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HYDROGENIUS DATABASE

— SSRT Properties —

No. A84

Database on Slow Strain Rate Test (SSRT) Properties of JIS-SUS316L
(316L Type) Austenitic Stainless Steel in 115 MPa Hydrogen Gas

2021

Edited by
Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)
Kyushu University

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1. MATERIALS

Table 1 Production process and related data of SUS316L.

Heat	Production process	Product form	Dimensions
M ¹⁾	Hot-rolled	Plate	Length: 8100 mm Width: 2500 mm Thickness: 30 mm
P ¹⁾	Hot-rolled	Round bar	Length: 2000 mm Diameter: 20 mm

1) Reported by the manufacturer.

Table 2 Chemical compositions of SUS316L.

	Heat		Element (mass %)							
			C	Si	Mn	P	S	Ni	Cr	Mo
Product analysis	M ¹⁾		0.020	0.62	0.83	0.029	0.001	11.93	17.47	2.11
	P ¹⁾		0.013	0.35	1.66	0.037	0.012	11.92	16.58	1.98
Ladle analysis	M ²⁾		0.018	0.62	0.83	0.030	0.001	12.11	17.49	2.09
	P ²⁾		0.010	0.35	1.64	0.037	0.014	12.04	16.61	2.02
	Requirement ³⁾	max	0.030	1.00	2.00	0.045	0.030	15.00	18.00	3.00
min							12.00	16.00	2.00	

1) Performed by HYDROGENIUS.

2) Reported by the manufacturer.

3) JIS G 4304 (2015), "Hot-rolled Stainless Steel Plate, Sheet and Strip".

Table 3 Heat treatment conditions of SUS316L.

Heat	Heat treatment	Condition
M ¹⁾	Solution-treatment	1120°C, 4 min, water quenched
P ¹⁾	Solution-treatment	1080°C, 5 min, water quenched

1) Reported by the manufacturer.

2. MECHANICAL PROPERTIES

Table 4 Mechanical properties of SUS316L.

Heat		Tensile Properties			Vickers hardness (<i>HV</i>)
		0.2% proof strength $\sigma_{0.2}$ (MPa)	Tensile strength σ_B (MPa)	Elongation ϵ_f (%)	
M ¹⁾		256	548	62	
P ¹⁾		240	549	56	76
Requirement ²⁾	max				200
	min	175	480	40	

1) Reported by the manufacturer.

2) JIS G 4304 (2015), "Hot-rolled Stainless Steel Plate, Sheet and Strip".

3. SSRT PROPERTIES

Table 5 SSRT conditions.

(a) Kyushu University

Type and capacity of testing machine	Servo-hydraulic, 50 kN or 100 kN	Screw type, 100 kN
Loading condition	Uniaxial, Monotonic	
Environment	In 0.7 ~ 115 MPa hydrogen gas at $-45 \sim 200^\circ\text{C}$ In 0.1 MPa nitrogen gas at -45°C In air at 200°C	In air at RT
Gas purity	Hydrogen gas: 99.999% (5N)	---
Test speed	$1.5 \times 10^{-3} \text{ mm/s}^2$ ($5.0 \times 10^{-5} \text{ s}^{-1}$) ³ $1.0 \times 10^{-3} \text{ mm/s}^2$ ($5.0 \times 10^{-5} \text{ s}^{-1}$) ³	
Specimen ¹⁾ (dimensions in mm)	<p>(a) Type A</p> <p>(b) Type B</p>	

1) Specimen surface was finished by longitudinal polishing with 600 grade emery paper (LP) or circumferential buffing with a colloidal SiO₂ (0.04 μm) solution (CP).

2) Test speed was determined by crosshead speed.

3) Estimated from crosshead speed divided by the length of parallel section; 30 mm for Type A and 20 mm for Type B. The value of $5.0 \times 10^{-5} \text{ s}^{-1}$ is given by $1.5 \times 10^{-3} \text{ mm/s} / 30 \text{ mm}$ or $1.0 \times 10^{-3} \text{ mm/s} / 20 \text{ mm}$.

(Table continues on the following page)

Table 5 Slow strain rate test (SSRT) conditions. (Continued)

(b) Japan Petroleum Energy Center

Type and capacity of testing machine	Servo-hydraulic, 50 kN	Screw type, 50 kN
Loading condition	Uniaxial, Monotonic	
Environment	In 82 MPa hydrogen gas at 250°C	In air at 250°C
Gas purity	Hydrogen gas: 99.9999% (6N)	---
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)		

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

2) Test speed was determined by crosshead speed.

3) Estimated from crosshead speed divided by the length of parallel section. The value of $5.0 \times 10^{-5} \text{ s}^{-1}$ is given by $1.0 \times 10^{-3} \text{ mm/s} / 20 \text{ mm}$.