New Products & Technologies

Seamless Stainless Steel Pipe*

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1 Introduction

With its application expanding in recent years, stainless steel is showing a high growth of demand. In the field of steel pipe, too, the demand for stainless steel is growing, owing to its excellent corrosion resistance, heat resistance, high-temperature strength and low-temperature toughness, as essential piping material not only for the oil refinery and petrochemical industry but also for LNG facilities, fiber industry, paper and pulp industry, and further for thermal and nuclear power generation plants.

In order to meet such a demand, the company has established a stainless steel pipe manufacturing technology based on the Mannesmann pipe-making method which had been considered incompatible to the manufacture of stainless steel pipe. The company has been manufacturing stainless steel pipe with high dimensional accuracy in outside diameter, wall thickness, and wall thickness deviation.

This report reviews an outline of austenitic stainless steel pipe which is made by this Mannesmann pipe-making method.

2 Manufacturing Method

Pipe with its outside diameter up to 7″ is manufactured by Mannesmann mandrel mill method (small-diameter seamless pipe mill), and pipe with its outside diameter of 7″ and over is manufactured by the Mannesmann plug mill method (medium-diameter seamless pipe mill). These production processes are shown in **Fig. 1**.

3 Manufacturing Specifications and Features

3.1 Chemical Composition

Grades and chemical composition of austenitic stainless steel pipe which can be manufactured by the company are shown in **Table 1**.

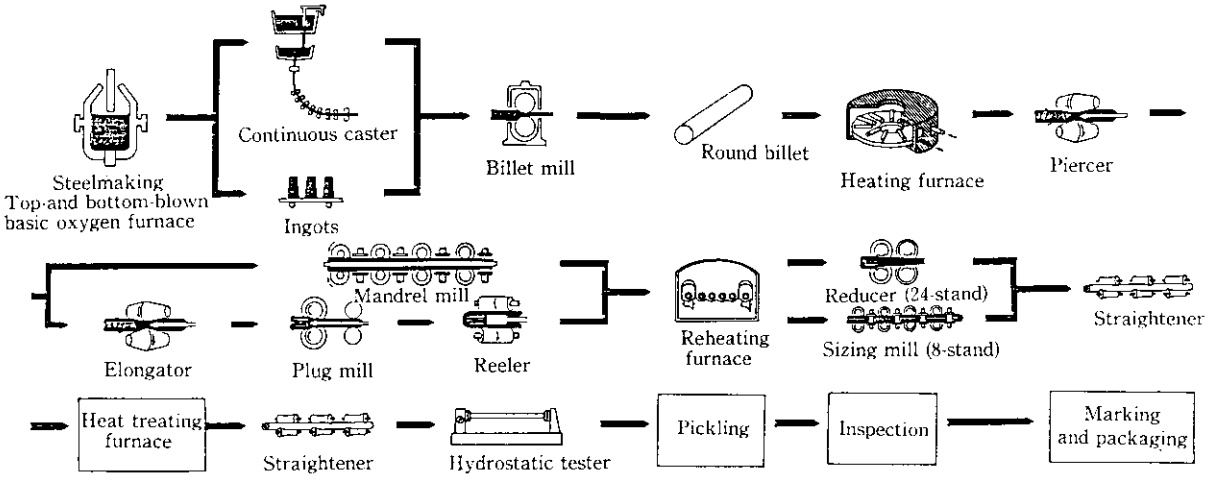

Fig. 1 Manufacturing process

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Table 1 Chemical composition (JIS G3459) (wt. %)

	C	Si	Mn	P	S	Ni	Cr	Mo	Ti
SUS 304	≤0.08	≤1.00	≤2.00	≤0.040	≤0.030	8.00-11.00	18.00-20.00	—	—
304L	≤0.03	≤1.00	≤2.00	≤0.040	≤0.030	9.00-13.00	18.00-20.00	—	—
304H	0.04-0.10	≤0.75	≤2.00	≤0.040	≤0.030	8.00-11.00	18.00-20.00	—	—
316	≤0.08	≤1.00	≤2.00	≤0.040	≤0.030	10.00-14.00	16.00-18.00	2.00-3.00	—
316L	≤0.03	≤1.00	≤2.00	≤0.040	≤0.030	12.00-16.00	16.00-18.00	2.00-3.00	—
316H	0.04-0.10	≤0.75	≤2.00	≤0.030	≤0.030	11.00-14.00	16.00-18.00	2.00-3.00	—
321	≤0.08	≤1.00	≤2.00	≤0.040	≤0.030	9.00-13.00	17.00-19.00	—	5×C%≤
321H	0.04-0.10	≤0.75	≤2.00	≤0.030	≤0.030	9.00-13.00	17.00-20.00	—	4×C%-0.6

3.2 Mechanical Properties

Specified mechanical properties of austenitic stainless steel pipe are shown in **Table 2**. Histograms of tensile test values under JIS G3459 SUS 304TP are shown in **Fig. 2**. Both yield strength (YS) and tensile strength (TS) sufficiently satisfy specifications, and as for elongation (El), very high values are obtained.

3.3 Dimensions

Histograms of the outside diameter and wall thickness under SUS304TP 40A×Sch20S are shown in **Fig. 3**. Both the outside diameter and wall thickness rarely show dispersion. Thus it can be said that the pipe

Table 2 Mechanical properties (JIS G3459)

Tensile Test / Grade	YS min. (N/mm²)	TS min. (N/mm²)	El min. (%)
SUS 304	205	520	35
304L	175	480	35
304H	205	520	35
316	205	520	35
316L	175	480	35
316H	205	520	35
321	205	520	35
321H	205	520	35

Note 1. Test specimen: JIS Z 2201 No. 12
2. Longitudinal tensile test

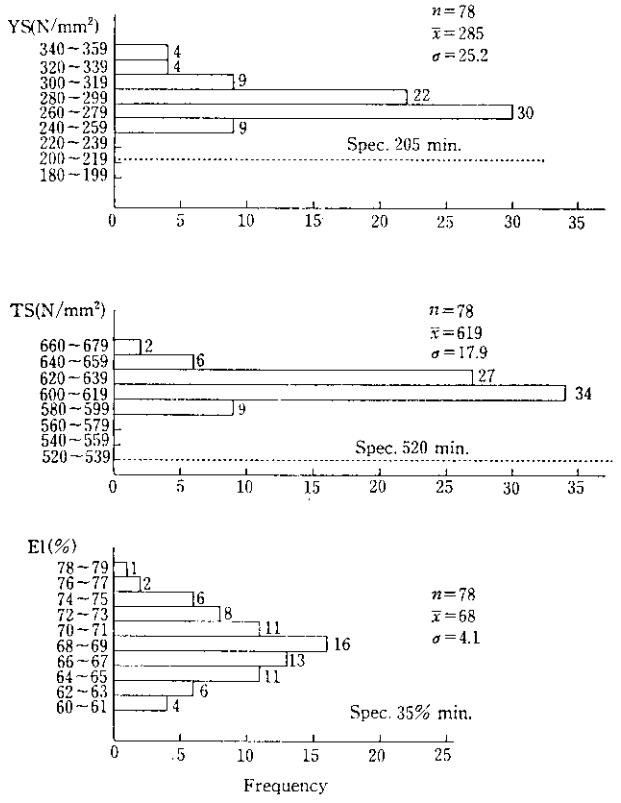

Fig. 2 Mechanical properties of SUS304 TP(25A × Sch20S)

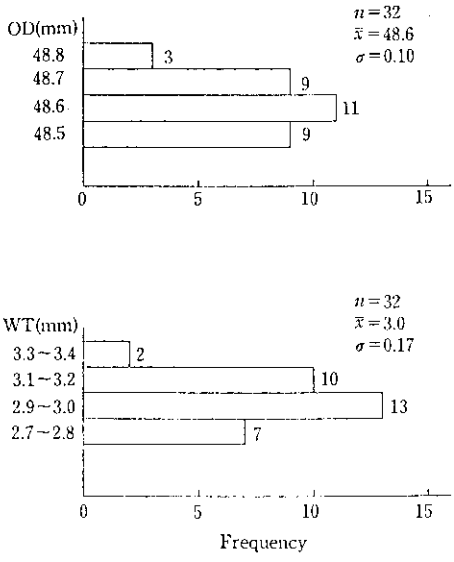

Fig. 3 Dimensional distribution of outside diameter and wall thickness SUS304 TP (40A × Sch20S)

shows the features of pipe-making by the Mannesmann method.

3.4 Microstructures

Microstructures etched by the 10% oxalic acid are shown in **Photo 1**. No ditch structure or no precipitation of carbides is observed on the austenite grain boundary, thereby indicating that carbon is in the condition of sufficient solid solution in the austenite phase.

4 Available Dimensions

The available sizes of SUS304 are shown in **Fig. 4**. It is possible to manufacture the pipe having an outside diameter from 34.0 mmϕ to 406.4 mmϕ, and the pipe having a wall thickness of Sch20S to Sch160, partially excluding a large diameter size of 300A or above.

Photo 1 10% oxalic acid etch test results of seamless SUS304 stainless steel pipe

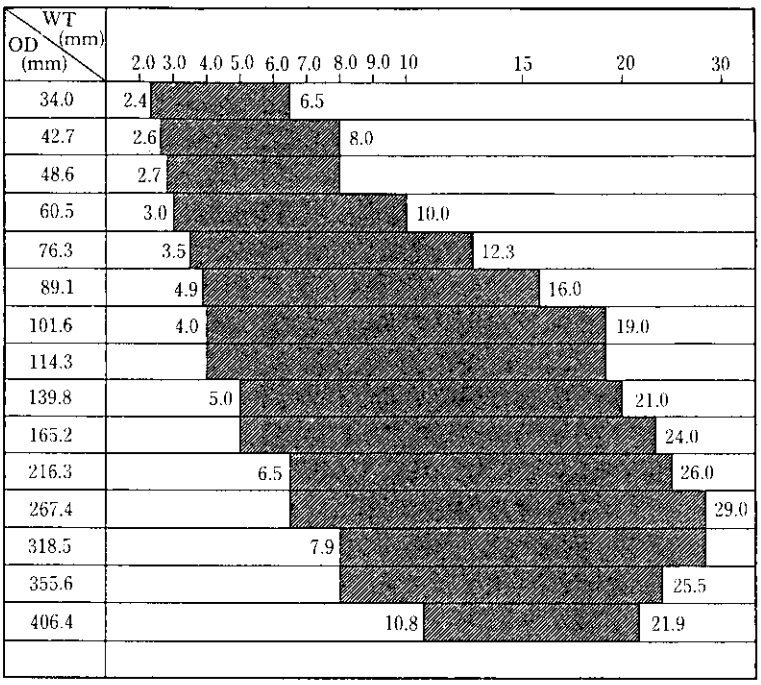

Fig. 4 Size availability of seamless SUS304 stainless steel pipe