



ARMOUR STEEL

Advanced safety.
A true fact.



LÁMINA Y PLACA
COMERCIAL

VILLACERO

PLANOS, LARGOS
Y TRANSFORMACIÓN

ARMOUR STEEL

Extreme protection.
A true fact.



Ramor protection steel is for customers who seek extreme protection and safety performance for their endproducts.

Ramor steel plate has excellent ballistic properties in combination with high hardness and strength. Ramor has been developed for applications where blast protection or high ballistic resistance is required.



APPLICATIONS

- Civil vehicles
- Bank counters and vaults
- Military vehicles and equipment
- Doors, window frames, walls
- Money exchange offices
- Secured containers
- Shooting gallery devices

DATA SHEET

DIMENSIONS

RUUKKI RAMOR	HEAVY PLATES	CUT LENGTHS
Ramor™ 500	6 - 30 mm	2,5 - 6,5 mm
Ramor™ 550	6 - 15 mm	3 - 6 mm

TOLERANCES

HEAVY PLATES

- Width and length EN 10051
- Flatness EN 10029 class N, steel type H

CUT LENGTHS

- Width and length EN 10029
- Flatness EN 10029 class N, steel type H

HEAVY PLATES		CUT LENGTHS	
Thickness mm	Upper thickness tolerances mm	Thickness mm	Upper thickness tolerances
6,00 - 6,99	0,74	2,50 - 3,00	0,32
7,00 - 7,99	0,76	3,01 - 4,00	0,36
8,00 - 9,99	0,80	4,01 - 5,00	0,40
10,00 - 11,99	0,90	5,01 - 6,00	0,42
12,00 - 14,99	1,00	6,01 - 6,50	0,44
15,00 - 19,99	1,10		
20,00 - 24,99	1,20		
25,00 - 29,99	1,30		
30,00	1,40		

El ancho máximo de las chapas cortadas de bobina es de 1500 mm.

La tolerancia mínima de espesor tanto para chapa gruesa como para chapas cortada de bobina (chapa) es ± 0 mm.

SURFACE QUALITY

Surface condition: According to EN 10 1632 Class B Subclass 3 Repair welding of plates is not permitted in production of Ramor steels. Cut lengths are delivered in asrolled condition. Plates can be delivered in asrolled condition or shopprimed condition.

PROPERTIES

The number of the designation in Ramor 400, Ramor 450, Ramor 500 and Ramor 550 indicates the nominal Brinell hardness value of 400, 450, 500 and 550 HBW, respectively. The Ramor 400 and Ramor 450 grades are designed to give protection against high pressures caused by explosions and blasts. Moreover, the Ramor 450 LT grade is designed to withstand extremely cold conditions and to endure heavy impact loads (LT=Low temperature). Ramor 500 and Ramor 550 grades are the most suitable choice when protection is needed against kinetic energy projectiles, i.e. ballistic performance.

MATERIALS TESTING PROCEDURE

TEST	ACCORDING TO STANDARD	TEST FREQUENCY
Tensile test	EN ISO 68921:2009	Typical values or according to agreement
Brinell hardness test 1)	EN ISO 65061	Each heat treatment individually
Charpy impact test	EN ISO 1481:2010	Typical values or according to agreement
Ballistic protection	PM2007/EN 1522 Stanag 4569	Spot testing

1) Hardness is measured in Brinell units (HBW) in compliance with EN ISO 65061 on a milled surface 0.0118" 0.079"/ 0.3 - 2 mm below plate surface. The measurement depth is determined on the basis of product form and plate thickness.

RECOMMENDED MINIMUM PLATE THICKNESS FOR DIFFERENT PROTECTION CLASSES, RAMOR™ 500

NORM	PROTECTION LEVEL	THREAT	BULLET WEIGHT (GRAM)	DISTANCE (METER)	STRIKING VELOCITY (EN M/S)	RECOMMENDED MINIMUM THICKNESS (EN MM)
EN 1522	FB3	.357 Magnum	10,20	5	430±10	2,50
NIJ 0108.01	nivel II	.357 Magnum	10,2	5	425±15	2,50
		9 mm FMJ	8,0	5	358±12	
NIJ 0108.01	nivel IIA	.357 Magnum	10,2	5	381±15	2,50
		9 mm FMJ	8,0	5	332±12	
NIJ 0108.01	nivel IIIA	.44 Magnum	15,55	5	426±15	2,50
		9 mm FMJ	8,0	5	426±15	
EN1522	FB4	.44 Magnum	15,60	5	440±10	3,00
PM 2007	Clase 4	.357 Magnum	10,20	5	430±10	
PM 2000	PM4					
EN1522	FB4+	7,62 x 39mm AK-47(M43)	8,00	10	720±10	4,25
PM 2007	Clase 6					
EN1522	FB6	5,56 x 45mm SS109 (M855)	4,00	10	950±10	6,50
PM 2007	Clase 7	7,62 x 51mm Nato Ball	9,55	10	830±10	
PM 2000	PM6					
EN1522	FB7	7,62 x 51mm P80 Nato AP	9,45	10	820±10	14,20
PM 2007	Clase 9					
PM 2000	PM7					
Stanag 4569	nivel 1	7,62 x 51mm Nato Ball	9,55	30	822±20	6,50
		5,56 x 45mm SS109 (M855)	4,00	30	900±20	6,50
		5,56 x 45mm M193	3,56	30	937±20	9,20
Stanag 4569	nivel 2	7,62 x 39mm AK-47 API BZ	7,77	30	695±20	12,20
Stanag 4569	nivel 3	7,62 x 51mm AP (WC)	8,40	30	930±20	25,10
		7,62 x 54mm B32 API	10,30	30	945±20	16,50

ESPESOR MÍNIMO RECOMENDADO PARA DISTINTAS CLASES DE PROTECCIÓN, RAMOR™ 550

NORM	PROTECTION LEVEL	THREAT	BULLET WEIGHT (GRAM)	DISTANCE (METER)	STRIKING VELOCITY (M/S)	RECOMMENDED MINIMUM THICKNESS (MM)
EN1522	FB4+	7,62 x 39mm AK-47(M43)	8,00	10	720±10	3,9
PM 2007	Class 6					
EN1522	FB6	5,56 x 45mm SS109 (M855)	4,00	10	950±10	5,9
PM 2007	Class 7	7,62 x 51mm Nato Ball	9,55	10	830±10	
PM 2000	PM6					
PM 2007	Class 9					
PM 2000	PM7					
Stanag 4569	Level 1	7,62 x 51mm Nato Ball	9,55	30	833±20	5,9
		5,56 x 45mm SS109 (M855)	4,00	30	900±20	5,9
		5,56 x 45mm M193	3,56	30	937±20	8,1
Stanag 4569	Level 2	7,62 x 39mm AK-47 API BZ	7,77	30	695±20	10,7

MECHANICAL PROPERTIES

STEEL GRADE	YIELD STRENGTH R _{p0,2} MP _a	TENSILE STRENGTH R _m MP _a	ELONGATION A ₅ %	HARDNESS HB	IMPACT STRENGTH	
					t °C	Charpy V J
Ramor 500	1450	1700	7	480 - 560	-40	20
Ramor 550	1550	1850	7	540-600	-40	16

The Charpy V impact strength test is carried out in accordance with EN 100451. When testing thicknesses less than 0.394" / 10 mm, the width of the test piece corresponds with the plate thickness and the impact strength value decreases in direct relation to the surface area of the test piece.

CHEMICAL COMPOSITION

GraSteel grade	CONTENT %, MAXIMUM (CAST ANALYSIS)									
	C	Si	Mn	P	S	Cr	Ni	Mo	B	
Ramor 500	0,32	0,70	1,50	0,015	0,005	1,00	2,00	0,70	0,005	
Ramor 550	0,36	0,60	1,00	0,015	0,005	1,50	2,50	0,80	0,005	

The steels are aluminium-killed and grainrefined.

PREFABRICATION SERVICES

BENT PLATE PRODUCTS

If needed, the products can also be ordered as shopprimed, furnished with welding bevels, and cut to shape.

PROCESSING INSTRUCTIONS

Ramor grades are designed to have favourable weldability and formability and good cutting properties. The protection steels are not intended to be heat treated. Safe working methods must be followed in workshop processing.

WELDING

Ramor steels can be welded with common welding methods. Austenitic or soft ferritic welding consumables are recommended, see the table. High strength ferritic consumables can also be used if the high strength of the joint is important. Only low hydrogen type of ferritic consumables (HD \leq 5 ml/100 g) may be used.

AUSTENITIC WELDING CONSUMABLES FOR RAMOR™ 500 Y RAMOR™ 550

WELDING

Ramor steels can be welded with common welding methods. Austenitic or soft ferritic welding consumables are recommended, see the table. High strength ferritic consumables can also be used if the high strength of the joint is important. Only low hydrogen type of ferritic consumables (HD \leq 5 ml/100 g) may be used.

BENDING

Minimum bend radii for cold forming of Ramor grades are shown in the table. Special care has to be taken in working safety. Mechanical cutting is not suitable as an edge preparation process for bent parts.

CUTTING

Ramor steels are suitable for laser and plasma cutting. Mechanical cutting can also be used if the cutting shears/blades are hard enough and the equipment used is rigid. Water jet cutting is preferred method because ballistic properties of the cut edge can be maintained.

MACHINING

Ramor steels can be machined using rigid hard metal tools and rigid equipment. Sufficient lubrication has to be provided and special attention has to be paid to clamping the work piece. The cutting parameters should be chosen in such a way that the vibration of the cutting tool and the work piece can be avoided, because vibration considerably decreases the lifetime of the cutting tool.

HEAT TREATMENT

Heat treatment above 356°F / +180°C is not recommended (absolute maximum 392°F / +200°C). If a tempering process is needed, please contact technical customer service for further assistance.

OCCUPATIONAL SAFETY

Special care must be taken in all stages of handling hardened steels. Flanging is challenging due to the high strength of the plate. If the bending radius, for example, is too small and a crack is created in the bending point, the plate may separate from the bending tool in the direction of the bend. Those bending the plate must take appropriate precautions to protect themselves and no unauthorised persons must be allowed in the area. The handling instructions of the steel supplier and safety instructions of the workshop must be adhered to in detail. New employees must receive appropriate training before they are allowed to process hardened steels.



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