# Responding to Needs for Steel Plates in Larger Sizes Part II Heat-Treatment Equipment for Plates with Heavy Weight and Extra Thickness

## 1. Introduction

Against the background of heavier weight of a steel plate due the increased thickness, width and length accompanying the upscaling of plant equipment, there are also heightened needs for high strength steel products to reduce construction costs by reducing material weight. In order to respond to these needs, JFE Steel introduced heat treatment equipment which enables quenching and tempering of heavy weight and extra thickness steel plates. The following presents an overview of these facilities.

## 2. Overview of Facilities

## 2.1 Heat-Treatment Equipment for Heavy Weight and Extra Thickness Plates

JFE Steel's West Japan Works (Kurashiki) started operation of heat treatment equipment for heavy weight and extra thickness steel plates in 2011, separately from the existing continuous type heat treatment equipment. **Table 1** shows an overview of the new heat treatment equipment. The heat treatment furnace is a batch type facility that enables heat treatment of plates with a maximum thickness of 400 mm, maximum length of 15 400 mm and maximum weight of 55 t, and manufactures quenched and tempered steel plates with heavy weight and extra thickness such as plates for boilers and pressure vessels  $^{1)}$ .

## 2.2 Quenching Equipment for Heavy Weight and Extra Thickness Plates

Although the startup of the above-mentioned heat treatment equipment made it possible to perform heat treatment of plates with heavy weight and extra thickness, the maximum plate length for quenching had been limited to 8 000 mm due to the shape and dimensional limitations of the quenching water tank. Therefore, a study of quenching equipment capable of supporting even heavier and larger sized plates was carried out, and the developed quenching equipment for heavy weight and extra thickness plates (**Photo 1**) was started up in 2017. This facility is used to manufacture quenched and tempered plates with heavy weight and extra plate thickness for boilers, pressure vessels and offshore structures.

Changing the shape of the quenching pit from the conventional cylindrical type to a rectangular type (box type) made it possible to quench plates with a maxi-

Equipment		Conventional (2011)	Developed (2017)	
	Туре	Batch	ı type	
Heat treatment furnace	Max. weight	150 ton		
	Max. temperature	1 050°C		
	Effective thickness	400 mm		
	Effective length	15 400 mm		
	Pit type	Cylinder	Rectangular (Box)	
Quenching pit	Max. thickness	400 mm		
	Max. width	4 650 mm	4 700 mm	
	Max. length	8 000 mm	15 400 mm	
Surface grinder	Max. thickness	450 mm		
Flame cutter	Max. thickness	400 mm		

Table 1 Overview of heat-treatment equipment for plates with heavy weight and extra thickness

<sup>†</sup> Originally published in JFE GIHO No. 46 (Aug. 2020), p. 87-88



Photo 1 Quenching equipment for heavy weight and extra thickness



Fig. 1 Water tank for quenching

mum length of 15 400 mm (see **Fig. 1**). In addition, it is also possible to manufacture quenched and tempered steel plates with heavy weight and extra plate thickness with uniform mechanical properties owing to the introduction of a special lifting device, which enables quick immersion of the heated steel plate in the water tank, and a stirring device for uniform cooling.

#### 2.3 Tensile Properties of Heavy Weight and Extra Thickness Plates

**Table 2** shows the tensile properties for a quenched and tempered plate (ASME SA-387 GR.22 CL.2) with the maximum width that can be produced by the new quenching equipment for heavy weight and extra thickness plates. The plate has substantially uniform properties in both the longitudinal direction and the transverse direction.

#### 2.4 Available Dimensions for Quenched and Tempered Plates

**Table 3** shows the available dimensions (maximum dimensions for heat treatment) of the new quenching equipment for heavy weight and extra thickness steel plates.

 Table 2
 Tensile properties for a quenched and tempered plate with available max. width

Steel grade: ASME SA-387 GR.22 CL.2
Dimension: t140×W4 700×L4 800 (24.6 ton)
Heat treatment: Quenching (930°C) and tempering (720°C)
PWHT: 698°C ×22 h and 606°C ×12 h

$\overline{}$	Strength	YS (MPa)		TS (MPa)			
Location		Spec.	1/4t	1/2t	Spec.	1/4t	1/2t
Тор	One side	≥311	402	401	518 to 689	566	562
	Center		406	408		567	570
	Opposite side		401	406		566	569
Bot.	One side		395	389		560	550
	Center		397	392		562	553
	Opposite side		398	395		543	555

Table 3	Available dimensions for quenched and tempered
	plate

Width (mm) Thickness (mm)	≤2 000	≤2 800	≤3 600	≤4 400	≤4 700
$100 \le 150$	15 400	15 000	11 600	9 500	8 400
≦200	15 400	11 200	8 700	7 100	6 300
≦250	12 600	9 000	7 000	5 600	
≦300	10 500	7 500	5 800	4 700	
≦350	9 000	6 400	4 900		
≦400	7 900	5 600	4 400		

Numbers: Max. product length

#### 3. Conclusion

The startup of the heat treatment equipment and quenching equipment for heavy weight and extra thickness plates has made it possible to manufacture heattreated steel plates with a maximum thickness of 400 mm, maximum width of 4 700 mm and maximum length of 15 400 mm. Utilizing these facilities, JFE Steel will continue to produce heavy weight and extra thickness steel plates which respond to the needs of customers.

#### References

 Araki, K.; Yuasa, T.; Tamura, Y. Heat-Treated Steel Plates with Heavy Section and Large Product Weight. JFE Technical Report. 2013, no.18, p. 56–62.

#### For Further Information, Please Contact(Oct.2021-):

Plate Business Planning Dept., JFE Steel Phone: (81)3–3597–3183 FAX: (81)3–3597–4567 http://www.jfe-steel.co.jp/en/products/plate/index.html Email:t-atsuitasec@jfe-steel.co.jp