



Plate

API Steels: For Offshore Structures

Introduction

ArcelorMittal USA has a long history of providing the API Grades 2H, 2MT1, and 2Y plate steel for the fabrication of offshore drilling and production platforms. This includes providing plates for the Shell Auger (1993), B. P. Pompano (1993), Amerada Hess Baldpate (1996/7), Exxon Petronius (1997), El Paso Prince (1999/00) offshore platforms. ArcelorMittal USA plate facilities in Burns Harbor, IN and Coatesville and Conshohocken, PA each have unique capabilities that benefit this market. These three mills supply the widest range of plate sizes and grades in North America.



Facilities

ArcelorMittal USA's facilities allow the production of plates as follows:

Table 1
General Plate Availability

Thickness	To 28" (711 mm)
Width	To 195" (4953 mm)
Length	Up to 1500" (38.1 m)
Weight	Pattern weights to 50 tons (45 t)

ArcelorMittal USA can also normalize or quench and temper (Q&T) plates in these plate sizes. The Burns Harbor 160" plate mill also has the capability to perform thermo-mechanical-controlled-processing (TMCP), including interrupted accelerated cooling (IAC). A schematic of these processes is shown in Figure 1. The plate sizes that can be specifically produced at each plant using the additional processing are shown in Table 2.

Figure 1
Processes for Producing Plate Steels

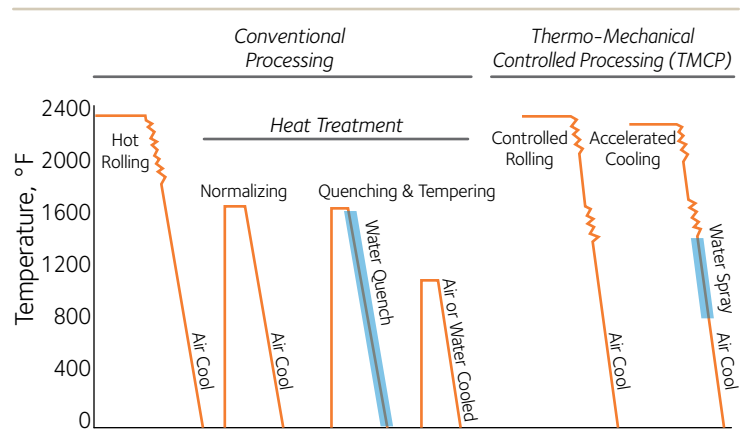


Table 2
ArcelorMittal USA's Available Processes (1)
(thickness, width, length, maxs. or range in inches)

Location	Normalizing	Q&T	TMCP
Burns Harbor	4", 150", 600"	4", 150", 600"	2", 120", 480-1400"
Coatesville	28", 195", 540" (2)	28", 195", 540" (2)	-
Conshohocken	3", 99", 700" (3)	1", 99", 500"	-

- (1) total plate weight will limit availability – refer to ArcelorMittal USA for plate outside these limits
- (2) lengths to 650" available, please refer to ArcelorMittal USA Plate offices
- (3) lengths to 800" available, please refer to ArcelorMittal USA Plate offices

The availability of TMCP is of significant value towards providing API-2MT1 grades. TMCP also allows the production of longer plates. The layout of the Burns Harbor mill showing the accelerated cooling unit is presented in Figure 2. The 2-stand mill also has an interstand cooling system, which is critical in the production of thicker TMCP plates.

ArcelorMittal USA has the capability to produce by continuous casting, as well as bottom-poured ingot casting. Furthermore, low sulfur levels with calcium inclusion shape control are available with Integra® and Fineline® processing. The Fineline® processing of the Coatesville, PA melt shop can meet 0.001% maximum sulfur levels in popular steel grades. This melt shop also has the capability to meet very stringent chemical controls, such as in carbon equivalent maximums. This is demonstrated in Figure 3 for recent melting of API-2Y-50 steels. The excellent Charpy-V-Notch impact toughness performance for this grade is shown in Figure 4.

Figure 3
Carbon Equivalent Distribution
33 Heats of API-2Y-50

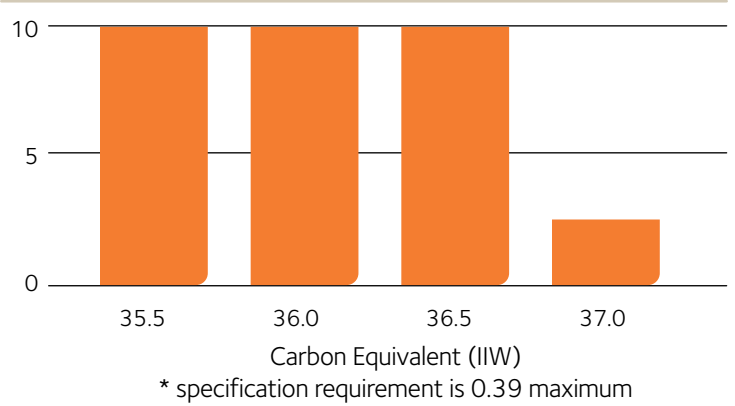


Figure 4
Distribution of Average CVN Energies
110 API-2Y-50 Plates
Transverse at -40°F, 0.75-2.5" Thick

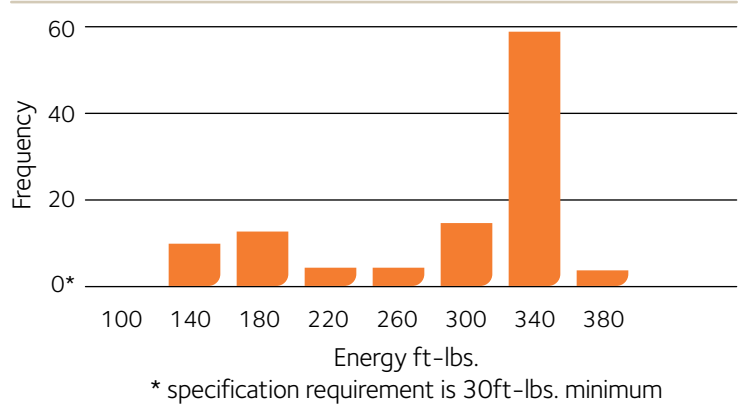
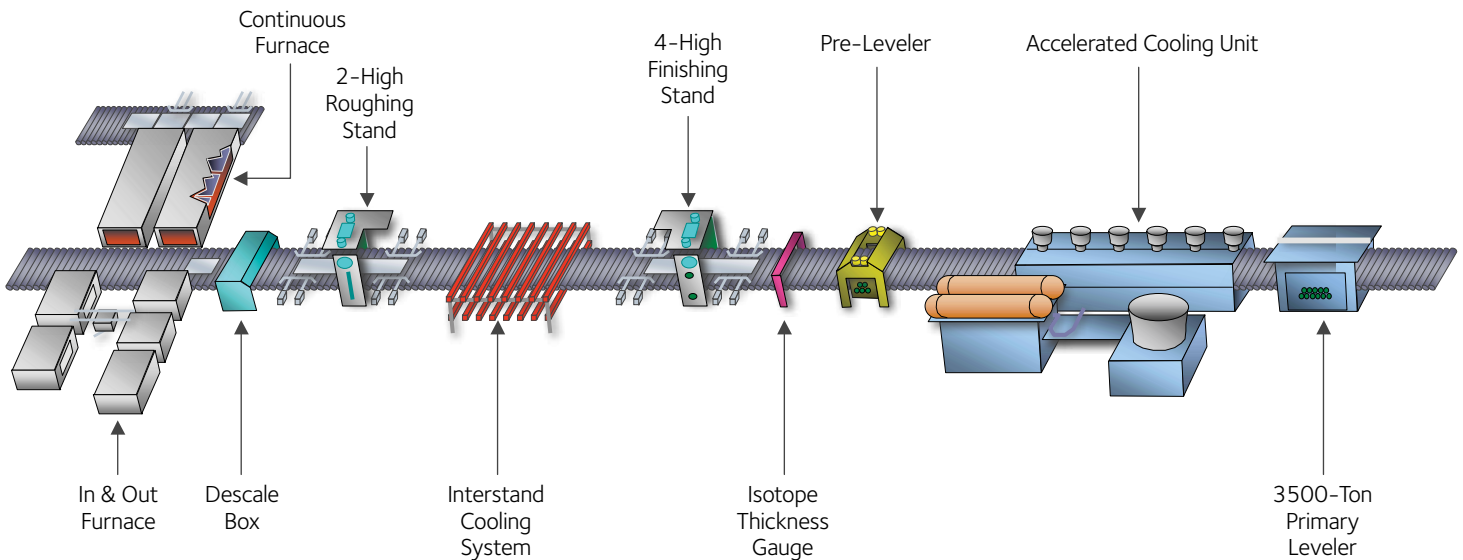


Figure 2
Burns Harbor 160" Plate Mill



API-RP-2Z Pre-Qualification

RP-2Z pre-qualification of API-2Y-50/60 has been successfully completed at Coatesville for plates 3 in. (76 mm) thick.

American Petroleum Institute Specifications

SPECIFICATION	API 2H† Grade 42	API 2H† Grade 50	API 2Y+**▲▲ Grade 50	API 2Y†▲▲ Grade 50T	API 2Y†▲▲ Grade 60
Type of Steel	HSLA	HSLA	HSLA	HSLA	HSLA
Requirements for Delivery	A6	A6	A6	A6	A6
Tensile Strength (ksi)	62/82	70/90	65 Min.	70 Min.	75 Min.
Yield Strength (Min. ksi) (Yield Point if designated YP)	42	50 to 2½" incl.; 47 over 2½"	50/75 to 1" incl.; 50/70 over 1"	50/80 to 1" incl.; 50/75 over 1"	60/90 to 1" incl.; 60/85 over 1"
Spec. Thickness (Max. in.)	4	4	6	6	4
ArcelorMittal USA - Plate Thickness (Max. in.)	4	4	6	6	4
Chemical Composition (%)	Unless a range is specified, individual values are maximums				
Carbon	.18	.18	.16	.16	.16
Manganese	.90/1.60	1.15/1.60	1.15/1.60	1.15/1.60	1.15/1.60
Phosphorus	.030	.030	.030	.030	.030
Sulfur	.010	.010	.010	.010	.010
Silicon	.05/.40	.05/.40	.15/.50	.15/.50	.15/.50
Chromium	*	*	.25	.25	.25
Nickel	*	*	.75	.75	1.0
Molybdenum	*	*	.08	.08	.15
Copper	*	*	.35	.35	.35
Other Elements	.020/.06 Al .04 Cb .020 Ti, .012 N .0100 Ce Ce, N, B, V, Zr not intentionally added F/G/P	.020/.06 Al .01/.04 Cb .020 Ti, .012 N .0100 Ce Ce, N, B, V, Zr not intentionally added F/G/P	.020/.06 Al .03 Cb .012 N .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P	.020/.06 Al .03 Cb .012 N .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P	.020/.06 Al .03 Cb .012 N .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P
Heat Treatment Required	N	N	Q&T	Q&T	Q&T
Remarks	CE .43 to 2½" incl. .45 over 2½". TCVN Req.	CE .43 to 2½" incl. .45 over 2½". TCVN Req.	CE .39 to 1½" incl.; .41 to 3½" incl.; .43 to 6". TCVN Req.	CE .39 to 1½" incl.; .41 to 3½" incl.; .43 to 6". TCVN Req.	CE .42 to 1½" incl.; .45 to 4". TCVN Req.

* Residuals must be reported.

** A Grade 42 is also available with properties and chemistry of API-2W Grade 42.

† Post-weld heat treatment may degrade heat-affected zone strength and toughness. Pretesting of specific welding and post-weld heat treating procedures is recommended to assure optimization of final property levels.

CE (IIW) = $C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15$

▲▲ The Coatesville mill is prequalified to API RP-2Z with Supplement S11 to 3" thick.

American Petroleum Institute Specifications

continued

SPECIFICATION	API-2MT-1†	API-2W†▲ Grade 42	API-2W†▲ Grade 50	API-2W†▲ Grade 50T	API-2W†▲ Grade 60
Type of Steel	HSLA	HSLA	HSLA	HSLA	HSLA
Requirements for Delivery	A6	A6	A6	A6	A6
Tensile Strength (ksi)	70/90	62	65	70	75
Yield Strength (Min. ksi) (Yield Point if designated YP)	50	42/67 1" incl.; 42/62 over 1"	50/75 to 1" incl.; 50/70 over 1"	50/80 to 1" incl.; 50/75 over 1"	60/90 to 1" incl.; 60/85 over 1"
Spec. Thickness (Max. in.)	2½	6	6	6	4
ArcelorMittal USA - Plate Thickness (Max. in.)	2½	2	2	2	2
Chemical Composition (%)	Unless a range is specified, individual values are maximums				
Carbon	.15	.16	.16	.16	.16
Manganese	1.15/1.60	.90/1.35 to 1½" incl.; .90/1.60 over 1½"	1.15/1.60	1.15/1.60	1.15/1.60
Phosphorus	.030	.03	.03	.03	.03
Sulfur	.010	.010	.010	.010	.010
Silicon	.15/.40	.05/.50	.05/.50	.05/.50	.05/.50
Chromium	-	.25	.25	.25	.25
Nickel	-	.75	.75	.75	1.0
Molybdenum	-	.08	.08	.08	.15
Copper	-	.35	.35	.35	.35
Other Elements	.010/.040 Cb .020/.060 Al .080 V, .020 Ti .012 N, .010 Ce N, Zr or B not intentionally added	.03 Cb .012 N .02/.06 Al .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P	.03 Cb .012 N .02/.06 Al .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P	.03 Cb .012 N .02/.06 Al .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P	.03 Cb .012 N .02/.06 Al .003/.02 Ti (based on N) N, B, V, Zr, Ce not intentionally added F/G/P
Heat Treatment Required	As rolled, N or Q&T	TMCP	TMCP	TMCP	TMCP
Remarks	CE .43 to 2" incl. .45 to 2½"	CE .39 to 1½" incl. .41 to 3½" incl. .43 to 6" TCVN Req.	CE .39 to 1½" incl. .41 to 3½" incl. .43 to 6" TCVN Req.	CE .39 to 1½" incl. .41 to 3½" incl. .43 to 6" TCVN Req.	CE .42 to 1½" incl. .45 to 4" TCVN Req.

▲ Inquiry basis only.

† Post-weld heat treatment may degrade heat-affected zone strength and toughness. Pretesting of specific welding and post-weld heat treating procedures is recommended to assure optimization of final property levels.

$$CE (IIW) = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15$$

Quality Assurance Systems

All of the ArcelorMittal USA plate facilities are certified to ISO 9001-2000 and ANSI/ISO14001 and are audited semi-annually. Additional certification of all facilities has been performed by ABS, DNV, TUV and DoD. Additionally, customer, end-user and internal audits of ArcelorMittal USA facilities are regularly performed.

Grades

The principal steels for offshore structures are the API grades listed in the preceding pages. ArcelorMittal USA also has a number of other grades that are of interest to this market, for example:

A709 HPS 70W	A high strength Q&T or TMCP plate steel with improved weldability, toughness and weathering characteristics for bridge applications
Lukens-690Z	A high strength 100 ksi (690 MPa) Q&T alloy steel with excellent toughness [30 ft-lbs. (40J)@-76 °F (-60 °C) long.] through 8 in. (203 mm) thick
Duracorr®	A 12% chromium, utility stainless steel (ASTM A1010) with 50 ksi (345 MPa) minimum yield strength, which excels in marine environments
Lukens-130™	A 130 ksi (896 MPa) minimum yield strength, Q&T alloy steel through 3 in. (76 mm) thick
Spartan™	A family of Cu-Ni, Q&T high strength alloy steels, which can meet the requirements of ASTM A710 and the Navy's HSLA-80/100



Burns Harbor 160" Mill Accelerated Cooling Unit

Refer to the ArcelorMittal USA's website at: www.arcelormittal.com for more information on these and other plate steel grades.

Contacts

If further information or clarification is required, contact T +1 800 966 5352. Additional technical information is also available by emailing Bob Emery at robert.emery@arcelormittal.com or calling T +1 219 787 7423.

All information in this brochure is for the purpose of information only. ArcelorMittal USA reserves the right to change its product range at any time without prior notice.

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