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HYDROGENIUS DATABASE

— Fatigue Properties —

No. C54

Database of Fatigue-Strength Properties of Hydrogen-Charged
JIS-SUS304 (Type 304) Austenitic Stainless Steel in Air

2017

Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)
Kyushu University - JAPAN
National Institute for Materials Science (NIMS)
Ibaraki - JAPAN

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Database of Fatigue-Strength Properties of Hydrogen-Charged JIS-SUS304 (Type 304) Austenitic Stainless Steel in Air

1. MATERIALS

Table 1. Details of processing and related data of SUS304.

Heat	Production Process	Product Format	Dimensions (mm)
D ¹⁾	Hot-rolled	Round bar	Diameter: 20 mm
V ¹⁾	Hot-rolled	Plate	Length: 7000 mm, Width: 3100 mm Thickness: 30 mm

¹⁾ As reported by the manufacturer.

Table 2. Chemical composition of SUS304.

	Heat	Element (mass%)							
		C	Si	Mn	P	S	Ni	Cr	
Product	D ¹⁾	0.05	0.27	1.31	0.035	0.028	8.10	18.60	
Analysis	V ²⁾	0.04	0.53	1.32	0.025	0.002	8.15	18.70	
Ladle	D ³⁾	0.06	0.50	1.47	0.031	0.024	8.15	18.31	
	V ³⁾	0.04	0.57	1.22	0.023	0.002	8.09	18.15	
Analysis	Requirements ⁴⁾	Max.	0.08	1.00	2.00	0.045	0.030	10.50	20.00
		Min.						8.00	18.00

¹⁾ As performed by HYDROGENIUS.

²⁾ As performed by NIMS.

³⁾ As reported by the manufacturer.

⁴⁾ As per JIS G 4303:2012, "Stainless Steel Bars", and JIS G 4304:2005, "Hot-rolled Stainless Steel Plate, Sheet and Strip".

Table 3. Heat-treatment conditions of SUS304.

Heat	Heat-treatment	Conditions
D ¹⁾	Solution-treatment	1050°C, 2 min, water-quenching
V ¹⁾	Solution-treatment	1080°C, 3 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. 38, Tables 1, 2, 3 and 4.

2. MECHANICAL PROPERTIES

Table 4. Mechanical properties of SUS304.

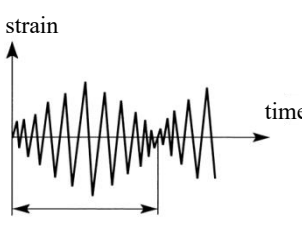
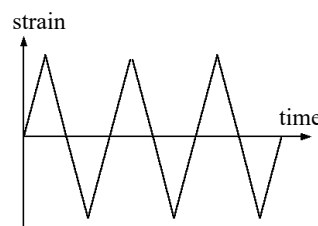
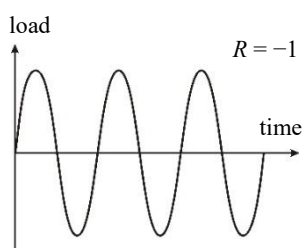
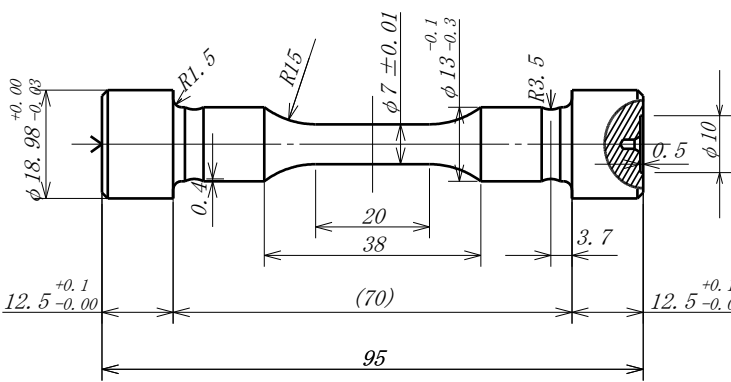
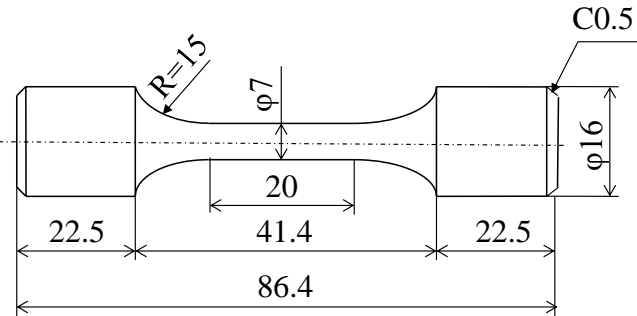
Heat	Tensile Properties				Vickers Hardness (HV)
	0.2% Proof Stress, $\sigma_{0.2}$ (MPa)	Tensile Strength, σ_B (MPa)	Elongation, ϵ_f (%)	Reduction of Area, ϕ (%)	
D ¹⁾	279	630	57	75	
V ¹⁾	276	658	63		
Requirements ²⁾	Max.				200
	Min.	205	520	40	60

¹⁾ As reported by the manufacturer.

²⁾ As per JIS G 4303:2012, "Stainless Steel Bars" and JIS G 4304:2005, "Hot-rolled Stainless Steel Plate, Sheet and Strip".

3. FATIGUE-STRENGTH PROPERTIES

Table 5. Fatigue-test conditions.

Type of test	Uniaxial		
Testing machine	50 kN, servo-hydraulic fatigue machine		
Loading conditions	Incremental step-test	Constant strain amplitude test	Constant stress amplitude test
Waveforms	$\dot{\epsilon}_{ta, \max} = 1 \times 10^{-3}$, $\dot{\epsilon} = 1 \times 10^{-3} \text{ s}^{-1}$ $R_{\epsilon} = -1$ 		
		Triangular	Sinusoidal
Strain rate or frequency	$1 \times 10^{-3} \text{ s}^{-1}$, $5 \times 10^{-3} \text{ s}^{-1}$		0.01 ~ 1 Hz
Environment	Laboratory air, RT		
Specimens ¹⁾			
			

¹⁾ The specimen surface was finished by buffing, using a colloidal SiO₂ (0.04 μm) solution.

Table 6. Conditions of hydrogen-charging.

Hydrogen exposure	Exposure to hydrogen gas at pressures of 10 MPa, 40 MPa, 68 MPa or 100 MPa, at a temperature of 270°C or 300°C
Hydrogen-gas purity	99.999% (5N)
Holding time	245 h or 400 h

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

Specimen shape	Disk with a diameter of 7 mm and a height of 10 mm, cut from a fractured fatigue specimen
Type of hydrogen measurement	Thermal desorption analysis, TDA
Heating rate	100°C/min
Hydrogen-detection accuracy	0.3 Vol. ppm