Ramor protection steels


CONFERENCE

No other steel manufacturer in the world has the same knowledge and expertise in terms of armor steel production as SSAB.

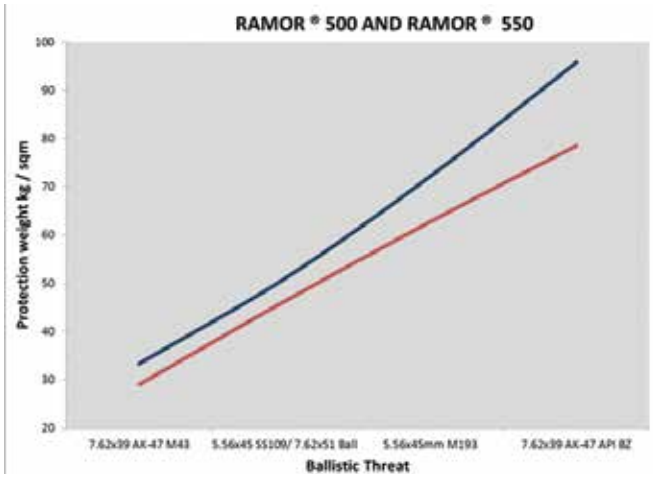
From our long experience, we understand the needs of our users and the demands that are required of our products. With our unique manufacturing capability, knowledge and expertise we can create the properties necessary to meet these demands.

With tailor made properties, tight thickness tolerances and excellent surface quality, these steels have protected lives and kept property safe for over a decade.

Reduce weight but not standards. Upgrade to Ramor 550.

Ramor armor steel is extremely strong and tough. By using optimized alloy content in combination with patented direct quenching process, high hardness and toughness can be achieved.

Ramor offers excellent ballistic properties in combination with high hardness and strength. Ramor is developed for applications where blast protection or high ballistic resistance is required, such as armored vehicles, doors, window frames and systems for transport of valuables. Shooting range equipment is another application for which the product has been developed in cooperation with customers.



Save weight by upgrading to Ramor 550

The weight of armouring in a passenger compartment can be reduced by up to 10 to 20 percent when upgrading from Ramor 500 to Ramor 550.

Type of threat	Weight saving potential
Mild threats (3.0 - 6.5 mm)	10-15%
High threats (8.0 - 14 mm)	15-20%

The weight saving will;

- increase payload
- give better off-road capability
- reduce fuel consumption
- extend the vehicle life-time

For more details and technical advice, please contact your local sales man or visit www.ssab.com

Passenger compartment manufactured from Ramor 500 or Ramor 550: Bent and welded componenets.

- Typical vehicle parts are
  - A-, B- and C-pillars
  - All four sides, roof, fire wall, etc.
- The thickness 3.0 - 13 mm is chosen based on the protection class
- You can save the weight equivalent of 2-3 persons by shifting from 500 to 550 grade

Floor Structures: Ramor 400, Ramor 450 or Ramor 500.

Understanding your needs. Understanding Ramor steel.

Protect product range*	Thickness (mm)
Ramor 300	3.0-6.0
Ramor 400	3.0 - 30.0
Ramor 450	8.0 - 16.0
Ramor 500	2.0 - 30.0
Ramor 550	3.0-15.0

* For more product information check datasheets at www.ssab.com

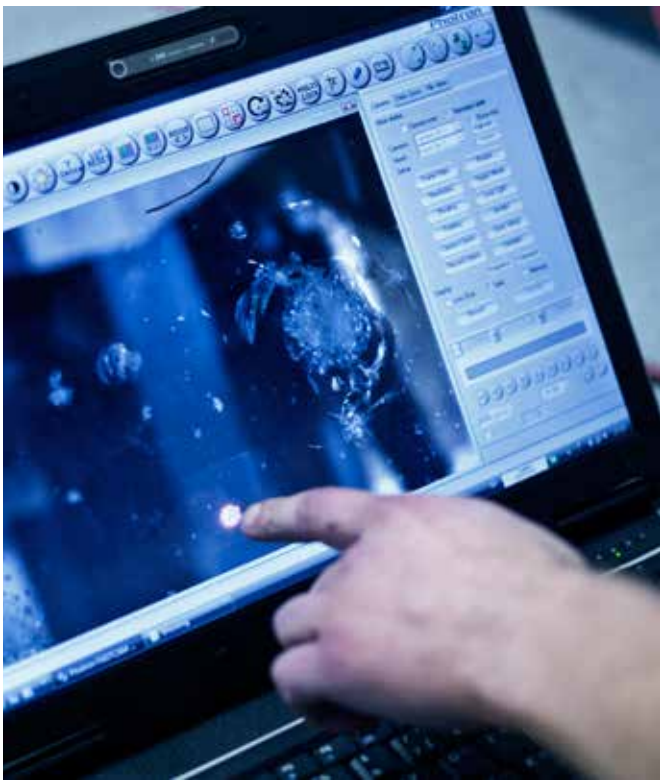


Plate thickness requirements vs protection levels

EN 1522

Protection level	Threat	Velocity (m/s)	Range (m)	Ramor 500 (mm)	Ramor 550 (mm)
FB2	9mm Luger FJ/CB/SC	415±10	5	2.0	
FB3	357 Magnum	430±10	5	2.3	
FB4	.44 Mag FJ/FN/SC	440±10	5	2.5	
FB4+	7,62x39 AK47(M43)	700±10	10	4.0	3.7
FB6	5,56x45 SS109 7,62x51 NATO Ball	950±10 830±10	10	6.5	5.9
FB7	7,62x51 NATO AP	820±10	10	14.5	13.0

NIJ 0108.01

Protection level	Threat	Velocity (m/s)	Range (m)	Ramor 500 (mm)	Ramor 550 (mm)
II	9mm FMJ .357 Magnum JSP	358±12 425±15	5	2.2	
IIIA	9mm FMJ .44 Magnum SWC	426±15 436±15	5	2.5	
III	7,62x51 FMJ	838±15	15	6.0	5.0

VPAM PM 2007

Protection level	Threat	Velocity (m/s)	Range (m)	Ramor 500 (mm)	Ramor 550 (mm)
VPAM6	7,62x39 Ball	720±10	10	4.25	3.7
VPAM7	5,56x45 SS109 7,62x51 NATO Ball	950±10 830±10	10	6.5	5.9
VPAM8	7,62x39 API BZ	740±10	10	12.2	10.1
VPAM9	7,62x51 NATO AP	820±10	10	14.5	13.0

GOST R

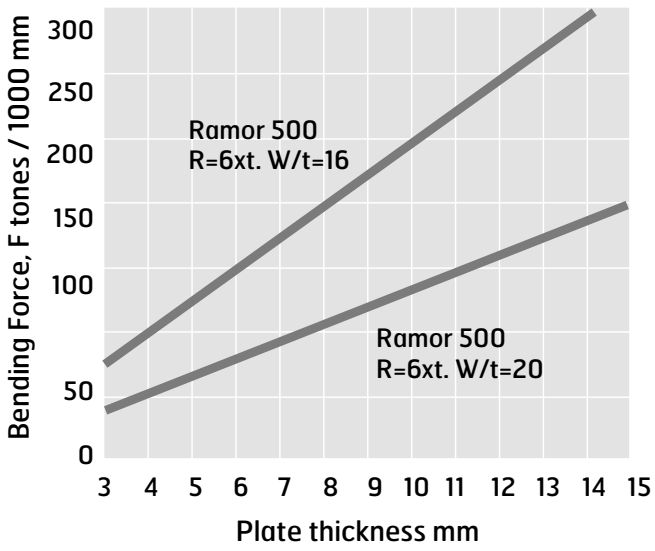
Protection level	Threat	Velocity (m/s)	Range (m)	Ramor 500 (mm)	Ramor 550 (mm)
II	5.45 mm 7H7 7.62 mm H-134C	310-335 415-445	5 5	2.2 2.2	- -
III	AK-74 7H6 AKM 57-H-231	900±10 725±15	10	4.7	3.9

Ramor Workshop Recommendations

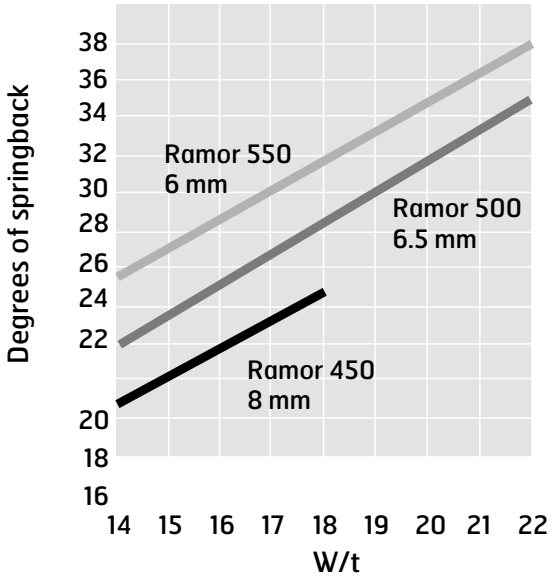
TYPICAL MECHANICAL PROPERTIES

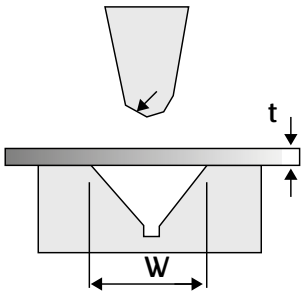
Ramor	Yield strength R_e MPa	Tensile Strength R_m MPa	Elongation A_5 %	Hardness HBW	Impact strength t °C	all directions Chapy V J
Ramor 300	820	940	8	260-320	-40°C	60 J
Ramor 400	1100	1300	8	360-460	-40°C	20 J
Ramor 450	1200	1400	10	400-480	-40°C	35 J
Ramor 500	1450	1700	7	490-560	-40°C	20 J
Ramor 550	1550	1850	7	540-600	-40°C	16 J

Bending force for Ramor 500 (for Ramor 550 add +10 %)



Springback after bending R/t = 6





R = minimum bending radius
t = plate thickness
W = die opening width (mm)

Ramor	400	450	500	550
Minimum bending radius R both directions	5xt	4xt	6xt	6xt
Recommended gap width W/t	14 - 18	12 - 16	16 - 20	16 - 20

RECOMMENDED AUSTENITIC WELDING CONSUMABLES

Welding method	EN Classification	AWS Classification	Consumables (Esab)	Type
GMAW, solid wire	EN 12072 G 18 8 Mn	AWS 5.9 ER307	OK Autrod 16.95	Austenitic
SMAW, electrode	EN 1600 E 18 8 Mn B 4 2	AWS 5.4 E307-15	OK 67.45	Austenitic

RECOMMENDED UNDERMATCHING FERRITIC CONSUMABLES

Welding method	EN Classification	AWS Classification	Consumables (Esab)	Type
GMAW, Solid wire	EN 440 G3Si1	AWS A5.18 ER70S-6	OK Autrod 12.51	Ferritic
SMAW, electrode	EN 499 E 42 4 B 42 H5	AWS A5.1 E7018	OK 48.00	Ferritic

PREHEATING / WORKING TEMPERATURE UNDERMATCHING FERRITIC CONSUMABLES

	Plate thickness mm				
	10			20	30
Ramor 400	+20°C			Austenitic +20°C	
Ramor 500		+100°C	+150°C	Austenitic +20°C	
Ramor 450, 550	Austenitic +20°C				

THICKNESS TOLERANCES (LOWER TOLERANCES = 0.00)

Thickness mm	Cut to length	Cut to length Special tolerance*	Heavy plates
2.00 – 3.00	+0.32 mm	+0.20 mm*	
3.01 – 4.00	+0.36 mm	+0.24 mm*	
4.01 – 5.00	+0.40 mm	+0.24 mm*	
5.01 – 6.00	+0.42 mm	+0.28 mm*	+0.74 mm
6.01 – 6.50	+0.44 mm	+0.30 mm*	+0.74 mm
6.51 – 6.99			+0.74 mm
7.00 – 7.99			+0.76 mm
8.00 – 9.99			+0.80 mm
10.00 – 11.99			+0.90 mm
12.00 – 14.99			+1.00 mm
15.00 – 19.99			+1.10 mm

* Special tolerance by separate agreement only. Typical plate thickness is middle of 0 mm and upper tolerance.

SSAB is a Nordic and US-based steel company. SSAB offers value added products and services developed in close cooperation with its customers to create a stronger, lighter and more sustainable world. SSAB has employees in over 50 countries. SSAB has production facilities in Sweden, Finland and the US. SSAB is listed on the Nasdaq OMX Nordic Exchange in Stockholm and has a secondary listing on the Nasdaq OMX in Helsinki.

702-en-SSAB: Ramor - protection steels V4-2016 Halledo

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