

Ultrafort® MarAge660

for Ballistic Protection

Data Sheet

Ultrafort® MarAge660 is a non-standard special steel

22.04.26 REV.2.

Chemical composition in %

C	Ni	Mo	Co	Ti
≤0.03	18.0	5.0	10.0	1.0

Material Properties

- Martensitic precipitation-hardening steel
- Good machinability in solution-annealed condition
- Good hot formability
- Good weldability characteristics

Typical Applications

- Automotive industry
- Aerospace industry
- Defense industry

Physical Properties

at 20 °C room temperature

Density	8,10 kg/dm ³
Electrical resistivity	0,47 (Ω mm ²)/m
Thermal conductivity	23,57 W/(m K) ¹⁾
Specific heat capacity	440 J/(kg K) ¹⁾

¹⁾ hardened condition

Coefficient of thermal expansion in 10⁻⁶ m/(m.K)

	rolled	hardened
20–100 °C	9.9	10.3
20–200 °C	10.7	11.0
20–300 °C	11.1	11.2
20–400 °C	11.2	11.5

E-Modul in GPA

20 °C	203
100 °C	199
200 °C	194
300 °C	187
400 °C	181

Mechanical Properties

Heat Treatment / Delivery Condition

	rolled	hardened
Hardness in HRC	≤38	55–60
Tensile strength R _m in MPa	~1100	~2280
Yield strength R _{p0,2} in MPa	~900	~2230

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Hot Forming

- Due to its microstructure (nickel martensite) it can be readily formed in the solution-annealed or as-rolled condition
- Hot forming: 1150–800 °C
- Cooling: Air
- Information on maximum bending angles as a function of bending radius available upon request

Heat Treatment

Solution annealing (+AT)	820–900 °C / 1 h	Air
Aushärten	500 °C / 6 h	Air

- After hardening, slight dimensional change (contraction approx. 0.5 mm/m) should be expected

Ballistic Properties

Ammunition	Test level APR2006	Impact velocity in m/s	Distance in m	Necessary sheet thickness in mm
.357 Magnum, 10,2 g VMSK, Lead core	4	430	5	3.0 ^(a)
.44 Magnum, 15,6 g VMSK, Lead core	4	440	5	3.4 ^(a)
7,62 mm x 39, 8,0 g VMS/WK+P	6	700	10	5.0 ^(a)
5,56 mm x 45, 4,0 g VMS/WK+P	7	950	10	6.0 ^(b)
7,62mm x 51; 9,5 g VMS/WK	7	830	10	6.5 ^(b)
7,62 mm x 39, 7,8 g VMS/HK	8	745	10	7.4 ^(b)
7,62 mm x 51, 9,8 g VMS/HK	9	820	10	9.5 ^(b)

^(a) hardened to 50 ± 2 HRc ^(b) hardened to 57 ± 2 HRc

Note

Provided technical data and information in this data sheet are typical values. Normal variations in chemistry, size and conditions of heat treatment may cause deviations from these values. We suggest that information be verified at time of enquiry or order. For additional data or metallurgical assistance, please contact us.

Welding

- Good weldability using TIG (WIG) or MIG process
- Filler materials: similar composition or matching electrodes
- Preheating not required
- Post-weld heat treatment recommended

Machining

- Good machinability in solution-annealed and as-rolled condition

Delivery Conditions

- Plate – rolled, straightened shot-blasted
- As-rolled hardened or solution-annealed condition
- Required plate thickness depends on respective ballistic protection requirement
- Official inspection certificates provided upon request
- Thickness: ≥ 4,0–12,0 ^{+0,5/-0,0} mm
- Dimensions: min. 500 mm x 1000 mm (upon request)
max. 1000 mm x 2000 mm (depending on thickness)
- Maximum plate weight: ~110 kg



Swiss Steel Group

Deutsche Edelstahlwerke
Witten/Krefeld GmbH & Co.KG
Austraße 4
DE-58452 Witten
defense@swisssteelgroup.com
www.swisssteel-group.com