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HYDROGENIUS DATABASE

— SSRT Properties —

No. B64

Database of Slow-Strain-Rate Test (SSRT) Properties of Hydrogen-Charged JIS-SUS316L (Type 316L) Austenitic Stainless Steel in Air

2017

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Database of Slow-Strain-Rate Test (SSRT) Properties of Hydrogen-Charged JIS-SUS316L (Type 316L) Austenitic Stainless Steel in Air

1. MATERIALS

Table 1. Details of processing and related data of SUS316L.

Heat	Production Process	Product Format	Dimensions (mm)
C ¹⁾	Hot-rolled	Plate	Length: 6100 mm Width: 2500 mm Thickness: 50 mm
H ¹⁾	Hot-rolled	Plate	Length: 6100 mm Width: 2500 mm Thickness: 50 mm

¹⁾ As reported by the manufacturer.

Table 2. Chemical composition of SUS316L.

	Heat	Element (mass%)								
		C	Si	Mn	P	S	Ni	Cr	Mo	
Product Analysis	C ¹⁾	0.021	0.54	0.88	0.021	<0.001	12.22	17.64	2.19	
	H ²⁾	0.021	0.56	0.87	0.020	<0.001	12.20	17.70	2.07	
Ladle Analysis	C ³⁾	0.018	0.50	0.84	0.021	0.000	12.09	17.45	2.05	
	H ³⁾	0.018	0.50	0.84	0.021	0.000	12.09	17.45	2.05	
	Requirements ⁴⁾	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⁾ As performed by HYDROGENIUS.

²⁾ As performed by NIMS.

³⁾ As reported by the manufacturer.

⁴⁾ As per JIS G 4304:2005, "Hot-rolled Stainless Steel Plate, Sheet and Strip".

Table 3. Heat-treatment conditions of SUS316L.

Heat	Heat-treatment	Conditions
C ¹⁾	Solution-treatment	1120°C, 4 min, water-quenching
H ¹⁾	Solution-treatment	1120°C, 4 min, water-cooling

¹⁾ As reported by the manufacturer.

It should be noted that the following data are identical to those featured in HYDROGENIUS DATABASE No. 40, Tables 1, 2, 3 and 4.

2. MECHANICAL PROPERTIES

Table 4. Mechanical properties of SUS316L.

Heat	Tensile Properties				Vickers Hardness (HV)
	0.2% Proof Stress, $\sigma_{0.2}$ (MPa)	Tensile Strength, σ_B (MPa)	Elongation, ϵ_f (%)	Reduction of Area, ϕ (%)	
C ¹⁾	229	528	66		
H ¹⁾	229	528	66		
Requirements ²⁾	Max.				200
	Min.	175	480	40	

¹⁾ As reported by the manufacturer.

²⁾ As per JIS G 4304:2005, "Hot-rolled Stainless Steel Plate, Sheet and Strip".

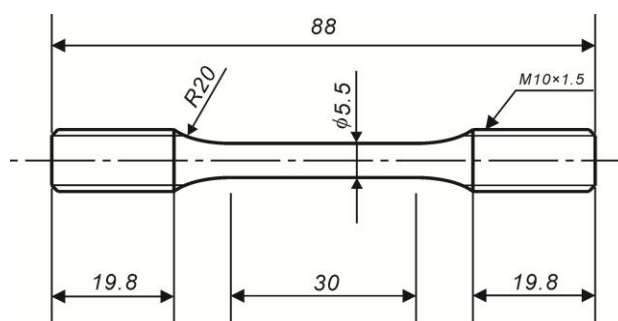
It should be noted that the following data are identical to those featured in HYDROGENIUS DATABASE No. 40, Tables 1, 2, 3 and 4.

3. SSRT PROPERTIES OF HYDROGEN-CHARGED SPECIMENS IN AIR AND IN 0.1-MPa-NITROGEN GAS

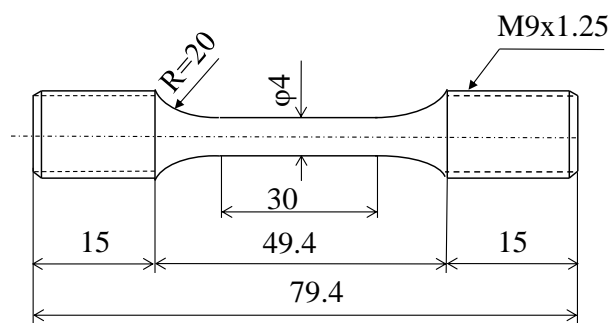
Table 5. Slow-strain-rate test (SSRT) conditions.

Type and capacity of testing machines	Servo-hydraulic, 50 kN	Screw-type, 50 kN
Loading conditions	Uniaxial, Monotonic	
Environment	In 0.1-MPa-nitrogen gas at $-120^{\circ}\text{C} \sim -40^{\circ}\text{C}$	In air at RT $\sim 200^{\circ}\text{C}$
Gas purity	0.1-MPa-nitrogen : 99.999% (5N)	---
Test speeds	$2.0 \times 10^{-3} \text{ mm/s}^2$ ($6.7 \times 10^{-5} \text{ s}^{-1}$) ³⁾	$1.7 \times 10^{-2} \text{ mm/s}^2$ ($5.7 \times 10^{-4} \text{ s}^{-1}$) ³⁾ $1.5 \times 10^{-3} \text{ mm/s}^2$ ($5.0 \times 10^{-5} \text{ s}^{-1}$) ³⁾

Specimens¹⁾
(dimensions in mm)



(a) Type-A



(b) Type-B

¹⁾ Surface-finishing was performed via longitudinal polishing, using 600-grade silicon-carbide paper.

²⁾ Test speed was determined based on cross-head speed.

³⁾ Test speed was determined based on the 30-mm parallel-length of a specimen. For example, $6.7 \times 10^{-5} \text{ s}^{-1}$ is given by $2.0 \times 10^{-3} \text{ mm/s} / 30 \text{ mm}$.

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Table 6. Hydrogen-charging conditions of tensile specimens.

Hydrogen-charging	Exposure to hydrogen gas at a pressure of 68 MPa or 100 MPa and a temperature of 270°C or 300°C
Hydrogen-gas purity	99.999% (5N)
Holding time	245 h or 300 h

Table 7. Hydrogen-measurement conditions of fractured tensile specimens.

Specimen shape	Disk with a diameter of 4 mm and a height of 10 mm, cut from a fractured SSRT specimen
Type of hydrogen measurement	Thermal desorption analysis, TDA
Heating rate	100°C /h
Hydrogen-detection accuracy	0.3 Vol. ppm