Industeel

Relia®

ArcelorMittal

Relia® : Quality Wear Resistant Plates

Relia® is a range of high hardness, low-alloyed martensitic steels. The hardness of **Relia®** grades is obtained through intense water quenching during plate manufacturing. **Relia®** offers outstanding resistance to abrasive wear typically 3 to 6 times higher than classical 355 MPa-class construction steel (actual performance may vary depending on the type of wear and operating conditions). As a result, the use of **Relia®** plates will extend the service life of wear parts and machinery components over standard construction steel, without sacrificing on quick and easy fabrication in the workshop.

Relia® plates are available in 3 nominal hardness levels 400, 450 and 500 HBW. In addition to their high superficial hardness, **Relia®** plates offer good toughness, uniform hardness, enhanced weldability, improved cold formability and narrow plate manufacturing tolerances. **Relia®** wear resistant steels are the preferred solution for consistent and reliable processing behavior in the workshop combined with optimal in service performance.

Properties

Standards

Relia® is a series of proprietary grades developed by ArcelorMittal. There exists no engineering standard for plates intended for wear resistant applications. The present datasheet describes the product characteristics of **Relia®** grades manufactured by Industeel as heavy plate or cut-to-length sheets followed by subsequent heat treatment by quenching. Direct quenched products obtained from thermomechanically rolled strips are also available from ArcelorMittal sister companies under the same trademark.

Technical characteristics

Chemical composition

The guaranteed limits for chemical composition are detailed in the Technical characteristics table. Individual compositions are adjusted depending on thickness.

Hardness

The technical characteristics table shows the guaranteed Brinell hardness HBW ranges in the as-delivered condition, according to EN ISO 6506-1. Test shall be performed on a ground or milled surface below the decarburized layer typically 0,2 – 2 mm depending on plate thickness. **Relia®** have a narrow range of hardness variation to ensure better consistency from plate to plate. In addition, for **Relia®** up to 20 mm, a through-hardening to a minimum of 90% of the guaranteed minimum surface hardness will be achieved.

Properties

Tensile properties

Abrasion resistant steels are not specified or guaranteed by their tensile strength and elongation typically required for structural steels. Typical values for 15 mm plate thickness are provided in the technical characteristics table for reference information only.

Impact properties

For **Relia®** 400 and 450 up to 20 mm, Charpy V-notch min impact energy of 27 J are indicative values only, without guaranty.



Technical characteristics		Relia® 400 4-150 mm	Relia® 450 4-50 mm	Relia® 450 50-80 mm	Relia® 500 8-80 mm
Tensile test[1]	YS 0.5 (MPa)	1 100	1 200		1 400
	TS (MPa)	1 250	1 400		1 600
	Total Elong (%)	13	10		10
Hardness	HBW	370-430	420-480		470-530
	Through-hardening[2]	330	380		420
CVN-Impact test[1]	Temperature (°C/F°)	-40	-40		-
	Average energy (J)	27	27		-
Chemical composition (in mass %)	C	0.17	0.20	0.28	
	Mn	1.90	1.50	1.50	
	P	0.02	0.02	0.02	
	S	0.003	0.003	0.003	
	Si	0.60	0.60	0.60	
	Al	0.060	0.060	0.060	
	Nb	0.03	0.03	0.03	
	V	0.03	0.03	0.03	
	Ti	0.05	0.05	0.05	
	Cr	0.8	0.8	1.0	
	Mo	0.2	0.2	0.5	
	Ni	1.0	1.0	0.8	
	Cu	0.4	0.4	0.4	
	B	0.004	0.004	0.004	
	Cev [3] [4]	0.45	0.52	0.67	

Notes: [1] Typical values for 15 mm plate thickness (provided for reference information only).
[2] Up to 20 mm the plate is deep hardened to min 90% of the specified range for surface hardness
[3] Up to 20 mm; otherwise max 0.56 for Relia ®400 and max 0.67 for Relia ® 450.
[4] = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15

Delivery conditions

Dimensional program

Delivery condition: Q (quenched).
For dimensions outside the limits displayed in the table, please contact us.

	Min widh (mm)	Length (m)	Max width (mm) per thickness (mm)														
			3	4	5	6	8	9	10	12	20	25	30	50	80	150	250
Relia® 400	1 200	4 to 13		2 000		2 500		3 100		3 800		3 800					
Relia® 450	1 200	4 to 13		2 000		2 500		3 100		3 800		3 800		3 000			
Relia® 500	1 200	4 to 13					2 500			3 000			3 000				

Also available as cut-to-length sheets obtained form 2000 mm wide hot rolled strips, followed by quenching treatment.

Tolerances

Dimensions and shape

Unless otherwise specified, tolerances on dimensions and shape are determined according to EN 10029. Plates obtained from cut-to-length strips may be delivered with untrimmed edges. The same tolerances on width as trimmed edges will apply. For further information, please contact us.

Thickness tolerance

Unless otherwise agreed, tolerances on thickness are determined according to EN 10029 Class A (minus thickness tolerance depending on nominal thickness). If class B, C or D tolerances are required, it shall be indicated at the time of enquiry and order. Tight thickness tolerances closer than those specified by EN 10029 are also available upon enquiry. Plates obtained from cut-to-length strips are delivered with close thickness tolerances -0,2/0,2 mm. For further information, please contact us.

Flatness

Unless otherwise agreed, flatness shall conform to the provisions of EN 10029 Class N - steel type H (products with a specified yield strength > 460 MPa and all grades of quenched and quenched and tempered products). If agreed at the time of enquiry and order, **Relia®** can be delivered with an optional extra-close tolerance for flatness corresponding to the special tolerances of EN 10029 Class S - steel type L. Some thickness limitation may apply, please contact us.

Surface

Relia® plates are delivered in accordance to EN 10163-2 Class A, Sub-class 1. Shot blasting and protection with shop primer is available on request. For primer type and its characteristics, please contact us.

Plate processing

Fabrication guidelines

Thermal cutting

Relia® plates are compatible with all thermal cutting processes such as oxyfuel, plasma, laser, etc. Preheating at 100-150°C is recommended for plates thicker than 40 mm (10 mm for **Relia® 500**) and mandatory over 60 mm or in cold environments where the plate temperature is below 10°C. Excess preheating above 200°C may reduce the hardness of **Relia®**.

Cold formability

Thanks to their high cleanliness and uniform properties, the **Relia®** plates are specifically designed for improved formability. Brake press bending of **Relia®** plates should be carried out using best shop practices such as using hardened V-dies with an appropriate radius. It is recommended to use adequate lubrication, to grind of thermal cut or sheared plate edges and to apply the load in a smooth, steady manner. **Relia®** should not be hot formed unless the part is subsequently heat treated by an approved process.
For plates up to 20 mm, recommended minimum bending radius and die opening are summarized in the following table. For plate thickness above 20 mm, please consult us.

	Min Internal Bending Radius*	Min die opening*
Relia® 400	3 (4)	10 (12)
Relia® 450	5 (6)	12 (14)
Relia® 500	6 (8)	14(18)

** Values shown in plain are for bending perpendicular to the plate rolling direction; values in bracket are for bending along the longitudinal direction. Those values shall be understood as the min ratio over the plate thickness.*

Welding

Due to its low carbon content and carbon equivalent, **Relia®** exhibits very good welding characteristics when the guidelines below are followed.



Weld preparation

Weld surfaces should be dry, clean and grinded to eliminate rust, scale, grease or paint traces as well as any gas-cutting dross. In all cases, it is recommended that welding is carried out above 5°C.

Welding process

All conventional fusion welding methods can be used, such as:

> SMAW (Shielded Metal Arc Welding)> minimum internal bending radius (table below)
> GMAW (Gas Metal Arc Welding)
> FCAW (Flux Cored Arc Welding)
> SAW (Submerged Arc Welding)

Heat input should be limited to 10-30 kJ/cm with maximum interpass temperature of 220°C.

Welding consumables

The manufacturer's recommendations should be strictly followed for the storage, handling and use of welding consumables. For protection of weld against wear, very hard welding products could be used for covering passes. All products in accordance with the following standards are acceptable:

Ferritic filler	Euronorm	AWS
SMAW	EN757 / EN ISO 2560 E42 x E46 x	A5-5 E70 x
GMAW	EN ISO 14341 G42 x G46 x	A5-18 ER70Sx
FCAW	EN756 / EN ISO 17632 T42 x	A5-20 E71 x
SAW	EN 756 S1 x S3 x	A5-17 / A5-23 E70 x

Using ferritic filler and welding configuration leading to high combined thicknesses above typically 50 mm (15 mm for **Relia® 500**), preheating will be required to prevent (delayed) cold cracking. Further information about the suggested preheating temperatures depending on the combined thickness, welding method and heat input is available upon request.

Stainless filler

Ferritic filler	Euronorm	AWS
SMAW	EN 1600 E1 8 8 Mn x	A5-5 E308 x
GMAW	EN ISO 14341 G42 x G46 x	A5-18 ER70Sx
FCAW	EN756 / EN ISO 17632 T42 x	A5-20 E71 x

Stainless welding products self harden after welding and require no preheating or cap passes.

Machining

Machining of **Relia®** requires the use of coated or uncoated cobalt-alloyed, high speed steel or cemented carbide tips, using a generous supply of cutting fluid or oil-based lubricant.
Relia® is easy to drill, tap and mill respecting the parameters displayed in the following tables.

Drilling

		Relia®400	Relia®450	Relia®500
High Speed Steel	Cutting speed (m/min)	10-30	5-25	5-15
	Feed (mm/rev)	0.1-0.2	0.1-0.2	0.1-0.2
Carbide Tool	Cutting speed (m/min)	50-90	40-80	40-60
	Feed (mm/rev)	0.1-0.2	0.1-0.2	1.0-0.16

Tapping

		Relia®400	Relia®450	Relia®500
High Speed Steel	Cutting speed (m/min)	3-6	3-6	3-6
	Feed (mm/rev)	1-3	1-3	1-3

Milling

		Relia®400	Relia®450	Relia®500
High Speed Steel	Cutting speed (m/min)	30-50	20-40	13-30
	Feed (mm/rev)	0.1-0.2	0.1-0.2	0.1-0.2
Carbide Tool	Cutting speed (m/min)	50-150	40-120	30-100
	Feed (mm/rev)	0.05-0.5	0.05-0.5	0.05-0.5

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Technical data and information are to the best of our knowledge at the time of editing. However, they may be subject to some slight variations due to our ongoing research programme 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.Further information may be obtained from the address opposite.