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HYDROGENIUS DATABASE

— SSRT Properties —

No. A98

Database on Slow Strain Rate Test (SSRT) Properties of cold-rolled JIS-SUS304 (304 Type) Austenitic Stainless Steel in 115 MPa Hydrogen Gas

2022

Edited by
Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)
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Database on Slow Strain Rate Test (SSRT) Properties of cold-rolled JIS-SUS304
(304 Type) Austenitic Stainless Steel in 115 MPa Hydrogen Gas

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1. MATERIALS

Table 1 Production process and related data of SUS304.

Heat	Production process	Product form	Dimensions
f ¹⁾	Hot-rolled	Plate	Length: 7000 mm Width: 2950 mm Thickness: 50 mm

1) As reported by the manufacturer.

Table 2 Chemical compositions of SUS304.

	Heat	Element (mass %)										
		C	Si	Mn	P	S	Ni	Cr	Mo	Co	Cu	N
Product analysis	f ¹⁾	0.053	0.46	1.12	0.034	0.002	8.04	18.10	0.29		0.31	0.29
Ladle analysis	f ²⁾	0.06	0.46	1.09	0.033	0.002	8.07	18.16		0.25		
	Requirement ³⁾	max	0.08	1.00	2.00	0.045	0.030	10.50	20.00			
		min					8.00	18.00				

1) As reported by HYDROGENIUS.

2) As reported by the manufacturer.

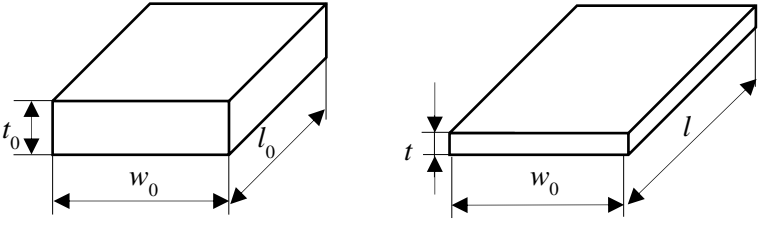
3) As per JIS G 4304 (2021), "Hot-rolled Stainless Steel Plate, Sheet and Strip".

Table 3 Heat treatment conditions of SUS304.

Heat	Heat treatment	Condition
f ¹⁾	Solution-treatment	1100°C, 5 min, water cooled

1) As reported by the manufacturer.

Table 4 Cold-rolling process of SUS304.

<p>Definition of cold-rolling reduction-ratio, CW (%)</p>	$CW = ((t_0 - t) / t_0) \times 100$  <p style="text-align: center;">Before cold-rolling After cold-rolling</p>	
<p>True pre-strain, ϵ_{pre}</p>	$\epsilon_{pre} = \ln \frac{A_0}{A} = \ln \frac{1}{1 - (CW / 100)}$	
<p>Heat</p>	<p>Cold-rolling reduction ratio, CW (%)</p>	<p>True pre-strain, ϵ_{pre}</p>
<p>f</p>	<p>0</p>	<p>0</p>
<p>f</p>	<p>20</p>	<p>0.22</p>
<p>f</p>	<p>40</p>	<p>0.51</p>

2. MECHANICAL PROPERTIES

Table 5 Mechanical properties of SUS304.

Heat		Tensile Properties			Vickers hardness (HV)
		0.2% proof strength $\sigma_{0.2}$ (MPa)	Tensile strength σ_B (MPa)	Elongation ϵ_f (%)	
f ¹⁾		299	613	65	
Requirement ²⁾	max				
	min	205	520	40	

1) As reported by the manufacturer.

2) As per JIS G 4304 (2021), "Hot-rolled Stainless Steel Plate, Sheet and Strip".

3. SSRT PROPERTIES

Table 6 SSRT conditions.

Type and capacity of testing machine	Servo-hydraulic, 50 kN or 100 kN
Loading condition	Uniaxial, Monotonic
Environment	In 50 ~ 115 MPa hydrogen gas at $-45 \sim 200^{\circ}\text{C}$ In 0.1 MPa nitrogen gas at $-45^{\circ}\text{C} \sim -10^{\circ}\text{C}$ In air at RT, 85°C , 200°C
Gas purity	Hydrogen gas: 99.999% (5N)
Test speed	$1.0 \times 10^{-3} \text{ mm/s}^2$ ($5.0 \times 10^{-5} \text{ s}^{-1}$) ³⁾
Specimen ¹⁾ (dimensions in mm)	<p>The drawing shows a cylindrical specimen with a central gauge section. The total length is 80 ± 0.1 mm. Each grip section is 14 mm long. The gauge length is 20 ± 0.1 mm. The diameter of the gauge section is $\phi 3 \pm 0.02$ mm. The diameter of the grip sections is $\phi 10$ mm. The thread on the grip sections is $M10 \times 1.5$. There is a chamfer $C1$ on the end of the grip section. A fillet with a radius $R3.5$ transitions between the grip and gauge sections.</p>

1) Specimen surface was finished by longitudinal polishing with 600 grade emery paper.

2) Test speed was determined by crosshead speed.

3) As determined based on a 20-mm, parallel-length of a specimen. $5.0 \times 10^{-5} \text{ s}^{-1}$ is given by $(1.0 \times 10^{-3} \text{ mm/s}) / 20 \text{ mm}$.