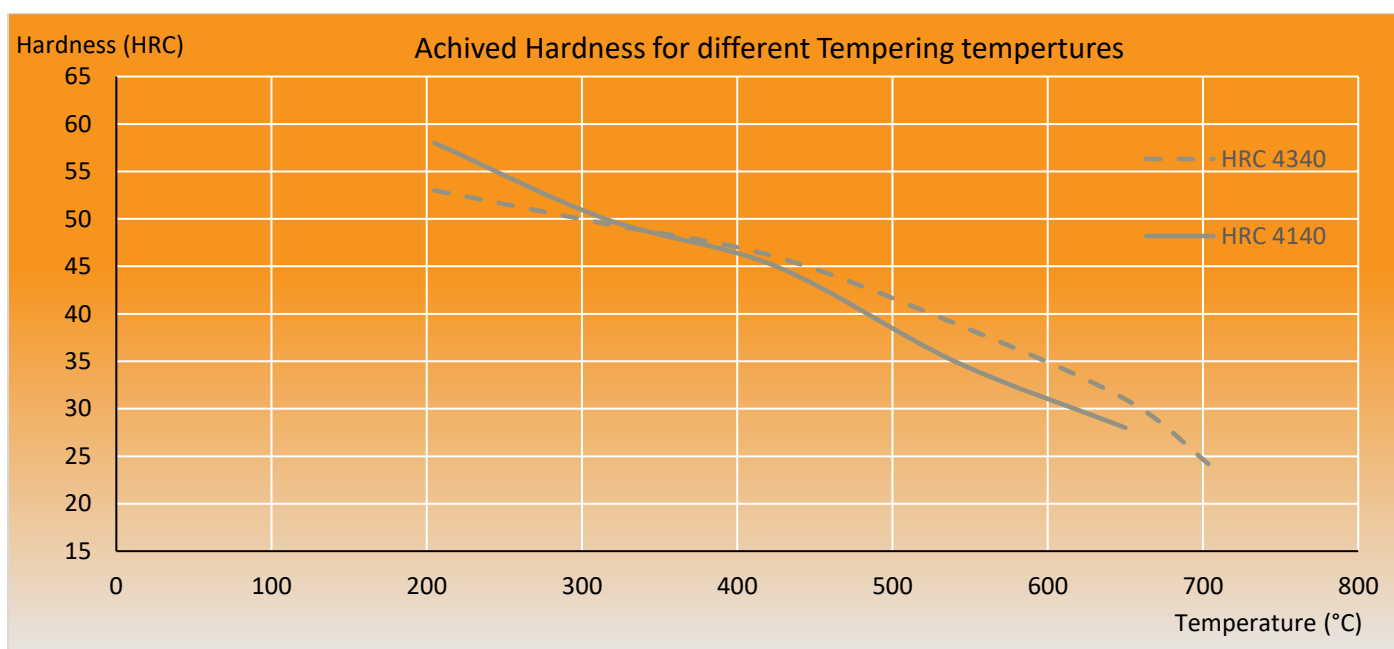


Diagram 1. Hardness for different tempering temperatures.

## Etching

Etching is done to reveal the pattern on the finished piece. The work piece is preferably dipped into the etching acid. Before etching, close the bore with a rubber cork in the dipped end. The best conditions for etching are good, polished surfaces which are carefully degreased. Etching before browning improves the pattern and makes it more distinct.

	Etching Solution	Chem. comp.	Blend (%)	Time (min)	Temperature °C/°F	Color 4340	Color 4140
I	Hydrochloric acid 37 %	HCl	100	5	45/ 110	Bright	Grey
II	Sulfuric acid 30 %	H <sub>2</sub> SO <sub>4</sub>	100	20	40/ 104	Bright	Grey

Table 5. Etching suggestions with corresponding colors and relief of the different alloys

Etching procedure:

1. Grind the piece progressively up to desired grit, 600 or higher. Finish off with polishing if desired.
2. Degrease the piece carefully and finish off using glass cleaner.
3. Mix the etching acid in the recommended ratios and remember to always pour the acid into the water.
4. Heat the acid mixture in a water bath.
5. Immerse the piece in the mix and leave it in for the time you choose. Longer soaking time will give deeper relief.
6. Neutralize the piece by dipping it into water with bicarbonate.
7. A light buff with 2500 grit or more, after etching, can help to make the tops bright.
8. Make the oxide coating.

## Oxide coating

### Browning

A Blueing treatment will affect both alloys of the Damascus which makes the pattern indistinct.

Instead, a browning process is recommended. Depending on desired finish there are several browning recipes to choose from.

- Firearms Blueing and Browning by R.H. Angier, ISBN 978-0-8117-0610-0
- Gun and its Development by W.W. Greener, ISBN 1-58574-734-3

## Products dimensions and delivery conditions

We supply stainless gun barrel steel in following formats

- Round bars, four dimensions between Ø35 to Ø60.
- Annealed condition.

Even if it comes to creating customized patterns on Damascus products or if you like dimensions outside standard range contact us true our sales channel.

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